

**NATO  
HANDBOOK  
ON MARITIME MEDICINE**

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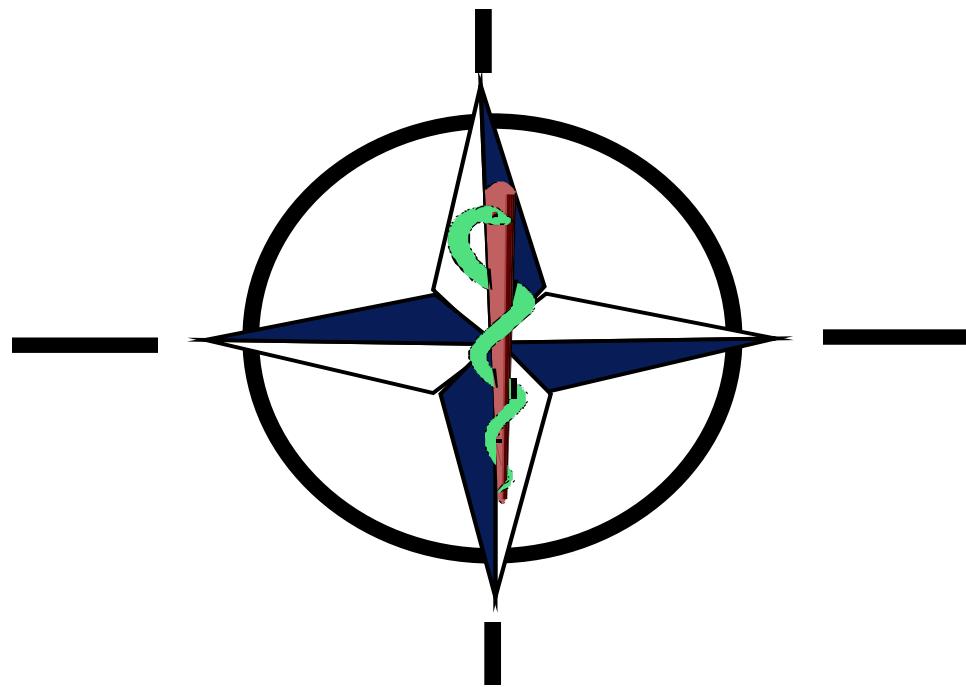
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**NOVEMBER 2008**

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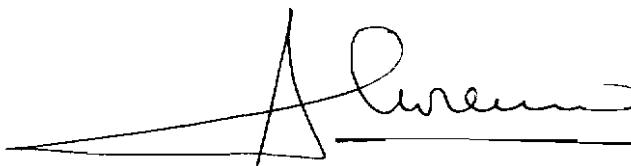
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NATO STANDARDIZATION AGENCY (NSA)  
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24 November 2008

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## Introduction

The aim of the NATO Handbook on Maritime Medicine is to provide guidance for NATO medical officers in all aspects of maritime medicine that are not covered in standard medical textbooks and other publications, or which require special consideration because of the varied conditions encountered in the Naval environment afloat. This handbook is not intended for specialists ashore or aboard specialized naval vessels. National medical policies may overrule the guidelines set by this handbook. The handbook does not constitute an official position of NATO nations; certain aspects however are already covered by STANAGs.

Shipboard care delivery is challenging. The shipboard medical officer is acting under unique conditions, living close with his patients, being on focus around the clock. The CO and the total crew are awaiting superb medical care and meticulous performance as department head.

In contrast to shore based hospital life emergencies managed by the medical officer aboard cannot be transferred from the emergency room to the specialised ward. Ships hospital is all inclusive, emergency room, intensive care ward, intermediate care ward, laboratory, radiology department, etc.

The improved communication capability aboard ship has very much influenced shipboard medical care so that it has become much more effective. Primary and second opinions can be received easily by telemedicine data store-and-forward, digital imagery from cameras, standard medical textbooks on CD-ROM, and standardized reporting templates. That technology has its valued place, but that place is well circumscribed. Of greater importance are the mind and heart required to deliver competent, compassionate care in a remote and hazardous location by initiative, leadership, training, and responsibility.

The NATO Handbook on Maritime Medicine is a formally agreed document, and may be quoted as a reference. However, it does not necessarily represent the official opinion or position of the nations, commands, or agencies on issues discussed.

For reference list refer to → **Subchapter 26-1**, for glossary of terms refer to → **Subchapter 26-2** and for abbreviations refer to → **Subchapter 26-3**.

## 1. NATO Publications and Standards

### 1.1 Allied Publications

### 1.2 NATO Standards

### 1.3 Civil Standards

#### 1.1 Allied Publications

An Allied Publication (AP) is an official NATO standardization document which NATO nations and commands normally use as a common implementing document and which is distributed down to user level. Implementation of administrative APs is normally directed by competent authorities. APs which require formal national agreement will be approved through the use of a covering STANAG. APs which require input of national data are normally not covered by a STANAG. In addition to normal APs, there are 2 special types of AP.

Allied Joint Publication (AJP). In order to accomplish its mission, NATO services must increasingly operate together. Those publications that are necessary for joint forces are termed Allied Joint Publications (AJPs).

Multinational Publication (MP). NATO forces must be able to operate with non-NATO forces. Unclassified APs may easily be released to non-NATO forces, however specific approval must be granted for the release of classified APs. To improve interoperability of NATO and non-NATO forces in areas covered by a classified AP, TAs may produce an unclassified extract of a classified AP called a Multinational Publication (MP). An MP is not an agreed NATO standard (that is the parent AP) but an extract of a NATO standard.

#### 1.2 NATO Standards

The requirement for new or revised NATO standards can be urgent or routine and their applicability can vary from a small number of nations to all Alliance nations. NATO standards are laid down in STANAGs/APs and agreed to by nations. The content of STANAGs or APs is normally categorized as:

"Operational". These are standards that affect future or current military practice, procedures or formats. They may apply, among other things, to such matters as concepts, doctrine, tactics, techniques, logistics, training, reports, forms, maps and charts.

"Materiel". These are standards that affect the characteristics of future or current materiel to include Consultation, Command and Control (C3). They may cover production codes of practice as well as materiel specifications. Materiel embraces

complete systems, C3 systems, weapon-systems sub-systems, interfaces, assemblies, components, spare parts and consumables (including ammunition, fuel, supplies, stores and spares).

Administrative". These standards primarily concern terminology, which applies to both the "operational" and the "materiel" fields. This category also includes standards that facilitate Alliance administration in those fields without direct military application (including financial, military ranks, environments, etc.).

### **1.3 Civil Standards**

Suitable civil standards shall be adopted for use within NATO, preferably without modifications, unless there are compelling reasons not to do so. The following general order of precedence shall be applied when selecting civil standards for purposes of NATO standardization:

- International Standards produced by ISO, IEC, ITU, IETFI and other internationally recognized standardization organizations, or any Publicly-Available Specification (PAS) adopted for NATO use.
- Regional (International) Standards, for instance European Standards (EN) or European Telecommunications Standards (ETS).
- National Standards.
- Commercial Publicly-Available Standards.
- Civil standards and Commercial and Government off-the-shelf equipment and products (COTS and GOTS) may be used, provided that an appropriate NATO body has reviewed them and has recommended adoption for NATO use on the basis of their maturity, cost-effectiveness, security aspects and product availability.

If civil standards are adopted, wholly or partially, for purposes of NATO standardization, the applicable Civil Organization, number, title and date of issue of the respective standard are to be referenced within the STANAG and/or AP as appropriate. The options for adopting external standards include a cover STANAG, or a STANAG/AP in which the external standard is referenced or reproduced (wholly or in part) together with additional text which may augment and/or limit the external standard in some way.

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### **2.1 Medical Officer Responsibilities**

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- 2.1.2 Dental Records**
- 2.1.3 Medical Treatment**
- 2.1.4 Controlled Medical Substances**
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### **2.2 Shipboard Health Care**

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### **2.1 Medical Officer Responsibilities**

#### **2.1.1 Medical Records**

A patient's medical record is a legal document containing an individual's past and present medical history. The manner of custody will be such as to protect its personal nature.

Everyone attending the medical department, whether the MO sees him or not, needs an entry made in the medical record. This is not only for medical-legal purposes. The chart is the only continuing record of medical care. Crew members are transferred frequently, so if they go on draft without proper documentation, they may undergo redundant investigations at the next duty station to rule out a problem that has already been concluded. Even details like how much of a medication was prescribed will help someone else trying to care for your patient.

( **Note →** ) Always write down the important facts in the medical records. A complete medical record is required on every crewmember and must be maintained properly.

In addition, all medical records must be verified annually, both to ensure that the medical department has one for each individual as well as to make sure all information is current.

The following records and logs may have to be maintained:

- Medical Department Journal.
- Statistical Data Log (Sick Call Log).
- Training Log.
- Heat Stress Log.
- Temperature Log.
- Ancillary Log (x-ray, laboratory).
- Sexually Transmitted Disease Log.
- Potable Water Log.
- Sterilization Log.
- Medical Waste / Disposal Log.
- Pest Control Log.

### **2.1.2        Dental Records**

If the ship has a Dental Officer on board, the following does not apply for the MO. If not, more often, it applies. Dental records are maintained the same way medical records are. Every crew member has a dental record, and the MO maintains them. Since most sailors don't like going to the dentist teeth problems are likely to be one of the most frequent (pain) problems in the Sick Call.

Dental readiness is divided into four classifications.

- Class 1 is no dental disease and requires no treatment.
- Class 2 is a mouth that has some minor dental disease but is not expected to cause any problem within the next 12 months.

- Class 3 means that there is dental disease expected to cause dental problems within the next 12 months.
- Class 4 means no dental exam has been done within the last 12 months.

( **Note →** ) Class 3 and 4 dental patients are a big problem, since they can require emergency dental care and possible MEDEVAC (refer to → **Chapter 20, Subchapters 2.1.10 and 19.4**).

To obtain the necessary dental exams, there are many resources to be utilized. Shore-based dental commands are one area. Prior to a deployment, crew members are given priority to correct as many dental problems as possible. However, usually everything else is a priority right before a deployment, therefore getting the patient to a dental appointment can be difficult.

### **2.1.3            Medical Treatment**

In most vessels the MO will be in charge of all medical stock on board. He must maintain proper stock levels and timely replacement orders. This is dependant on the size of the ship.

The MO will determine what a corpsman is authorized to prescribe at routine Sick Call. Routine medicinal, non-controlled stock should be available for the corpsmen to dispense independently, provided they have done a proper work-up, documented the patient's condition, and provided for good follow-up.

There are certain medications that only the MO should prescribe. These include:

- Any controlled substance, by law.
- Systemic antibiotics.
- Systemic steroids.
- Any cardiovascular medications.
- Any medications that need a precise, accurate, specific diagnosis.
- Any medication that has a known side effect that requires monitoring.
- Oral contraceptives.

( **Note →** ) Most prescriptions will ultimately require the MOs signature.

Medications for the common cold, constipation, uncomplicated diarrhoea, wound dressing, motion sickness, and headaches associated with viral symptoms can usually be handled by the corpsmen.

#### **2.1.4        Controlled Medical Substances**

The number of people with narcotics access should be kept to the absolute minimum. Only the Medical and Dental Officers may prescribe any controlled substance. On ships without MOs, the senior Medical Department representative may be authorized in certain circumstances. At very small units, i.e. submarines, it may be the duty of the CO to authorize narcotic medication in an emergency.

Prescribing and dispensing drugs onboard ship is different from doing it in a hospital. Without a trained group of pharmacists responsible for keeping medications safely secured, the CO will consider the Medical Department to be the pharmacy. This puts a double burden on the MO; not only must he prescribe wisely, but dispensing must also be properly controlled.

#### **2.1.5        Intravenous Therapy (IV)**

The MO must prescribe all IV therapy. MOs may include in their standing orders authority for corpsmen to start an IV in an emergency situation. Trained corpsmen may be allowed to start and monitor an infusion, but only with written orders. The MO should administer all IV medications. Exceptionally well-trained and experienced personnel may be given some of these responsibilities, but drugs with a known incidence of allergic or adverse reactions may cause problems even the best corpsman cannot handle.

( **Note →** ) Most cases of diarrhoea can be handled with oral rehydration, but MOs may use IVs to give corpsmen practice in IV placement.

#### **2.1.6        Non-Medical Treatment**

Most non-medicinal treatment like dressings, hot packs, eye irrigations, will be administered by corpsmen without the MOs direct supervision, but not without a direct order.

A few procedures should not be delegated. These include:

- Suturing hand wounds and facial lacerations.
- Reducing and casting fractures.
- Elective surgical procedures.

- Arthrocentesis of any joint.
- Peripheral nerve blocks.

### **2.1.7            Laboratory**

Almost every ship with a MO will have laboratory facilities; the bigger the ship, the more capable the facility. A well run, efficient laboratory with a competent technician in charge is a luxurious commodity. A marginal lab with insufficient supplies run by a poor technician will provide unreliable data, which is worse than no data.

It is strongly recommended for the MO to double check Gram stain technique; malaria smears, culture plating technique, and examine all of the CBC slides and KOH preps until confident that they are being performed correctly. MOs should brush up on their basic science and microscopy techniques prior to embarkation.

Overall management of the laboratory will be the MO's responsibility. All laboratory chits should bear his signature. Most routine studies, such as CBCs, urines, serology and throat cultures, can be ordered by the corpsmen during routine Sick Call. A daily review and countersigning of chits assures that they are being ordered appropriately. More sophisticated screening laboratory work, such as thyroid tests that need to be sent out, must be ordered by the Medical Officer.

### **2.1.8            X-Rays**

Most vessels are issued at least one portable X-ray unit and manned with a technician trained to operate it. Larger ships will have a fixed unit with an adjustable table. Even the small portable units will allow you to get good extremity films and sometimes a good AP chest film. Abdominal series and skull series are difficult with these units because they lack power, but in an emergency, such a view might be obtained with enough quality to enable the MO to make some decisions.

Film processing varies between ships. Some have fully digital radiology, and some smaller ships have digital plate units, but some still have the old tank method.

The MO will be required to have a radiation safety survey of the x-ray machine conducted every 2 years. This tests the machine to make sure that it is operating properly and not emitting unsafe levels of radiation.

### **2.1.9            Quality Assurance**

Quality assurance (QA) is of paramount importance. Keeping good records and making proper entries in medical records is vital. The MO must review all the medical records for Sick Call at the end of the day. All entries show date and signature, vital signs recorded, proper diagnosis and treatment plans outlined, appropriate studies ordered and documented, and proper follow-up arranged. Those are the minimum requirements for health care records.

The MO needs to issue an instruction called Medical Officer Standing Orders. This is to outline what types of patients the medical staff can see on their own, what patients they must consult the MO about, and what patients the MO must see and how quickly. The MO can also describe basic algorithms for beginning treatment. This should be general enough to cover all areas of patient care and types of presenting symptoms but not detailed enough to be a "cookbook" approach.

The QA reviewer, usually the Group or Squadron Medical Officer, will be assigned to and will come for reviewing regularly. They will review the Sick Call log to see patient work load and completeness of entries, the medical department daily journal to see that required information is being entered, and review the logs for proper follow-up and treatment. Should the commission find any cases where they doubt the standards of care, they will conduct a more extensive review of that case, read the record more closely, talk to the patient and staff, consult with specialists, and do whatever is necessary to make a determination of the existing standard of care. For more details of QA procedures, refer to the appropriate Nation's instructions.

In theory, QA is intended to ensure that the medical care given is of the highest quality. If problems are found, the QA process is intended to assist in identifying ways to correct those problems and to try to prevent their recurrence.

#### **2.1.10 MEDEVAC**

Circumstances that mandate the evacuation to the nearest medical facility may lead to a message request for medical evacuation (MEDEVAC) (refer to → **Subchapter 19.4**). The priority status of the patient must be included in that message.

- **URGENT** indicates a life-or-limb threatening injury or illness. This should result in a MEDEVAC within 24 hours.
- **PRIORITY** means not immediately life-threatening, but serious. These patients get MEDEVACed within 72 hours.
- **ROUTINE** means the patient can be MEDEVACed up when the next available regular flight can be arranged. This may take several days.

The key in MEDEVAC is wording the initial requesting message correctly. If a patient is in critical condition, he should be classified as URGENT by all

means. The problem comes with patients who are sick, but not critical, or who have injuries that are not life-threatening but require prompt treatment. They are all classified PRIORITY, but this alone won't get a timely flight. What will is describing the injury in enough detail to let decision takers know that the patient needs prompt care. If this fails, the accepting facility will take its time in sending for the patient.

A routine or even priority MEDEVAC can take as long as a week to ten days between the sending of the message and the patient's arriving at the treatment facility. MEDEVAC flights make frequent stopovers to pick up and discharge other patients, which slows down the process considerably. It should be ascertained that the patients are "shipped" with everything they need (medical records, consultation forms, service and pay records, clothing, etc.).

**( Note → )** There is no diagnosis when sending a MEDEVAC message request. The international classification of diseases (ICD) codebook, which is part of the required library aboard the ship, must be used. The codebook lists possible diagnoses, giving an assigned code number and letter for each.

**( Note → )** The ICD code should be used whenever official message traffic is written and received concerning a patient's diagnosis.

Actions taken by the ship's MO prior to MEDEVAC request are:

- Message to the nearest MEDEVAC facility (accepting hospital or clinic) stating the patient's name, age, military service number, diagnosis (ICD), and priority. Information that would aid in implementation of a MEDEVAC, as well as any restrictions on flight or altitude.
- Consideration of the effects of flight and altitude on the patient, e.g., pneumothorax or other conditions sensitive to the rigors of rotary or fixed wing flight.
- Need for trained medical personnel to accompany the patient, drugs the patient requires, the presence of an IV, etc.

The message should always be confidential and have the Fleet Commander as an additional addressee to keep him/her informed of a medical emergency.

### **2.1.11      Medical Guardship Assignment**

In certain ports your own ship will be designated "medical guardship". This means there is a requirement for the MO to provide care for surrounding ships' personnel who do not have MOs aboard, at least during the daytime. Ships without available MO will contact the medical guardship whenever possible before sending referral patients or physical examinations to local clinics.

In foreign ports, medical guardship for the MO and his department personnel sometimes means staying on board at all times. There may be only limited

possibilities for liberty in a foreign port if there is no other place to take sick or injured crewmen.

There is often more than one MO in a group or formation; this makes medical guardship easier, because duties can be shared. Being the guardship does not necessarily mean there is no liberty for the MO; just that he must be able to be contacted quickly if necessary. CO and XO must know where the MO can be found in an emergency. This will limit the MO's liberty as he must ensure he remains relatively close to the ship.

#### **2.1.12 Predeployment Schedule**

To assist MOs in planning for a deployment, there are predeployment check-off lists available. Ideally, more than six months ahead of time the MO will know when he is deploying, but last minute deployments may occur and the MO will just have to do his best, which is another reason for keeping all programs current.

Pre-deployment check-off guides offer a good support tool and provide timely progression of predeployment preparations. The MO should make sure that all routine and predeployment inspections are completed at least one month prior to the departure date. This allows the medical department to concentrate on last minute supply headaches, courses, training, and personal business.

**( Note → )** Before embarking on a cruise, contingency plans based on destination and mission should be made.

For certain areas of the world, some basic principles apply. When deployed to the Indian Ocean area and other desert climates, expect to need large amounts of antifungal preparations (all types), non-steroidals (you will always have sports injuries), cold medication and antibiotics for the respiratory infections (the dust creates the problem), sunscreen, anti-diarrhoeal preparations (most diarrhoea overseas is bacterial and needs antibiotics), and IV solutions for rehydration from diarrhoea or heat casualties.

#### **2.1.13 Embarked Medical Personnel**

Included within contingency planning is whether or not embarked medical personnel will be on board. This can be as a surgical team or with a tropical medicine specialist. The MO of the ship is responsible for the care of all embarked personnel, and, technically, any embarked medical personnel fall under his jurisdiction.

This can be difficult if the embarked surgeon is very senior.

It may require great diplomacy on the MOs side. Generally, embarked medical personnel are willing to help out.

## 2.2 Shipboard Health Care

### 2.2.1 Medical Practice on Board

The primary day-to-day duty is patient care. The MO is responsible for maintaining the health of all crewmembers. Although the CO has ultimate responsibility, the MO is the ship's medical expert. His decisions will be scrutinized more carefully than if he was working in a clinic or emergency room because of the close proximity to the rest of your crew.

( **Note →** ) MOs are literally "on call" 24 hours a day when the ship is deployed.

At Sick Call, approximately 20-50% will be orthopaedic problems (both occupational and non-occupational injuries). The former can be knees and backs that have previous injury and have pain secondary to the steel decks and ladders on the ship. The non-work related injuries are usually sports or physical training injuries, although motor vehicle accidents during harbour days abroad are still a big problem. 10-15% will be psychological problems, mostly personality disorders. Another 20% will be infectious disease, respiratory, diarrhoeas, STDs. Up to 20% will be gynaecological, if the ship has women on board and the other 20% or so will be a variety of ailments related to routine outpatient medicine, such as dermatology. There will be adequate medical resources to take care of most ailments, and the MO will have to refer (refer to → **Subchapter 2.2.8**), using telemedicine (refer to → **Subchapter 4.2.3**) advice or MEDEVAC (refer to → **Subchapter 2.1.10** and **19.4**) in a very small percentage of cases.

( **Note →** ) There are regularly crew members who present with suicidal ideation, and these threats must be taken seriously. Most of the suicidal crew members will tell honestly if they really want to kill themselves. If they make this clear, the MO must send them to a psychiatrist for an evaluation and let him clear the patient for duty. Always send an escort with the patient all the way to psychiatry. Give explicit instructions to escorts, and inform them of the reason an escort is required.

Because MOs are easily available, they may see a lot of patients with problems that normally wouldn't get taken to a physician. For many sailors, getting appointments at shore-based clinics for routine care is very difficult and frustrating. They would prefer to see their ships MO because it is "their doc." It is more than advisable to be accommodating as far as possible.

The Sick Bay is designed as the MOs clinic. He should keep "house calls" to a minimum. Regular Sick Call hours (refer to → **Subchapter 2.2.2**) must be established and posted so everyone knows availability.

On board, patients are no different than ashore. They deserve timely care, informed consent, follow-up, and proper referral for specialty care. One of the areas often overlooked is proper follow-up after admission to a shore-based hospital. It is one of the most important jobs to stay in contact with the hospital to keep in close contact regarding the patient's progress.

( **Note →** ) Make sure to brief the CO and XO on the patient's progress.

### **2.2.2            Sick Call**

Time every morning and afternoon for routine Sick Call should be set aside. This gives the crew an opportunity to have acute problems taken care of, as well as to get seen for routine, non-emergency care. Hours should be fixed and well communicated to the crew. If Sick Call gets too big, it should be split up. The bottom line is to treat, refer, or reschedule in a manner that allows the crew to get back to work in a timely fashion. Organization of the Sick Call may be by appointment, especially if patient population is big enough. Patients call in the morning and are given appointment times in 15-20 minute blocks and told to arrive 10 minutes prior to their appointment time in order to get their vital signs done. Patient waiting time is reduced, as is the number of people waiting for treatment. Emergencies are, of course, seen at any time in between.

( **Note →** ) Take care that Sick Call doesn't become a refuge for crew members looking to skate out of work.

In sick call MO's (rather than medical corpsmen) should see:

- All significant abdominal pain.
- All chest pain.
- Patients complaining of haematuria, haematemesis, haemoptysis, or haematochezia.
- All hand and facial lacerations requiring sutures.
- Any patient requiring narcotics.
- Any patient who specifically requests to see the MO should have access to him, but not before he or she is screened by the corpsman.
- Immunization patients who have a history of allergic reactions to medications.
- Patients with sustained high fever.
- Any patient referred by the corpsmen.

The corpsmen should see:

- Anyone who initially presents to Sick Call. This gets patients screened.
- Patients who need routine immunizations.
- Personnel reporting aboard. The corpsmen should screen their health record to identify deficiencies and problems.
- Patients with routine indigestion, headache, upper respiratory infections, minor trauma, etc.
- Patients who need routine laboratory work, RPRs, urinalysis, CBCs done prior to having physical examinations.

These guidelines must be modified to suit the particular situation.

### **2.2.3 Crew Medical Examinations**

A large part of the onboard medical practice will be conducting routine physical examinations. There are a lot of physical examinations to be performed frequently, i.e. discharge, re-enlistment, extension, light duty, retirement, respirator bearer, diving medical. Requirements are slightly different for each examination. The frequency of physical examinations ranges from one year up to 5 years.

Physicals should only be scheduled with the MO after all the preliminary examinations are done and all the results are available. The chemistry analyzers on all ships with MO will do most of the laboratory work required and provide training to the medical department personnel at the same time.

Exams must be done with great care; all bodily systems must be reviewed. Efficiency is important when doing six to seven physical exams a day, along with Sick Call and other collateral duties. If physical problems occur, the MO must refer to the appropriate regulations to determine if they are disqualifying, then refer to the appropriate specialist for treatment or a medical board. Acquiring consultations with specialists is essential for problems or disqualifying attributes. The patient is to be referred to the next higher authority in the medical system.

**( Note → )** A Physical Evaluation Board (PEB) may be needed to determine if the subject can remain in the service.

**( Note → )** Along with the required tests, always check immunization records.

The MO should ask the chief in personnel for a list of all personnel who will be leaving, re-enlisting, or extending in the following month. Armed with this list, medical department personnel can seek out these crew members to start their preliminary physical examinations.

Any MO on a tender will do a lot of physicals for other ships. This should be properly organized - basic labs and forms may be completed at the units.

#### **2.2.4      Fitness for Duty Examinations**

In cases involving possible alcohol intoxication, drug abuse, medication reactions, or other unusual exposures or circumstances, it must be determined if the individual concerned is competent to perform duty. Examinations will only be performed on the written request of the commanding officer or the commanding officer's duly designated representative.

That means only the CO or the CDO, can order fitness for duty examinations. When ordered, the MO should find out why they are ordered. Usually it is because someone has come to work intoxicated or had alcohol on their breath. Very often this examination is ordered for disciplinary or legal reasons, not for medical reasons. When doing competency for duty exams, the MO should always take a very conservative approach. If the individual in question does anything of importance and be might be under the influence of drugs or alcohol, the MO should put them in Sick Bay in a bedded-down status until the screening tests come back or they have slept it off safely.

#### **2.2.5      Management of Patients with Altered State of Consciousness**

Altered consciousness can be induced by abuse of alcohol and drugs, either individually or in combination, or by other medical conditions. The danger of death to a person intoxicated with drugs and/or alcohol is real. Additionally, injuries can cause altered states of consciousness, often compounding the threat to an intoxicated person. Once consciousness becomes so altered that protective reflexes are impaired, observation becomes mandatory and chain of command attention is warranted.

When an individual is identified as being in a seriously altered state of consciousness, the officer of the deck (or day) shall be notified and the medical department representative or MO must be called to evaluate the patient. If in port after working hours, personnel with altered consciousness should be taken to the closest military medical facility; an appropriately staffed and equipped civilian facility will be used in areas with no military facility. When circumstances do not permit transfer ashore, MO consultation shall be obtained.

In the absence of medical department personnel, constant supervision by a competent member of the patient's department or division is required. Immediate transfer of the patient, with escort, to nearest facility with a medical department if such transfer is feasible; otherwise, continue monitoring

continuously until either relief by medical authority or full patient recovery occurs is mandatory.

( **Note →** ) MOs should include the management of patients with altered state of consciousness in their medical training of the ships crew.

#### **2.2.6        Operating Rooms**

Most ships will have one or more operating rooms (OR) available. Despite the size restrictions, the larger ships have very useful facilities. Sterilizer and scrub areas are usually available in adjacent rooms. Most rooms also have an ECG monitor, defibrillator, and surgical supplies, including major instrument packs for chest and abdominal procedures.

Some surgical areas do not have the necessary gas induction equipment for general anaesthesia, but often this is neither required nor desired, the tendency is to use total intravenous anaesthesia (TIVA) (refer to → **Subchapter 14.4.6**).

The MO has responsibility for how the OR is set up. One suggestion is to rig it as a trauma room. Trauma always occurs at the most unexpected time and place. It can be invaluable to have IV solutions, catheters, needles, crash kits, ET tubes, gastric lavage tubes, defibrillators, etc. all readily accessible in any emergency.

#### **2.2.7        Ward Patient Care**

The ability to hold personnel in an inpatient status exists on most surface ships. On larger ships, the capability is broadened by the presence of MOs and enhanced ancillary services. Surgical platforms not only have a ward but also have an Intensive Care Unit (ICU) capability. The ability to deliver quality inpatient, surgical, and post-surgical health care rests on established administrative procedures, protocols, and standards of care. On ships staffed by MOs, the following areas of concern must be addressed for specialized care:

- **Patient administration.** Each patient admitted must have orders written by the admitting MO. All care provided during the inpatient stay will be documented in a separate, inpatient record using appropriate, standardized inpatient forms. A method of patient identification and tracking must also be developed to ensure accurate accountability. When a patient is discharged, records will be retained and maintained according to the appropriate regulations.
- **Care Protocols.** Specific patient care protocols must be established and reviewed periodically to ensure that they maintain currency.

- Housekeeping. Inpatient facilities have inherent requirements for cleanliness and patient comfort with special emphasis on infection control. Wards and ICUs must be kept clean and orderly to support these requirements. Appropriate infection control measures will be used in accordance with established standards of care. There must be adequate provision for the supply of linens and pyjamas. Dietary needs of the patients must also be met in accordance with their level of ambulation. Upon discharge, each patient's berth will be stripped and cleaned, including mattresses as necessary. Equipment, linen, and bedding must be disinfected with adherence to established standards for infection control.

( **Note →** ) Admission of a patient to the ship's medical ward is no different from admitting to any hospital.

The chart of a patient at sea should be indistinguishable from one at a hospital on shore. Proper admission orders, signed and dated with times, should be written. A long form history and physical examination is required. The MOs orders, progress notes, and nursing notes are kept by the corpsmen and are likewise the same as in any shore-based hospital.

At sea the MO will probably find himself the only physician on call for patients. It will be necessary to spend much more time monitoring and checking on them than in a hospital with a highly trained nursing staff, residents, and a staff of consulting physicians. The corpsmen in charge of the ward may be the best, but they are not capable of the high degree of sophistication provided in a hospital setting, especially not in prolonged emergency care. Critically ill patients will need nearly constant bedside attention until they can be moved.

( **Note →** ) Check and double-check impressions, orders, and treatment plans. Communicate with consultants ashore. This is almost always possible, if not by voice circuit, then by message; use telemedicine.

Less ill crew members who are admitted to the ward remain the Medical Department's responsibility until they are discharged back to duty. The basic idea is to get the patient well and back to duty as quickly as possible and to make certain that everyone knows that this is the real mission and purpose of the medical department: to keep the largest number of sailors at their post the greatest percentage of the time.

( **Note →** ) There is little or no reason to admit patients to the ward while in port.

The most notable exception would be a foreign country without good medical facilities. Stateside, and in navy bases worldwide, a shore-based hospital or clinic is usually available and infinitely preferable.

## 2.2.8            Referrals

There will be times, both at sea and in port, when the MO will need consultations. Referring patients to clinics and naval hospitals for special evaluations can be easy if you do it correctly. Telemedicine is another steadily growing possibility for second opinion consultation.

Paperwork is a prerequisite to have the patient seen by the right specialists, in the right place, and in a timely manner. This is a matter of common courtesy and proper professionalism. The patient must take all his records along.

**( Note →)** Contact the consultant in any case before referring a patient. Telephone calls or telemedicine provides a point of contact for the patient. This speeds up the waiting process and paperwork. The telephone is perhaps the single most important, effective, and underutilized medical instrument.

**( Note →)** The use of fleet liaison offices at military hospitals, dental centres, and naval medical facilities is strongly encouraged to ensure proper, adequate, and timely resolution of medical support problems. This technical liaison channel provides direct access for unit medical departments to the resources of shore facilities.

In general, patients should not be referred to a hospital for consultation with a specialist without first having been seen by a medical officer except in emergencies or when a medical officer is not available and delay might jeopardize the welfare of the patient. If operating conditions dictate, direct transfer of the patient should be effected without delay. Patients should be referred for consultation when the medical history and condition so warrant.

#### **2.2.9              Appointments**

Referral appointments are usually made for the patient by the medical department.

Being at sea and expected to be in home port in less than a week, a message requesting appointment times for patient referrals can be sent, or emailed in the consult and await the appointment card. Messages, however, do get a quicker response.

Crewmembers returning from medical consultations must receive appropriate follow-up from the ship's MO, who shall also determine further medical care requirements (e.g. medications, physical therapy, follow-up appointments, etc.).

### **3. Medical Rooms and Equipment**

#### **3.1 Safety in Medical and Dental Facilities**

- 3.1.1 General Precautions for Safety**
- 3.1.2 Special Precautions**
- 3.1.3 General Equipment and Treatment Precautions**

#### **3.2 Operating Rooms**

- 3.2.1 General Remarks**
- 3.2.2 Electro-Cautery**
- 3.2.3 Defibrillator**
- 3.2.4 Anaesthesia Machine**

#### **3.3 Ward Patients Care**

- 3.3.1 General Remarks**
- 3.3.2 Hygiene Considerations**

#### **3.4 Equipment**

- 3.4.1 General Remarks**
- 3.4.2 Specific Areas of Concern**
- 3.4.3 X-Ray**
  - 3.4.3.1 General Remarks**
  - 3.4.3.2 Standard Operation Procedures**
  - 3.4.3.3 Personnel Protection**
  - 3.4.3.4 X-Ray and Film Processor Unit**
- 3.4.4 Laboratory**
- 3.4.5 Dental**

#### **3.1 Safety in Medical and Dental Facilities**

In medical and dental facilities on board basic safety precautions must be observed to protect medical and dental personnel and their patients from harm. The MO is responsible for his own department's safety and must pay attention to this as a primary area of concern. Any specific item of equipment has its operating manual and other accompanying documents that should be consulted for details.

##### **3.1.1 General Precautions for Safety**

- Ensure oxygen breathing apparatus is always available in the sickbay for use by medical staff when evacuating disabled patients or patients who have respiratory problems.

- Heat lamps are a potential source of burns if the patient is overexposed. Instructions regarding proper use and safety precautions must be adhered to at all times. This also applies to cautery units.
- Ensure anaphylactic shock treatments are immediately available for use when immunizations are given.
- Patients in the ship's ward must be made aware of all escape routes. Escape routes from the sickbay must be clear of any obstructions to enable safe passage of stretchers.

**( Note → )** Smoking and open flames are not permitted in areas where oxygen is being administered.

**( Note → )** Secure all wheeled medical equipment when not in using wheel blocks or securing straps for this purpose.

### **3.1.2            Special Precautions**

- Used needles and syringes should be disposed of in "sharps" containers.
- Keep all liquid pesticides secure and bulk amounts in a flammable liquid storeroom.
- Ensure that pesticides are only used by Sickbay personnel who are qualified in the appropriate safety and toxicity precautions.
- Keep all poisons and bulk compounding materials secure.
- Double-lock the pharmacy when not in use, with keys made available only to authorized personnel.
- Do not stow, use, or dispense methyl alcohol in the pharmacy. Account for methyl alcohol in same manner as ethyl alcohol and narcotics. Attach a prominent label to each container with clear warning of the dangers associated with it.
- Maintain a poison antidote locker. Secure the locker with a seal and ensure a complete inventory is made whenever the seal is broken and antidotes removed.
- Stow inorganic medical acids such as hydrochloric, sulfuric, nitric and phosphoric in lead-lined containers in the medical storeroom. Stow organic acids such as glacial acetic, oxalic, carbolic, cresylic, and picric acids in a locker lined in acid resistant material (not lead) in the flammable liquids storeroom.

- Turn off propane gas to the flame photometer at the tank when not in use.
- A well-maintained poison antidote locker must be located in the main Sickbay. This locker should contain most major antidotes for chemicals and toxic substances onboard. A complete list of requirements can be found in the each navy's detailed instructions.

(**Note →**) Only keep a minimum working stock of flammable materials (e.g., alcohol and acetone) on hand in the Sickbay space. Keep bulk stocks in a separate locked cabinet in the flammable liquid storeroom.

Ensure only Sickbay personnel handle bacteriological specimens.

All medications affecting awareness must be labelled and personnel prescribed such drugs educated on their effects, due to the number of extremely hazardous jobs onboard.

### **3.1.3 General Equipment and Treatment Precautions**

- All drugs, biological substances, and pharmaceuticals must be in-date (not expired). They must be stowed at the correct temperature in accordance with the manufacturer's instructions. An alarm on the biological substances refrigerator should indicate when the temperature is outside its safe operating zone.
- Stabilize all equipment used in operating rooms in situ.
- Mount a level on the operating table for use by anaesthetists administering spinal anaesthesia.
- Lock sterilizer doors in the open position with trays locked either in or out to prevent accidental burns.
- Inspect stretchers and first aid boxes regularly in accordance with the specific instructions of each navy.
- Since the autoclave is a potential source of steam burns, staff in the operating department should take the appropriate precautions to prevent injury. The door, steam valves and piping to the autoclave should contain a warning label and simply worded operating instructions.
- The electrosurgical unit is a potential source of electrical shock for both operator and patient. Ensure the correct techniques for grounding the patient are always followed.
- Ground the patient when using the cardiac monitor/defibrillator. Do not touch any metal surface when charging or administering a shock from the

defibrillator paddles.

- Portable medical kits must be available and correctly stocked. First aid boxes with comprehensive inventories should be sealed and correctly labelled and distributed throughout the ship. Monthly inspections by appropriately qualified staff should be undertaken monthly to identify and replace missing items. Battle dressing and decontamination stations must be fully stocked at all times.
- The material condition of all stretchers, including safety straps, should be in good repair.
- To prevent overexposure to skin when using heat lamps each treatment should be accurately timed. Instruct the patient to remove all metal objects, e.g., belt buckles pendants, and medals from treated to avoid burns. Ensure the heat lamp is administered from a safe distance to achieve the optimal heat intensity.
- Regularly check physical therapy spaces equipment to maintain electrical safety. Only authorized electrical appliances may be used in the physical therapy spaces at any time.

### **3.2 Operating Rooms**

#### **3.2.1 General Remarks**

On most ships operating rooms (OR) will be available. Despite size restrictions, the larger ships will normally have very functional facilities, including major instrument packs for chest and abdominal procedures. Some ORs do not have the necessary instrumentation for general anaesthesia.

The OR is best rigged as trauma room. The set-up is almost entirely influenced by the Medical Officer (MO). Trauma always occurs at the most unexpected time and place. It can be invaluable to have IV solutions, catheters, needles, crash kits, ET tubes, gastric lavage tubes, defibrillators etc. all readily accessible in any emergency.

Performance of elective minor surgery is at the discretion of the MO but he must be trained and hold surgical or clinical credentials from the appropriate governing authority to do so.

**( Note → )** Informed consent from all interested and entitled parties must be sought prior to elective minor surgery being performed.

Bigger ships may become surgery-capable platforms, when supported by an embarked Fleet Surgical Team or other surgical support element. These ships maintain one or more operating rooms; spaces that meet established standards for conducting surgical procedures. The requirements for surgical equipment and supplies are listed in detailed documents.

The capability to achieve in-patient status exists on most surface ships. On smaller ships, this capability is limited to one or two berths that can be used for short periods of time. On larger ships however, the capability is broadened by the presence of specialised MOs and enhanced ancillary services. Surgical platforms not only have a ward but also have an Intensive Care Unit (ICU) capability. The ability to deliver quality inpatient, surgical, and post-surgical health care rests on established administrative procedures, protocols and standards of care.

### **3.2.2            Electro-Cautery**

- Safety checks should be carried out prior to using this equipment to ensure proper grounding is achieved.
- Inspect attached electrical cord to check for frayed or electrical wires. Any faulty cord should not be used.
- Only authorized and adequately trained personnel shall be permitted to operate this equipment.

### **3.2.3            Defibrillator**

- Always double-check control settings prior to use.
- Safety checks should be carried out prior to using this equipment to ensure proper grounding is achieved.
- Only trained personnel under the direct supervision of the MO shall be permitted to operate this equipment.
- Conduct regular maintenance in accordance with the appropriate regulations.
- Inspect attached electrical cord to check for frayed or electrical wires. Any faulty cord should not be used.

### **2.3.4            Anaesthesia Machine**

- Daily safety checks should be performed to ensure effective maintenance of valve fittings.
- Only trained personnel under the direct supervision of the anaesthetist shall operate this equipment.

- Perform a daily inspection to ensure that full tanks of oxygen and nitrous oxide are maintained.
- Make periodic changes of calcium carbonate to absorb water and carbon dioxide in accordance with the manufacturer's instructions.
- Inspect the anaesthesia machine in accordance with manufacturer's policy.

### **3.3 Ward Patients Care**

#### **3.3.1 General Remarks**

Admission of a patient to the ship's medical ward is no different from admitting to the hospital. The chart of a patient at sea should be indistinguishable from one at a hospital ashore. Proper admission orders, signed and dated with times, should be maintained. A comprehensive history and physical examination is required if the patient's stay exceeds 72 hours. All medical instructions, summaries and nursing notes are to be maintained to the same high standards found in any shore-based hospital.

( Note ( ) At sea, it will be necessary for the MO to spend much more time monitoring and checking on the patients than would generally be expected in a shore-side hospital with a highly trained nursing staff, residents, and consulting physicians.

Medical staffs in charge of the ward are not capable of the high degree of sophistication provided in a hospital setting. Critically ill patients will need almost constant attention until they can be moved. It is recommended that diagnoses, medical notes and treatment plans are continually updated.

( Note ( ) Communicate with consultants ashore when necessary. This is almost always possible, if not by voice circuit, then by message. There are a steadily growing number of platforms equipped with telemedicine.

( Note ( ) There is little or no reason to admit patients to the ward while in port. The most notable exception would be a foreign country without good medical facilities. In home ports and in most naval bases overseas, a shore-based hospital or clinic is usually available and infinitely preferable.

#### **3.3.2 Hygiene Considerations**

Inpatient facilities require high standards of cleanliness and patient comfort with particular emphasis on infection prevention and control. For patient isolation policy refer to ( Subchapter 7.2.

Wards and ICUs must be kept clean and orderly to support these hygiene requirements. Appropriate infection control measures will be used in accordance with established standards of care. There must be adequate provision for the supply of linens and

pyjamas. Dietary needs of the patients must also be met in accordance with their level of mobility. Upon discharge, each patient's berth will be stripped and cleaned, including mattresses. Equipment, linen, and bedding must be disinfected in accordance with established standards for infection control.

### 3.4 Equipment

#### 3.4.1 General Remarks

All equipment items required must be fully functional and the additional consumable supplies available as appropriate. Sterile supplies must not be exposed to conditions that compromise their sterility.

#### 3.4.2 Specific Areas of Concern

- ACLS requirements including defibrillators, suction apparatus, and drugs/supplies must be available.
- The required number of beds and gurneys with orthopaedic hardware and safety restraints as appropriate.
- ICU beds must have bedside oxygen, suction, and IV infusion pumps.
- Calibrated equipment including: mechanical ventilators, anaesthesia machines, respiratory gas monitors, and electrosurgical apparatus.
- Other specialized equipment including hypo/hyperthermia, fluid warming equipment, sonography and the required surgical endoscopes with attachments.

#### 3.4.3 X-Ray

##### 3.4.3.1 General Remarks

Most vessels are issued at least one portable X-ray unit and manned with a technician trained to operate it. Larger ships will have a fixed unit with an adjustable table. Even the small portable units will provide good extremity films and sometimes a good AP chest film. Abdominal series and skull series are difficult with these units because they lack power, but in an emergency, such a view might be obtained with enough quality to assist diagnosis and appropriate treatment regimes.

Film processing varies between ships: some have fully digital radiology, and some smaller ships automatic developing units, but some still have the old tank method. With the old tank method, film results

will be very poor if the tank is not kept scrupulously clean, the temperature kept within the recommended range and the chemicals changed completely after every three films are developed.

X-ray technicians are trained for the most basic views.

( Note ( ) An additional reference source for positions in radiography should be available as backup for specific views.

( Note ( ) X-rays films are always to be ordered and read by the physician.

X-rays records must be kept by storing the films in your established filing system.

X-ray equipment will be properly stowed to ensure that it is secured for sea. Supplies will be safely stored with regard to light sensitivity or hazardous qualities.

#### **3.4.3.2 Standard Operating Procedure (SOP).**

To ensure standardization of testing procedures, each ship with x-ray capability will maintain an SOP for all equipment capable of use. Procedures will include the requirement for all films to be delivered to a radiologist for professional reading.

All x-ray examinations conducted will be documented in an x-ray log. Entries will include, at a minimum: date, patient data, examination conducted, and results. Additionally, this log must indicate the date the film was sent to and returned from a radiologist with confirmation of results.

#### **3.4.3.3 Personnel Protection**

- Wear clothing affording personal protection from direct radiation.
- Do not use movable, upright, protective screens; use more permanent shielding.
- Inspect all x-ray protective devices at least annually for efficient barrier protection.
- Rotate persons between duties involving possible exposure and exposure-free work if they approach their maximum permissible exposure.

#### **3.4.3.4 X-Ray and Film Processor Unit**

- Perform radiation protection surveys at least at the given intervals to evaluate radiation in adjacent spaces and to recommend appropriate

shielding or corrective procedures.

- Limit and strictly control access to x-ray spaces during x-ray examinations.
- Train non-technicians assigned to the x-ray department on potential radiation hazards.
- Ensure that the control panel is secured (locked) at all times to exclude access by unauthorized personnel.
- Regular maintenance in accordance with prescribed procedures should be carried out by qualified personnel (x-ray technician) only.

#### **3.4.4              Laboratory**

Almost every ship with a MO will have laboratory facilities; the bigger the ship, the more capable the facility. A well run, efficient laboratory with a competent technician in charge is the optimum. A marginal lab with insufficient supplies will provide unreliable data, which is worse than no data.

**( Note → )** It is recommended that MOs train their laboratory personnel to carry out any procedures required beyond basic routine analysis.

Furthermore MOs should carry out routine laboratory techniques such as: Gram stain technique, malaria smears, culture plating technique, CBC slides and KOH preparations etc. until confident that they are being performed correctly.

Overall management of the laboratory is responsibility of the MO. All laboratory test requests should bear his signature/counter-signature.

The following should be noted:

- Make certain the space is kept clean and hygienic.
- Laboratory records and log books are to be kept up-to-date.
- Calibration and maintenance of equipment are critical to achieve accurate results.
- The various chemicals and alcohol in the lab make it a fire-prone area.

#### **3.4.5              Dental**

Most ships will not have a separate dental facility. Dental equipment will often be supplied in modules ready for use in the ship's hospital.

The safety precautions for dental facilities on board include:

- Face dental chairs athwart ships during treatment to minimize rolling movements.
- Do not compromise proper aseptic techniques due to space or personnel limitations.
- Ensure irrigating solutions are made only from stock bottled solutions and are properly labelled as to their contents.
- Store local anaesthetics (cartridges) in dry containers. Do not keep in holding solutions.
- Have appropriate emergency resuscitation equipment on hand and labelled in each dental operating room.
- Immobilize equipment during rough seas.
- Secure portable mobile equipment when ships are underway and carefully re-inspect for integrity following rough weather or rough handling.
- Keep to a minimum the flammable materials kept on hand when working.
- Be aware of the safety precautions relating to electrical equipment, oxygen equipment, use of syringes, needles, medications and drugs.
- Conduct bi-annual training for all dental personnel.
- Ensure all dental personnel wear face and eye protection. Patients are also required to wear eye protection when receiving oral treatment.

## **04. Communication and Reports**

### **4.1 Naval Correspondence**

- 4.1.1 Message Traffic**
- 4.1.2 Radio Communication**
- 4.1.3 Email Messages**
- 4.1.4 Other Forms of Communication**

### **4.2 Medical Communication and Information System (CIS)**

- 4.2.1 Medical CIS Requirements**
- 4.2.2 Medical Verbal Communication**
- 4.2.3 Telemedicine**

### **4.3 Medical Documentation**

### **4.4 Medical Reports**

- 4.4.1 Periodical Internal Requirements/Reports**
- 4.4.2 Periodical External Requirements/Reports**
- 4.4.3 Post-Deployment After-Action Critique**

### **4.1 Naval Correspondence**

Navies have very specific way to communicate, whether it is by letter, message, email or radio. General information on operational security (OPSEC) and correspondence should be obtained for more details on national sources or, refer to → **NATO documents**, including **ADATP-3, AAP-11, or Bi-SC 80-3, etc.**

All official mail leaving the ship must be routed through the chain of command for approval. Everything official leaves the ship with the Commanding Officer's (CO) signature, and the CO is responsible for all communications from the ship. To ease the CO's workload, the MO may be given "by direction" authority for some official external correspondence. This is generally limited to routinely required reports or routine requests for information. "By direction" authority should be used wisely, for it can easily be removed: it is a signature for the Captain, and if it is anything that the CO might want to have input on, or should at least read, it should be routed for the CO's signature.

**( Note → )** Official correspondence always originates from the CO.

The same is true if the MO has message release authority. This is again a matter of special concern, since once a letter or message is on the street, it can't be retrieved. When in doubt, at least it should be run by the XO.

Official correspondence will be clear, concise, complete, correct, and courteous. MOs, dental officers, and other medical department personnel are authorized to correspond formally with the Force Medical Officer on professional matters. Such correspondence should as well normally be routed via the administrative chain of command. Direct correspondence with the Force Medical Officer, with chain of command intermediaries as information addressees, is authorized for time-sensitive matters in which the well being of a patient might be placed at risk by using routine channels.

#### **4.1.1            Message Traffic**

Ships have various methods of disseminating the multitude of naval messages they receive each day. One of the MOs duties is to read message traffic each morning. Some Communications Departments have a pickup area for arriving messages. Other ships distribute messages electronically via a shipboard computer Local Area Network (LAN). The MO will receive all message traffic pertaining to his department, as well as the health and welfare of the crew. The MO might not receive SECRET-level messages, but must have access to CONFIDENTIAL-level material.

The body of any naval message will be in “navy language”, almost everything being abbreviated. If in doubt of the language or in need for an interpreter, the MO should find an appropriately skilled person to assist him.

Writing a message can be even more of a problem than reading one. Certain types of messages have specific formats, e.g., LOGREQS (logistics requisitions) before a ship enters port, MEDASSESSREP (medical assessment report), MEDSITREP (medical situation report) etc. All other general messages are also required to be in a specifically formatted style. It is intended to standardize message writing throughout all the services. There may be a need for assistance with the preparation before sending the first message. The MO should write the body of the message and have the chief or any experienced person draft it in the correct form for transmission. He should talk to the respective department heads for the specific message formats. The category of almost all messages concerning the medical department will be general administrative messages.

**( Note → )** Messages that are classified confidential or secret must be handled according to security regulations.

Signal message format shows specific lines and fields that correspond to the following contents. Listed are the most important points:

- **Priority classification of the message:** Rating is “Routine”, “Priority”, “Immediate”, etc. The rating determines how fast the message will be sent. “Priority” messages will probably arrive the same day.
- **Date-time grouping:** The first two numbers are the date; the next four correspond to Zulu time (Greenwich Mean Time, located in Greenwich,

England) that the message was sent or the appropriate time zone for ships outside GMT. The month and year are next. For example, 101115Z MAR 06 is 10 March 2006 at 1115 Zulu time.

- “FROM”: Determines the originator of the message.
- “TO”: Recipient of the message.
- “INFO”: Receivers of a copy of the message.
- Classification: Security classification of the message (open, confidential, secret, top secret).
- Subject line: Content of the message.
- Body of message: Brief, but concise.
- “BT”: Break transmission, signalling the end of the message.

( **Note →** ) The Communications Officer is always the consulting expert in any transmission matters.

#### **4.1.2                  Radio Communication**

Communication over the radio, ship-to-ship or ship-to-shore by using a non-secured voice net (a radio network that is not scrambled for security purposes) needs to fulfil certain rules, such as never divulging the name of your ship, the name of the ship you are talking to, your destination, your heading, or where you came from. All locations are given in code, and all ships have call signs that change daily. These are posted in the radio room, and on the bridge, and the call signs are what you use to identify yourself and others when talking on non-secure nets. Transmitting any of the previously mentioned information unencrypted is a severe breach of security because anyone can listen in and monitor the discussions taking place.

( **Note →** ) In radio communications it is of paramount importance to fulfil the security precautions.

Messages must be kept brief and to the point. Speaking over the radio is a business conversation, therefore state your business, conduct it, and relinquish the net so other units can conduct their business. If talking over a secured voice net, security is less of a problem; however, the business rules are the same. Only stay on secured voice net long enough to conduct the business.

Using the correct techniques for talking on the military radio system is easily learned but takes practice.

#### **4.1.3                  Email Messages**

Email access is becoming more common on ships. The rule of thumb, however, is that for information to be “official,” it has to come to the ship or leave the ship as navy message traffic.

( **Note →** ) Sensitive data such as patient’s data may have to be encrypted according to national laws or regulations.

#### **4.1.4 Other Forms of Communication**

Other forms of communications include semaphore, signal flags, and flashing lights. During various operations and evolutions, e.g. underway replenishment of fuel and/or stores (UNREP/VERTREP), also known as replenishment at sea, the radio net may be unavailable to communicate “routine” info/messages to a ship alongside. Signalmen can send and receive messages.

The MO may need to learn how to send such messages and be aware about the phonetic alphabet, i.e., alpha, bravo, charlie, etc. (refer to → **Annex 4-1**).

### **4.2 Medical Communications and Information System (CIS)**

Reliable and effective communications and information systems are critical to operational success and the effective employment and control of CIS resources are command responsibilities. CIS embodies the principal domains of computer automation systems, auditory communications systems and visual communications systems. Despite the apparent abundance of such modern communications technology as satellites, computers and steadily growing transmission rates, communication capacity is a limited resource.

#### **4.2.1 Medical CIS Requirements**

Medical support connectivity is an operational requirement. There is a need to allocate the most effective CIS means to capture the appropriate medical data from the operational area medical treatment facilities (MTF). This facilitates regulation and tracking of casualties within a theatre of operation (TOO) and gives the ability to respond quickly to medical contingencies. There is also a need for medical professionals to communicate with each other so that medical cases can be discussed and clinical advice provided. A well-structured medical CIS is the essential foundation of an efficient medical support structure.

Medical department must have access to the full range of communication equipment and information technology to carry out their mission responsibilities. CIS medical requirements for operations will include a span of dedicated and non-dedicated assets encompassing medical verbal and visual communication, automation technology, data and information management. The medical CIS and in particular the medical information management system must have the

capability to interface with the corresponding logistics data management systems.

Medical data/information management involves the collection, recording, processing and storing of medical information/data of operational significance. Establishment of baseline architecture for the collection, storage, transmission, and retrieval of information are functions that must be performed at national and multinational level.

Medical CIS should be capable of the passage of timely and accurate medical information to all entitled personnel and include:

- Patient tracking and regulating.
- Reporting on the status of readiness and sustainability of medical capabilities in the area of operations.
- Notification of deaths, serious illness and injury.
- Provision of statistics, for epidemiological and administrative purposes.
- Production of clinical evidence for official national or international inquiries.
- Provision of early assistance in the detection of biological/chemical attacks.

Automation technology embodies computer automation hardware and software capabilities, fundamental to medical support across the progressive spectrum of evacuation, treatment, record-keeping, surveillance, and the full range of staff functions, including information and data exchange through electronic mail linkages. This domain is critical for medical linkage into the architecture of the Crisis Response Operations in NATO Open Systems (CRONOS) and medical interactions at theatre and subordinate command levels.

( **Note →** ) Medical CIS provides real time-visibility of the operational medical situation.

#### **4.2.2 Medical Verbal Communication**

Medical verbal communications use the ships communication infrastructure and includes all forms of auditory linkages of staffs within the medical support structure, and between medical support elements and other NATO and national organisational elements and staff. This is a critical component of the communications infrastructure and must have sufficient connections and capacity to support all essential medical CIS needs. This infrastructure will be used as the backbone to support in operation theatre tactical military connectivity. Critical connectivity among MEDEVAC and medical treatment assets must be supported. Access to the ships signal communications systems,

in the form of satellite networks, commercial and military systems is required to provide a reliable and timely verbal communications architecture comprising radio, fax and telephone based capabilities.

#### **4.2.3 Telemedicine**

Telemedicine (TMED) is medical visual communication and includes those both real-time and store-and-forward technologies for transmitting visual imagery from one geographic location to another. Uses may range from tele-mentoring and tele-conferencing functions, among medical personnel, to the provision of long distance medical diagnostic support.

TMED capabilities and its optimum use are closely connected to the available bandwidth. The various TMED modalities require specific data rates for support of their full capability, however, depending on file size, even lower data rates may support on a less than optimum basis.

The recommended bandwidth may not be available on warships either due to the vessel having less bandwidth installed, or, the installed bandwidth may not be available for medical use because it is dynamically allocated to greatest need based on the ships mission in actual operations. Nations run individual practices to maximize use of scarce bandwidth resources using available bandwidth for medical purposes.

**( Note → )** Either all or sensitive medical data transmitted using TMED may have to be encrypted according to national laws or regulations.

### **4.3 Medical Documentation**

Medical documentation is represented by the recording and processing of medical information on a patient to include personal details, clinical history, as well as medical care and evacuation requirements and support provided. Careful and standardised medical documentation performed by the medical department is essential for:

- Medical treatment.
- Quality control.
- Evaluation process.
- Budgeting and legal aspects.
- Statistics and medical surveillance system functions.
- Programming medical supplies and other logistics support.

- Breaching language barriers and achieving effective translation documentation on patient treatment records.
- Medical intelligence documentation, reporting, and follow-up.

Patient documentation procedures should be clear and comprehensive. Medical documentation should be interoperable throughout the area of operations. Standardised NATO documents/forms should be utilised in all cases for which such templates exist, such as prescribed through medical STANAGs. Copies of printed patient documents and digitised medical records, when available, should move with the patient throughout the evacuation system to definitive care, and then be retained in the individual's medical record.

**( Note → )** When medical care is provided to patients other than their respective national MTFs, medical personnel should ensure that documentation of medical treatment is noted on official medical records and medical confidentiality is respected. Medical records will accompany the patients during evacuation and suitable medical documentation will also be released to the respective National medical liaison address.

**( Note → )** The following STANAGs deal with this subject: STANAG 2061 Procedures for Disposition of Allied Patients by Medical Installation; STANAG 2132 Field Medical Card, STANAG 2347 Medical Warning Tag, STANAG 2348 Basic Military Hospital (Clinical) Records and STANAG 2050 Statistical Classification of Diseases, Injuries and Causes of Death, STANAG 3204 Aeromedical Evacuation.

#### **4.4 Medical Reports**

MOs and their staff must be familiar with the internal (to CO via XO) or external reporting requirements outlined in Nations' regulations and with situational reports required by higher authorities on occasion. The CO has to be included as an information addressee on all messages concerning medical problems requiring assistance from any activity outside the ship.

The following are representative examples of the periodic requirements for conducting business in the medical department. Whether or not formal reports are required depends on a Nation's individual regulations. Requirements should be accomplished and reported as covered in other chapters (refer to → **Chapter 5, 6 and 7**). All specific medical reports required cannot be covered here, there are various national peculiarities.

##### **4.4.1 Periodical Internal Requirements / Reports**

###### (Daily)

- Medical department journal.

- Sick call log.
- Material condition.
- Routine and special examinations.
- Immunizations.
- Messing and berthing spaces.
- Inspection of cooks and food service attendants.

(Weekly)

- Maintenance and repair update.
- Bacteriological testing of potable water system.
- Formal berthing and head sanitation report.
- Collection, holding, and transfer (CHT) / marine sanitation devices (MSD).

(Biweekly)

- Formal galley inspection.
- Pest control survey/spray.
- Food service sanitation inspections.

(Monthly)

- Barbershop inspection.
- Laundry inspection.
- Dry storeroom inspection.
- Refrigerator decks inspection.
- Radiation health report.
- Inspection of controlled medication.
- Verification of outstanding supply requisitions.
- Update immunization requirements.

(Quarterly or semi-annual))

- Inventory of all emergency support equipment.
- Training report.
- Operational and safety checks all medical department equipment.
- Mass casualty drill.
- Medical record audit.

(Annual)

- Calibrations of medical equipment as required.
- Safety of x-ray equipment.
- Long range training plan.

(Situational)

- Accident and injury reports.
- Heat stress survey.

**4.4.2 Periodical External Requirements / Reports**

(Monthly)

- Morbidity report of medical services.

(Quarterly)

- Immunization report.
- Dental readiness report.
- Lifesaving medical equipment safety-checked by a biomedical repair technician and marked on tag.

(Semi-annual)

- De-rat certification.

(Situational)

- Reportable disease alert report.

- Maritime Quarantine declaration should be submitted to a local health department representative when the ship arrives in a foreign port.
- Medical assistance request.
- Medical event report.
- Personnel casualty report.
- Special epidemiological report.
- Death report.
- Aviation accident report.
- Diving accident report.
- Port situation report.
- Post-Deployment critique.

#### **4.4.3 Post-Deployment After-Action Critique**

Ships/units returning from deployment are required to submit a written, post-deployment, after-action critique in letter format concerning medical aspects of the deployment up the chain of command to appropriate medical CINC.

Each echelon in the chain of command will forward this report with appropriate endorsements. This critique need not be lengthy nor should it necessarily provide chronological histories of all medical department events. It should, rather, succinctly pinpoint problem areas:

- Unusual medical problems.
- Unexpected diseases.
- Major injuries/accidents.
- Medical intelligence.
- Lessons learned.
- Recommended changes to current publications (e.g. port directory).
- Supply support/problems.
- Other areas of concern or interest.

The purpose of the critique is to assist other commands who are to deploy in the future to properly prepare for their deployments and to inform cognisant shore facilities of important events/problems in deployed areas.

**( Note → )** Time sensitive medical matters which need speedy reporting should not be held for this post-deployment after-action critique, but should rather be reported in the appropriate format as they occur.

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## 5. Maritime Medical Support

### 5.1 Introduction

### 5.2 Medical Mission in Maritime Operations

### 5.3 NATO Multinational Maritime Forces Medical Support Organisation

- 5.3.1 Shore Medical Support
- 5.3.2 Afloat Medical Support
- 5.3.3 Levels of Medical Care

### 5.4 Medical Support Principles

- 5.4.1 Entitlement to Medical Care
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- 5.4.3 Medical Evacuation
- 5.4.4 Time-Related Constraints of Medical Care
- 5.4.5 Continuity of Care

### 5.5 Maritime Medical Support Planning

- 5.5.1 Multinational Maritime Force
- 5.5.2 Medical Support Plan
- 5.5.3 Casualty Estimates
- 5.5.4 Medical Capabilities in the Area of the Operation
- 5.5.5 Mass Casualty Situation

### 5.6 References

### 5.1 Introduction

The aim of the chapter on Medical Support in NATO Maritime Operations is to provide Naval Medical Officers with concise knowledge of various aspects of Medical Support in maritime environment. It should be noted that this chapter doesn't supersede all reference publications on medical support; the handbook should be read in conjunction with them.

This chapter does not cover medical aspects of amphibious operations, which are described in ATP 8(B) Doctrine for Amphibious Operations. More details relevant to medical support of landing forces can be found (refer to → **AMedP-15** Military Medical Support In Disaster Relief and to **EXTAC 1010** (Rev. A) Non-combatant Evacuation Operations (NEO)).

## **5.2 Medical Mission in Maritime Operations**

The mission of medical support in maritime operations is to support the mission, through conservation of manpower, preservation of life and minimisation of residual physical and mental disabilities. In order to accomplish the mission, a spectrum of services is required, ranging from preventive medicine through first aid, resuscitation and stabilisation of vital functions, to evacuation and definitive specialised care.

## **5.3 NATO Multinational Maritime Forces (MNMF) Medical Support Organisation**

In NATO, medical support to a deployed maritime force has two facets: shore support and afloat support (Ref C.).

### **5.3.1 Shore Medical Support**

Shore support encompasses all the activities in direct support of a maritime force. Generally, the logistic organisation ashore is based on Advanced Logistic Support Site(s) or ALSS(s) in support of the entire force and smaller, more mobile Forward Logistic Site(s) or FLS(s) located closer to the supported force. Both ALSS(s) and FLS(s) are commanded by shore-based Multinational Logistic Commander (MNLC), who ensures the MNMF Commander that he receives sufficient shore logistic (including medical) support to sustain maritime operation.

Shore medical support will be provided by medical support detachments and facilities co-located with ALSS(s) and FLS(s) and will be co-ordinated and monitored by MNLC. The FLS will possess medical treatment facilities at Role 2/3 level while the ALSS will be located within proximity of Role 3 or 4 facilities. Definitive treatment of casualties will be conducted in the home countries.

### **5.3.2 Afloat Medical Support**

A Role 1 medical facility constitutes the basic integral medical support of each individual unit afloat.

An independent maritime force deploying beyond the range of the ALSS and FLS will be provided with higher level of medical care facilities afloat (Role 2/3).

Medical Advisers are located on each level of the Multinational Maritime Force structure. They act as respective commanders' principal assistants for medical matters afloat.

### **5.3.3 Levels of Medical Care**

#### **( → ) Role 1**

The Role 1 medical treatment facility provides first aid, triage, resuscitation and stabilisation. It is an integral part of each ship. Such support extends from small war vessels where no medical staff is carried and where care is limited to self and buddy care, through ships with medical personnel but no physician, to ships with a number of medical officers and staff.

#### **( → ) Role 2**

Role 2 medical facilities provide emergency surgery. There is limited post-operative holding capacity and therefore evacuation is always essential to sustain the recovery of patients. This capability is available either afloat in some major combat or logistic vessels (some aircraft carriers, Primary Casualty Receiving Ships, oil-tankers), or ashore at the FLS.

#### **( → ) Role 3**

Role 3 medical facilities provide specialist surgical teams and more advanced medical support in which the major medical, dental and nursing specialities are represented. It requires sufficient holding capacity dependant on predicted casualty flow and intra-theatre medical evacuation capability. These capabilities can be provided afloat by some Primary Casualty Receiving Ships, some major amphibious ships, all hospital ships and ashore at the ALSS and FLS.

#### **( → ) Role 4**

Role 4 medical facilities provide full and definitive medical treatment. They will be shore based, either in Host Nation (HN) hospitals or in the home country.

### **5.4 Medical Support Principles**

The Alliance's Medical Support Principles are defined in MC326/2 and AJP 4.10 (A). However, since some precepts are particularly important for maritime forces, they are highlighted below (see also Ref D).

#### **5.4.1 Entitlement to Medical Care**

All persons entitled by Hague and Geneva Conventions shall be treated without any discrimination on the basis of their clinical needs and resources available. For maritime purposes this requires that "the wounded, sick and shipwrecked shall be collected and cared for."

#### **5.4.2 Standards of Medical Care**

Medical support to maritime forces must meet standards acceptable to all participating nations. Even in crisis or conflict, the aim is to provide a standard of medical care as close as possible to prevailing peacetime national medical standards, given the difficulties of doing so in an operational setting.

#### **5.4.3 Medical Evacuation**

Evacuation of casualties is a fundamental aspect of medical support of maritime forces. The casualty evacuation plan must enable the patient to reach emergency surgery as soon as possible after wounding. To achieve this goal and plan efficient evacuation system, the medical personnel should liaise closely with logisticians and operational planners.

Evacuation of patients comprises not only a transfer of casualties to shore medical facilities but also to Role 2 and/or 3 facilities afloat. It must be emphasized, that in the maritime environment transfer of patients from ships to facilities either afloat or ashore requires helicopter assets since they are the fastest, most efficient and safest means of transportation.

**(Note →)** In the maritime environment evacuation of patients highly depends on and may be impaired by various factors, from operational imperatives and constraints of movement, through distances between respective units and appropriate levels of care afloat and ashore, availability of helicopters or other means of transportation to fitness of patients for evacuation and weather conditions in the area of operation.

#### **5.4.4 Time–Related Constraints of Medical Care**

In order to reduce the mortality rate of casualties, resuscitation and stabilisation of patients which include life saving surgical intervention as well as intensive care procedures should be initiated as soon as possible, ideally within the first hour of trauma management, but not later than four hours after wounding.

In the maritime environment, due to complexity of medical evacuation it might happen that, although necessary treatment of casualties will normally be initiated immediately after an accident, transfer of patients to higher medical facilities and limb or life saving surgical intervention will be delayed beyond the critical first hour.

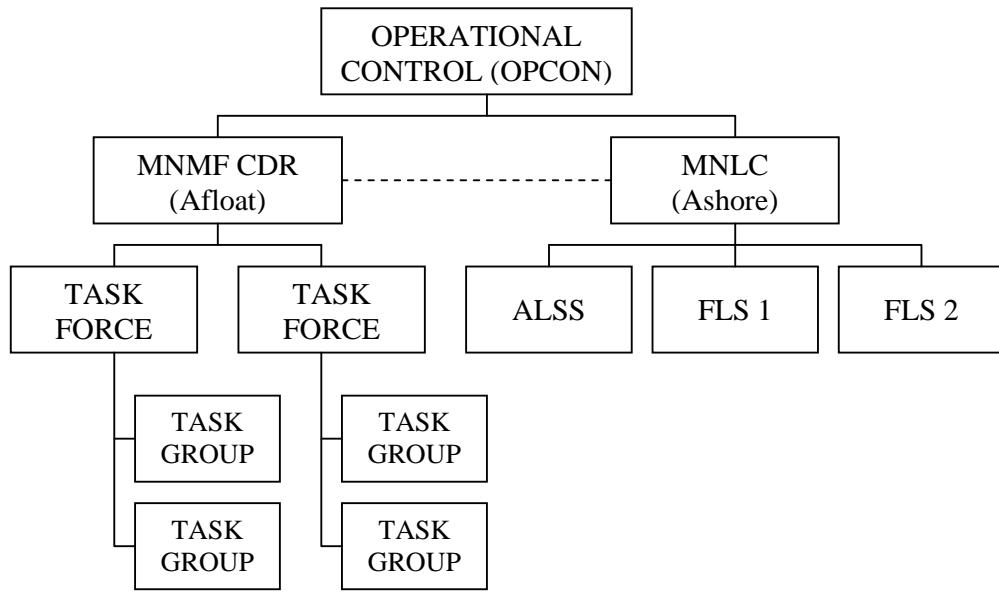
#### **5.4.5 Continuity of Care**

The medical personnel afloat must be aware that patients passing through the evacuation chain may be cared for by a series of surgeons of different nationalities in the different medical facilities. This might result in problems linked with incompatible medical equipment and instruments; different standards of the medical care and language difficulties.

## 5.5 Maritime Medical Support Planning

### 5.5.1 Multinational Maritime Force

Medical personnel contribute to the success of the operation by prevention of sickness and disease, rapid treatment of the sick and wounded, medical evacuation and if necessary, hospitalisation. In order to provide the best possible medical support to the maritime operation the efficient medical plans must be prepared. A wiring diagram below shows an example of a generic structure of Multinational Maritime Forces. It should be emphasised that the medical staff (acting as medical advisers to relevant commanders) can be found on each level of MNMF task organisation, where they are responsible for planning and executing the medical support to assigned forces.



Generic structure of MNMF

### 5.5.2 Medical Support Plan

The Medical Support Plan forms a part of the Operation Plan, which enables to successfully accomplish the mission of the operation. The Medical Support Plan states the essential medical tasks to be completed to support overall operation. A format of Medical Support Plan can be found in AJP 4.10 (A), but for purpose of this handbook some topics, which are more relevant to maritime operations are briefly highlighted below

( → ) Concept of Medical Support.

A clear and concise statement describing methods of how the medical support will be provided for given military operation (“defensive”, “offensive” action or peace support operation).

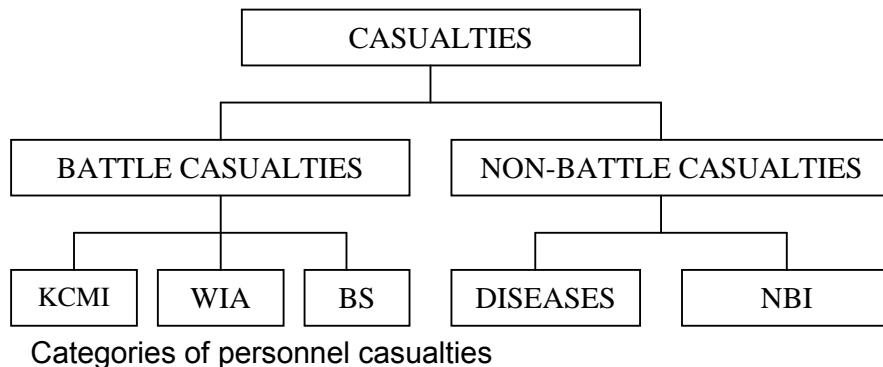
( → ) Medical intelligence data.

Health and sanitary conditions in the area of the planned operation – medical, bio-scientific, epidemiological and environmental information, which may influence planned operation. Examples – epidemic and endemic diseases, chemical pollution and climatic factors, availability and quality of local medical health service.

( → ) Casualty estimates.

### 5.5.3 Casualty Estimates

The casualty estimate is a prediction of total losses of personnel in an operation due to various causes. This estimate is based on historical data from various conflicts and operations. As shown in the diagram below, casualties are broken down into Battle Casualties (BC) and Non-Battle Casualties. BC include Killed, Captured and Missing-in-Action (KCMIA), Wounded-in-Action (WIA) and Battle Stress (BS) cases. Non-Battle Casualties include Diseases and Non-Battle Injuries (DNBI).

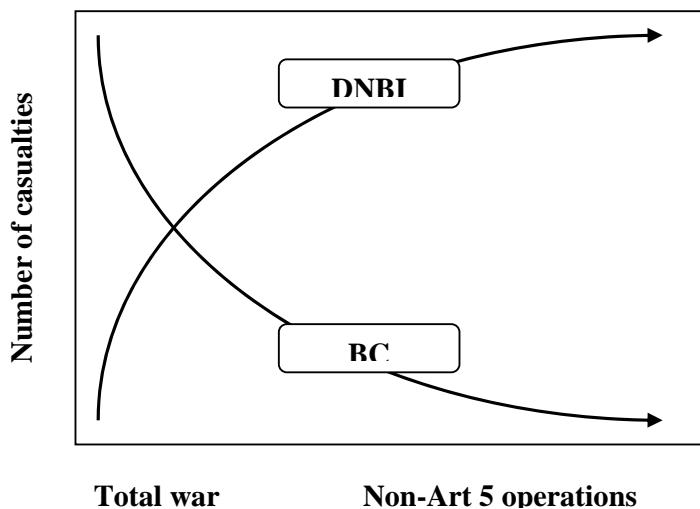


( Note → ) The medical planner should realise that battle casualty estimation is not primarily his responsibility. A large number of factors must be taken into account for the estimation of BC in contingency and operational planning. Therefore, the selection of BC planning rates should involve consultation with and coordination between operations, medical, intelligence and policy staffs, even though the determination of this estimate is primarily the responsibility of the operational staff.

DNBI rates estimates for the operation lies with medical staff.

( Note → ) With regard to the estimation of number of casualties in non-art.5 operations (disaster relief, peace support etc.), there is little historical data but, it can be assumed that casualty estimates would be significantly lower and different, in kind and character, than in conventional warfare.

The diagram below schematically shows relations between the number of BC and DNBI in different types of engagement.



#### **5.5.4 Medical Capabilities in the Area of the Operation**

Medical capabilities (Role 1-4) both afloat and ashore will have a considerable degree of variation. These variations will depend on the composition of the force, the remoteness of the deployment, as well as the specific requirements of the mission. For example, in some operations, especially conducted in remote areas, it will be necessary to provide Role 2 or 3 medical treatment capabilities afloat, located on Primary Casualty Receiving Ships (major amphibious ships).

#### **5.5.5 Mass Casualty Situation**

A mass casualty situation may be defined as a situation where the number of casualties produced in a relatively short period of time overwhelms the available medical and logistic support capabilities. The concentration of manpower within the relatively small volume of a ship's hull means that casualties occur in peaks and therefore a mass casualty situation will easily develop. In the maritime environment even two major casualties or a couple of minor injured onboard one ship may easily overwhelm her medical capabilities. In order to provide the best possible treatment to the most casualties during a mass casualty situation, it is necessary to establish a method of sorting of patients according to type and seriousness of injury and likelihood of survival (triage categories T1-T4). See also Ref I.

**5.6 References**

MC 326/2 - MC Directive For NATO Medical Support Principles and Policies

AJP 4.10 (A) - Allied Joint Medical Support Doctrine

ALP 4.1 - Multinational Maritime Force (MNMF) Logistics

SACLANT 3056 C-416/SER & SACEUR 1240.02.01/SHOLM/139/94 - Maritime Medical Planning Guidance for NATO - MMPG Paper (to be replaced by Bi-SC DIR 85/13 – NATO Medical Planning Handbook)

ATP 8(B) - Doctrine for Amphibious Operations

AMedP-15 - Military Medical Support in Disaster Relief

EXTAC 1010 - Non-combatant Evacuation Operations (NEO) Multinational Maritime Manual

EXTAC 1011 - Naval Humanitarian Assistance Mission

STANAG 2879 - Principles of Medical Policy in Management of Mass Casualty Situation

## **6. Inspections**

### **6.1 General Remarks**

### **6.2 Medical Readiness Assessment (MRA)**

### **6.3 Inspections Performed by the Medical Officer**

#### **6.3.1 General Cleanliness**

#### **6.3.2 Zone Inspections**

#### **6.3.3 Personnel Inspections**

#### **6.3.4 Health and Sanitation**

#### **6.3.5 Galley Inspections**

#### **6.3.6 Coffee Mess**

#### **6.3.7 Berthing Spaces Inspections**

#### **6.3.8 Head Sanitation**

#### **6.3.9 Laundry and Dry Cleaning**

#### **6.3.10 Potable Water System**

#### **6.3.11 Others**

### **6.1 General Remarks**

The ultimate responsibility for health and safety rests with the ship's CO. Every person on board has a duty to conduct himself and his work in a safe manner and to ensure that he does not place himself, others and the ship at risk. Disciplinary proceedings may result if this duty is neglected.

The Commanding Officer is required to prepare and promulgate a statement of his policy regarding health and safety and to ensure that the arrangements to execute this policy are prepared, promulgated and observed. These arrangements and the scope of activities requiring special safe work methods should be contained in the relevant SOPs.

The MO must steadily increase his knowledge of health and safety precautions. He is the one who takes over the industrial hygienist's (IH) tasks afloat, if there is no IH on board, the most common situation. The MO takes active part in the health and safety field advising the CO or Heads of Department about hazardous situations. When identifying areas of work where precautions have not been defined, the MO reports the situation through his CO to the naval authorities.

A logical approach to prevention must be adopted. There are four distinct steps to monitor the effectiveness of controls :

- Recognition.
- Evaluation.

- Control.
- Revaluation.

Recognition and evaluation of the risk of physical injury or health hazards must be based on factual knowledge, environmental monitoring, health monitoring and experience.

Inspections of personnel and spaces at intervals will take a good portion of the MOs time (and being inspected, of course). The MO and his department will be inspected by the CO, other senior staff, during a ship's formal inspection by its Squadron or Flag staff or during the Sea Training Base. There are numerous inspection teams that may come through periodically.

**( Note → )** Performing a good inspection is a learned skill, with increasing effectiveness over time. Don't inspect "against" the Head of Departments – better to do it in close cooperation.

## **6.2 Medical Readiness Assessment (MRA)**

Being inspected is intended to make sure that the MO and his Medical Department understand how to properly maintain themselves and the ship from a naval medical standpoint. Even though the inspection is meant to support, it may be stressful for the MO and regarded as much worse than performing inspections.

The Medical Readiness Evaluation or MRE is the absolute biggest and most important inspection for the Medical Department. The inspection evaluates everything, the departmental organization, supply, training, and quality assurance programs. Medical records will be checked for completeness. The administration system will be examined for proper filing of pertinent instructions, textbooks, documents, and reports. This includes all departmental instructions that must be written (Medical Department Organization, Battle Bill, Mass Casualty Bill, Medical Officer Standing Orders, etc.). All emergency equipment and supplies will be checked meticulously. All logs (daily journal, STD, Sick Call, training, etc.) will be examined, and the laboratory and x-ray capabilities will be inspected. The ability to provide ward care as well as the archives of patient records and other archived files will be assessed. The Watch, Quarter, and Station Bills must be updated and accurate.

The Medical Department spaces will be inspected for sanitation, safety, and habitability. It is a complete check; all areas of responsibility are touched.

Included within the MRA, or inspected separately, are the Environmental Health and the Industrial Hygiene Surveys. These surveys examine all the Preventive Medicine and Occupational Health and Safety areas of the ship. The potable water system, sewage system, galley, barber, laundry, and berthing areas are inspected. Immunization programs and physical requirements for all preventive medicine and occupational health programs are examined. Also noise, heat, and chemical surveys will be assessed and samples taken if necessary.

There are other inspections which the MO will be involved in, in more or less depth:

- Regularly performed major ship-wide inspections and survey boards.
- Operational propulsion plant examinations.
- Radiological control practice examinations and operational reactor safeguards examinations.
- Nuclear weapons acceptance inspections.

The contents of the medical involvement, however, must be taken from the relevant national documents.

### **6.3 Inspections Performed by the Medical Officer**

The ship's MO is sanitation officer, safety officer, personal appearance patrol officer, and maintenance expert all rolled into one inspecting a variety of areas and facilities. This sub-chapter will outline a general format for inspecting personnel and spaces.

Referrals to areas covered are given in detail elsewhere in this book.

#### **6.3.1 General Cleanliness**

Cleanliness must be uppermost in the MOs mind whenever checking his spaces. It is also uppermost in the XO and CO's minds.

Each person in charge of a particular area is responsible for keeping it clean and secure. Secure means that everything is clean, stored correctly, and rigged securely for sea. Ensure that spaces are locked and secured daily. Inspect them occasionally and report any discrepancies.

Hours devoted to cleaning should be held once a week. Every space, passageway etc. should be cleaned thoroughly on these days. The overheads need special attention, because they are hard to clean and often ignored. Periodically, the deck will need stripping and waxing, and the bulkheads will need to be washed down. The ward head should be the cleanest on the ship.

( **Note →** ) Medical spaces should be the example of cleanliness for the ship overall.

#### **6.3.2 Zone Inspections**

The MO is not technically required to engage in non-medically oriented duties. However, he may be required to conduct periodic zone inspections as part of the officer inspection force. Some ships perform several partial inspections, and

others do the ship from top to bottom in one day. No matter how it is done, the inspection can be difficult if the MO does not know what to look for.

Zone inspections are designed to evaluate the material condition of a space by looking for safety, electrical, and fire hazards and inspecting damage control equipment and fittings. Discrepancies are reported and submitted to the department responsible for the space so they can be corrected.

The approach to an inspection should be systematically, in order not to miss anything. It works very much like a physical examination. The following items should be checked routinely:

- Dirty vent covers.
- Broken or frayed wires.
- Burned out lights and/or nightlights.
- Leaky valves or pipes.
- Torn lagging (insulation).
- Burned out battle lanterns (emergency lights).
- Current fire extinguisher inspection tags.
- Current electrical safety tags on every piece of electrical equipment.
- Malfunctioning equipment.
- Dirty bulkheads and decks.
- Material condition of the deck. Does the deck need to be repaired or replaced?
- Areas that need paint.
- Safety items: goggles, shields, eyewash stations present and functional and not date expired.
- Is the compartment check-off list present, in its correct location and up to date?
- Proper labeling of the space and compartments.
- Proper gear in space.
- General cleanliness.

- Damage Control fittings. Are X-ray, Yankee, and Zulu fittings properly labeled and either set or able to be set?
- Is personal gear in the space and not properly stowed?
- Are particularly heavy items secured for sea with brackets and screws?

This partial list will cover 90% of a zone inspection. The situational remainder is common sense.

#### **6.3.3            Personnel Inspections**

The MO should inspect Sickbay personnel at least once a week, using this opportunity to check for general appearance, cleanliness, proper uniforms, haircuts, and shaves. While this may not sound important, personal appearance onboard ship is taken as a symbol of the operational effectiveness of a department. MOs have a reputation in the navy for being less military than line officers, it is important to set a good example by being sharp in one's own appearance and educate personnel to care about their reputation.

( **Note →** ) Inspections should be a teaching tool, not a disciplinary one.

MO should be aware about inspections serving a real purpose. Many young sailors are away from home for the first time, not knowing how to dress and behave. The discipline needed to meet the MOs approval is a positive, not demeaning, achievement for them. Failure to inspect them properly can diminish self-esteem and cause morale problems.

#### **6.3.4            Health and Sanitation Inspections**

Health and sanitation inspections are the responsibility of the Medical Department. They should be performed with a critical approach.

As Medical Inspector, the MO is the CO's advisor in an area where he may have little knowledge. If the medical inspector does not correct the minor deficiencies, they may become major deficiencies, resulting in the death or injury of personnel.

Not everything identified to be changed or repaired will be taken care of immediately. There may be jobs elsewhere with equal or higher priority that consume the crew's attention. Recommended changes can best be implemented by documenting and re-documenting discrepancies. Inspections are done for substantial improvements in the ship's readiness.

Important areas for inspection and required frequencies include:

- Food service: Informal-daily, formal-every two weeks.

- Barber shop: Monthly.
- Berthing areas: Daily, formal report-weekly.
- Heads: weekly for those not attached to berthing areas.
- Laundry: Monthly.
- Coffee messes: Periodically.
- Ship's store: Monthly.
- Sewage pump rooms: Weekly.
- Water sanitation: Daily for chlorine/bromine residuals, weekly for bacteriological surveys.
- Waste collection and disposal: As needed.
- Insect and pest control: Should set up system to inspect and spray if needed in each galley every two weeks.
- Mess cooks: Daily.
- Refrigerators and dry stores: Monthly.

The results of the above inspections are kept in the appropriate logs. Completion of inspections is also noted in the Medical Department daily journal. The discrepancies can be kept in the various logs. In addition to the above paper work, every two weeks a report is due to the CO via the XO of all the above sanitation inspections and their results.

The Medical Department is the "watchdog" of shipboard sanitation practices. Although not involved in the day-to-day running of sanitation programs, the MO is responsible for ensuring that all safe sanitary principles are followed, being in the lofty position of sanitation and preventive medicine specialist, without having any training in basic shipboard sanitation practices.

Again, very specific (national) rules and regulations have to be identified and followed.

### **6.3.5            Galley Inspections**

Galley inspections is an area of major concern.

Bad sanitation can cause food-borne illness, diminish morale, and even stop the ship functioning. Food service is run by the Supply Department. Every ship is assigned a number of mess specialist personnel who plan, prepare, and serve the meals, as well as keep the galley and dining areas clean and sanitary. In

addition, each ship provides "mess cooks" in numbers adequate to perform the heavy work of cleaning, breaking out food, storing food, and generally doing the manual labor. The mess deck master-at-arms is responsible for the dining area and scullery and runs the main mess deck. He trains and manages personnel assigned to maintain the enlisted dining facility.

The MO has to forward a regularly, written food service sanitation inspection report to the CO, which should be recorded on a dedicated form. It does not have to be done personally by the MO, it may be delegated to his staff. However, the MO should occasionally attend to see that all areas are thoroughly inspected and discrepancies recorded.

( **Note →** ) If the area inspected constitutes a health hazard, the MO should recommend to the CO that it be closed immediately until the discrepancies are corrected. Usually the threat of closure brings about rapid results.

It is recommended that walk-through inspections of the galley and food preparation areas are made about once a week to ensure:

- General cleanliness.
- Proper food preparation methods.
- Proper equipment types, use, and upkeep.
- Good food handling practices.

The most important thing for the MO to do is make his presence known. The MO should take his meals with the crew periodically.

The contents of a galley inspection should include:

- All surfaces: The deck, counter tops, salad bar etc. should be clean and free of grease and obvious food debris. Overheads should be dust free and the bulkheads clean. The exhaust hoods, grills, steam kettles, and ovens should be clean and without food debris. The same applies for refrigerators, inside and out. The can openers and meat slicers are common areas for food debris to collect; checking here makes clear that the MO knows what he is doing.
- Properly handling of leftovers. Any food items not properly covered, dated, and refrigerated must be discarded. Poor handling of leftovers is a common deficiency with potentially disastrous results. Anything over 36 hours old must be discarded.
- Personal hygiene: Food service personnel must wear gloves, hats, and clean uniforms when handling food, and no smoking, eating or drinking may occur in the food preparation areas. No personal gear or cleaning gear is allowed to be stored in food service areas.

- Meat slicer: Must be kept clean and no sampling may take place while meat is being sliced. Mess cooks who eat while preparing meals, risk the transfer of bacteria from their mouths to the food.
- All garbage should be promptly removed from the food service and scullery spaces and trashcans should be kept clean and sweet smelling.
- Refrigerator temperatures must be kept at the correct temperature and covered.
- Frozen food must be thawed in the thaw box, not on the counter top.
- Mouldy or rotten food to be stored in reefers.
- Environment: Thermometers have to be situated in the scullery and temperatures taken and recorded each shift.
- Dishwashers: temperature gauges on the dishwashers in the scullery must be checked to ensure that dishes are being washed and rinsed at the proper temperatures. There are heat sensitive tapes available to document the temperatures. If wash water fails to meet the proper temperatures, the dishwasher is not to be used, and a work order should be submitted to correct the problem. The water jets in the rinse section must not be clogged. Leftover detergent can cause chemical diarrhoea.
- Pests: No visible insects, especially cockroaches.
- Hoses hooked to fresh water lines to wash down decks and equipment are sources of contamination of the water supply and are forbidden.

( Note → ) There is no need to announce an inspection. Surprise inspections are more productive than announced ones. MOs should take Medical Staff along on all inspections and instruct them on proper sanitation practices.

( Note ( ) All food products are required to have a medical representative inspect them before they are accepted. Food from independent vendors must have a stamped invoice to prove it has been inspected before delivery.

Inspectors are usually located at each large naval facility to inspect vendors as they bring food items to the base. However, vendors do not always make this stop bypassing the inspector in an effort to make deliveries quickly. To help prevent this, mess specialist personnel will accept all food deliveries to the ship. They are required to inspect for freshness and quality. A Medical Department representative should be there to assist them:

- Fruits and vegetables should look fresh and be free of mould and rot.
- Frozen food should be frozen and remain frozen until stored in the freezers. Supply is usually good about making sure there is

extra help to get frozen food to the freezers quickly.

- Dry stores should be intact, free of insect infestation, and show no watermarks.
- Intact packaging.

( Note ( ) The Medical Department is required to perform a daily inspection of all mess personnel. A qualified member of the Sickbay staff can be assigned this job. Clean hands, trim nails, cleanly shaven faces, and clean uniforms are a must. All personnel handling food must not be suffering from: colds, runny noses, or cuts on their hands or arms.

#### 6.3.6 Coffee Mess

The formal, permanent coffee mess areas are in the wardroom, mess deck, CPO mess, and first class lounge. These areas are to be kept just as clean as any other food service area. Of particular note is the use of common cups, spoons, and un-refrigerated dairy creamers, all of these are prohibited.

The coffee mess has been notorious as a source of infectious diseases. Paper or personal cups, disposable wooden stirrers, and non-dairy creamers are authorized. The area should be cleaned of all spills, especially sugar. Coffee creamer and sugar should be in clean, closeable containers to deter cockroaches.

Coffee messes are authorized in many workspaces. The Sickbay representative must do the initial certification to ensure that the coffee mess complies with existing regulations. Occasionally these messes must be inspected as well.

#### 6.3.7 Berthing Space Inspections

The crews berthing areas are vitally important and should be informally inspected daily.

Most ships have daily messing and berthing inspections done by the XO as well as the officers and chiefs to ensure proper cleaning. For the Medical Officer, a daily inspection would be an impossible task. Generally, a member of the Sickbay staff may accompany the XO on the daily "heads and beds."

Inspections of living compartments must be performed routinely. Living areas can become big problems "overnight". Transmission of disease and the spread of cockroaches are greatly increased by unsanitary conditions.

Discrepancies (dirty decks, un-shined lockers, dirty linen, etc.) should be corrected that same day. Problem areas include:

- Overheads.
- Angle irons along the bulkheads.
- Gear under the mattress - a fire hazard.

- Scuttlebutts (drinking fountains).
- Linen.
- Dirty laundry adrift in the compartment.
- Food being stored.
- Mattresses.

#### 6.3.8 Head Sanitation

Toilets are another vitally important area that should be inspected daily. Problem areas to be particularly aware of are:

- Cleanliness under the urinals and commode rims.
- Mould and mildew on the shower curtains and mats.
- Splash shields around the urinals. - need to be clean, especially in the corners.
- Good function of commodes and urinals.
- No wash-down hoses.
- Adequate supply of rolls of toilet paper and paper towels.

#### 6.3.9 Laundry and Dry Cleaning

Annual physical exams are required on all laundry personnel. A monthly visit is all that should be required for the spaces unless there are problems. The MO should look closely at laundry and hygiene practices for:

- Proper use of gloves and masks for sorting dirty laundry.
- Separate areas for dirty and clean laundry. They shouldn't be adjacent.
- Proper hand washing procedures. Hands should be washed before entering and before leaving the space.
- 'No Eating or Drinking' and 'No Smoking' signs posted.
- Areas where bleach and detergent are stored must be labeled as eye hazard areas and have appropriate chemical warning labels posted. There must also be an eye wash station within 10 seconds of the work area, and eye protection goggles must be worn when working with chemicals.
- All washing machines have both salt and fresh water connections. The saltwater connections should be closed and padlocked when within 25 miles of shore or in otherwise contaminated waters. Fresh water inlets should be rigged (one-way valves) so cross-contamination cannot occur if suction is placed on the line.

The laundry should be generally kept in a neat and sanitary manner. All lint filters in dryers should be cleaned, presses should be in good

working order, and dirt and dust should be kept to a minimum. Dust and lint are fire hazards.

Larger ships will have a separate dry cleaning facility attached to the laundry. The person who runs this must also have a laundry physical as well as a dry cleaner's physical (for halogenated hydrocarbons), both pre-placement and annual. Each must also be certified to wear a respirator and actually wear a respirator and goggles when using the dry cleaning fluids. There must be a plumbed eye wash station within 10 seconds of the work area, as well as appropriate eye hazard signs posted.

#### 6.3.10 Potable Water System

Engineering is an area which the Medical Department works closely with. The Engineering Department is responsible for making water on the ship. The equipment takes seawater and uses steam from the boilers to distill the salt water into fresh water. This fresh water is then treated in different ways depending upon the intended use (potable water for the crew, feed water for the boilers or de-mineralized water for the reactors). Engineers monitor the pH, salinity, and temperature of the fresh water, since those values are important for the Engineering plant. They also monitor the chlorine or bromine residuals in the fresh water and the potable water systems. They will adjust the amount of chlorine or bromine being added to the potable water to bring residuals to at least trace halogen levels in the system.

The Medical Department is responsible for ensuring that the potable water system is safe.

This is accomplished by randomly monitoring the halogen residuals daily at selected points throughout the ship. Bacteriological counts are done weekly to ensure no contamination exists. Samples should be collected from various points throughout the ship and should read at least trace for halogen residuals; 0.2 ppm is the safer level. If levels drop below trace, Sickbay must notify Engineering, who will then batch chlorinate the potable water tanks to bring the halogen residual levels up to the correct standard.

Halogen residuals must also be tested on water received from other sources.

In port, the potable water connection must be monitored. When using questionably safe water sources, overseas, or pier-side in an emergency situation, the Medical Department plans to batch chlorinate the water to 5.0 ppm and to have residuals of 2.0 ppm after a 30-minute contact time. When taking water from a water barge, batch chlorinate should be performed on the barge first if possible, so as not to risk contaminating the ship's potable water system. This is to avoid a water-borne disease outbreak.

The bacteriological water tests include inspecting the ice machines for coliforms (*E. coli*), which indicate contamination in the potable water system. The ice machines are a common source of contamination.

For batch chlorination, calcium hypochlorite is used. This is a hazardous (explosive) chemical, which requires special storage and handling.

For more details refer to ( Chapter 12.

6.3.11            Others

More inspections are dealt with elsewhere in this publication:

- Disease Outbreak Investigation - refer to ( Subchapter 7.1
- Rodents - refer to ( Subchapter 7.1
- Hearing Conservation - refer to ( Subchapter 9.1.2 / 9.2.5.
- Ventilation and Air Conditioning - refer to ( Subchapter 9.1.3
- Heat Stress - refer to ( Subchapter 9.1.4
- Protective Aids - refer to ( Subchapter 9.2
- Hazardous Workplaces - refer to ( Subchapter 11.2.2
- Sanitation and Waste - refer to ( **Chapter 13.**

## 7. Preventive Medicine

### 7.1 International Health Regulations (IHR)

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### 7.1 International Health Regulations

#### 7.1.1 General Rules

Procedures designed to ensure maximum security against international spread of diseases with minimum interference of world traffic are prepared by the World Health Organisation (WHO) and published as the International Health Regulations (IHR). The diseases of interest are cholera, plague and yellow fever. The IHR are reviewed annually at the World Health Assembly and MOs

should have access to an up to date copy (in 2004, IHR from 1969 with amendments from 1973 and 1981). As of January 2004 a 'working paper for regional consultation' is under way. The revised edition is published and in process of ratification.

The duties and obligations of a Port Authority will be determined by IHR in so far as that country is a signatory of the regulations (with the exception of any reservation the signatory country may have). National legislation and the case of Naval Medical Officers of Health, Armed Forces regulations may alter the situation. The IHR recognizes no difference between inland and seaports.

Part III of the IHR (WHO 1982) deals with the setting up of port health organisation and the provision of premises and equipment necessary with particular reference to the quarantinable diseases. The articles in this part lay down that each port shall have:

- (1) The organisation and equipment adequate to apply the measures required by the regulations.
- (2) Provision of pure drinking water and wholesome food for all who use the port.
- (3) Provision of an effective system for the safe removal and disposal of human excrement, refuse, waste water, condemned food and other articles dangerous to health.
- (4) Provision of an organised medical and health service with adequate equipment and premises to deal with infected persons, disinfections, disinsection and deratting.
- (5) Sufficient competent people to inspect and issue deratting certificates at such ports as may be designated.
- (6) Absence of rodents, *Stegomyia aegypti* and other mosquito vectors of disease.

The health authority is bound to conduct periodic inspections of equipment, installations and premises and to collect samples of food and water for laboratory analysis. It is also required to issue, free of charge and on request, certificates specifying the treatments carried out to ships or goods.

As a general caveat to Part IV of the IHR, no disinfections, disinsection, deratting or other sanitary operation shall cause:

- (1) Injury or undue discomfort to any person.
- (2) Damage to a ship or its equipment.
- (3) Damage to cargo, goods or baggage.

General rules are laid down concerning surveillance of persons and subjection to medical examination.

A health authority may also take all practical measures to prevent pollution of the water by discharge of sewage or refuse from ships using the port or its approaches.

#### **7.1.2 Arrivals, Pratique and Quarantine**

The IHR (article 35) states: "Whenever practicable, States shall authorise granting of free pratique by radio to a ship or aircraft when, on the basis of information received from it prior to its arrival (refer to → **Subchapter 7.1.3**), the health authority for the intended port or airport of arrival is of the opinion that its arrival will not result in the introduction or spread of a disease subject to the IHR."

This measure would not be applied to ships which are merely taking passage through waters within a country's jurisdiction and not calling at a port or on the coast. However a Maritime Waterway or Canal may be treated as a Port by the health authority.

A Maritime Declaration of Health signed only by the Commanding Officer (and MO if borne) may be required by the health authority. The format of such declaration is given in the IHR, appendix 3.

Except in an emergency constituting a grave public danger, free pratique must not be withheld on account of either infection or suspected infection of persons other than those specified in the IHR ( refer to → **Subchapter 7.1.3**).

If free pratique is not granted in advance, pratique may be granted on arrival or after such health inspections, and health measures as the country visited requires have been applied.

A ship is placed in quarantine from the time of its arrival until such time as pratique is granted. This includes the time during which the appropriate health measures are being applied. A ship in quarantine must be allowed to embark fuel, water and stores.

#### **7.1.3 Diseases Subject to the IHR**

Under the regulations, member states are required to notify the port health authority within 24 hours that a ship has arrived with one or more cases of plague, cholera or yellow fever. It is essential that the CO informs the Port Health Authority and/or his operational authority at the earliest opportunity of any suspected case of any of these diseases.

WHO member states are required to inform the WHO of any change in the vaccination requirements for any international voyage. The WHO has published

a booklet "International Travel and Health - Vaccination Requirements and Health Advice" in 2002. Supplements with detailed amendments are published during the year in the WHO "Weekly Epidemiological Record". Valid data can be found as well on the CDC-websites of the National Centre for Infectious Diseases – Travellers Health–Vaccinations at <http://www.cdc.gov/travel/vaccinat.htm>.

The "Weekly Epidemiological Record" details the notifications received during that week of the four diseases and other important diseases, a list of newly infected areas and those removed from the infected area list. National authorities normally hold these publications.

#### **7.1.4 Plague, Deratting Exemption Certificates**

The incubation period of plague is considered to be 1 to 7 days and vaccination is not required, as a precondition of entry to a territory. Countries are required to systematically collect and examine rodents and their ectoparasites and ships are required to be either permanently kept free of rats or periodically deratted.

Before leaving an area where there is an epidemic of pulmonary plague for an international voyage, every suspected case is to be placed in isolation by the health authorities for six days from the date of the last exposure to infection.

A ship is regarded as infected if it has a case of plague onboard, if a plague-infected rodent is found onboard or if a case of human plague has occurred onboard more than six days after embarkation.

Health authorities have certain rights with regard to ships which are infected or are suspected of being infected with plague. The suspect case may be disinfected and kept under surveillance for up to six days from the date of arrival and his baggage may also be treated. Articles such as bedding or linen may be similarly disinfected or have insects removed. When a ship arrives at a port with a case of plague, or if a case has occurred within six days of the ship's arrival at the port, the passengers and crew may be isolated for up to six days. Deratting may be done if necessary, subject to certain provisions, particularly if there is abnormal and unexplained mortality among the rats on board or if rodent plague is demonstrated.

The ship will cease to be regarded as infected or suspected when effective measures have been taken or when plague is disproved and the ship may then be granted pratique.

If an unaffected healthy ship arrives from an infected area, it is to be given free pratique but suspects may be kept under surveillance. The health authority may require deratting and disconnecting the ship if they have good reason for this.

The IHR requires that an internationally approved Port Health Authority inspect all foreign-going vessels every six month for the presence of rats. WHO

publishes a directory of ports designated in applications of the IHR. In certain ports the designation is for warships and naval auxiliaries only. The certificates in such ports may be issued by the naval (as distinct from civilian) health authority and arrangements are made through the naval medical authorities.

If inspection reveals the presence of rats onboard then the Port Health Authority will order the ship to be fumigated or treated by trapping and/ poison-baiting or depending on the number of rats found at inspection. Once this has been successfully completed an international deratting certificate is granted, valid for six months. If the inspection fails to reveal any evidence of rats onboard, a deratting exemption certificate will be issued in English and French, containing full particulars of the inspection of holds and compartments.

#### **7.1.5 Cholera and Yellow Fever**

While an outbreak of cholera in a ship may produce serious clinical problems, it should be possible to contain the outbreak locally without international complications. The incubation period is a few hours to 5 days (usually 2-3 days). States have to assume the responsibility for surveillance, isolation, removal of contaminated food (excluding cargo), water, human excreta and other waste matter, disinfecting water tanks and food handling equipment. Personnel coming from an infected area within five days with symptoms of cholera may be required to submit to stool examination but not to rectal swabbing.

Primary prevention is relevant to diseases such as tuberculosis, polio, tetanus, typhoid and diphtheria in addition to the four diseases subject to the IHR. Periods of quarantine and isolation, so common twenty years ago for schoolchildren, have fallen into disuse for shore-based communities. The increased therapeutic advances make such action only rarely necessary. The situation in a ship is very difficult and an outbreak of debilitating illness can quickly jeopardize the ship's operational capability. The crew of a ship is likely to live and work much closer together than is the case ashore. This is particularly true of warships where personnel numbers are high in relation to the size of the ship due to the requirement to operate complex equipment and machinery. This crowding encourages the communicable diseases especially upper respiratory tract ones and high standards of hygiene are essential. Tuberculosis, long associated with such conditions has shown a dramatic fall in annual cases but the prevalence in sailors is still about double that of the civil community ashore.

Other environmental factors may influence communicable disease in sailors, including sexually transmitted diseases, STDs. The nature of their irregular life without the close security of homes and families encourages them to spend time in the bars, cafes and other haunts in the ports of the world where conditions are often less than perfect and opportunities for the spread of diseases are great.

Immunisation will not only protect the individual against a specific disease organism but also provides a degree of herd immunity, rising with the percentage of the crew immunised by this pathway.

#### **7.1.6 General Hygiene, Rodent and Insect Vectors**

High environmental hygiene standards are vitally important throughout ships as in their absence the risk of spread of bacteria and viruses in the closed community are enhanced. Poor design, inadequate ventilation and other adverse factors favour the chance for the spread of communicable disease.

Low standards of personal hygiene in the crew will encourage spread of communicable disease, particularly of the upper respiratory tract and those due to human body parasites.

Insect or animal vectors may be responsible for the spread of disease:

- (1) By transmitting the disease through partaking in the disease cycle.
- (2) By carrying infected material from one place to another, especially by moving from excrement or refuse to food.
- (3) Because they are themselves human parasites (body lice).

Rats may cause greater problems and prevention is easier than cure. The IHR require health authorities to keep ports free of rats and much has been done to achieve this aim but the problem is unlikely to be eliminated in the foreseeable future. Rat guards have some effect but a careful watch and scrupulous hygiene are still required. Control of sullage areas close to ships is a major factor in the prevention of spread of the rat population. Once onboard rats are only likely to become a real problem if present in sufficient numbers to breed and if food is readily available. Rat traps are usually effective for the occasional rat but poisoning by expert personnel may be necessary.

Cockroaches present a perpetual problem in ships and can be resistant to disinfection procedures. The most common varieties are the Oriental cockroach (*Blatta orientalis*), which averages about 22mm in length and the German cockroach (*Blattella germanica*) about 10 to 15 mm in length.

The cockroach spreads disease principally with its feet and disease prevention is by making it impossible for the cockroach to have access to food for consumption by humans. It is a scavenger, living on food particles and scrupulous hygiene in food storage cooking, eating and living spaces is the most effective means of controlling the cockroach population. Without such control, the use of insecticides is ineffective. The insect gets into the ship in foodstuffs, particularly in sacks of vegetables, and careful control of the storage of food is an essential prerequisite to a cockroach control programme. Once it has invaded below decks, it is less accessible behind panelling and much more difficult to control.

Pesticidal action by ship's staff should be limited to local use of aerosol cans of Pyrbuthrin. More extensive action requires skilled staff familiar with the precautions required in the use of extremely toxic chemicals. This can normally be arranged through the naval medical authorities. Careful preparation in advance of the pest control team is essential for success. The fewer the numbers of men on board at the time, the more effective the procedure is likely to be. Preventive action with chemicals in anticipation of cockroach infestation is not advised.

Mosquitoes can be a major problem and their control is of great significance in the prevention of malaria. They are unlikely to fly more than 400 metres from shore (but are influenced by prevailing winds) and ships anchoring or sailing in coastal waters may be troubled. Bare skin is an open invitation to attack by this voracious insect, which will find clothing troublesome (long sleeves and trousers are valuable preventive measures). Insect repellents and mosquito netting over beds and bunks are other useful measures.

Control of flies in a ship is not usually difficult. It is essential that they are eliminated from food handling areas and that food hygiene measures prevent their breeding.

#### **7.1.7           Food and Water Borne Diseases (Food Poisoning)**

The term "food poisoning" is applied to a group of gastrointestinal diseases caused by contamination of food or drinks by bacterial, viral or parasitic infections and by toxins as well as chemical contaminants. The illness is characterised by nausea, vomiting and diarrhoea. Although the illness may be considered minor in medical terms, an outbreak in a ship may quickly impair operational efficiency and must therefore be managed more rigorously than if it had occurred in a similar age group ashore. Expert assistance should be sought at an early stage in planning management of an outbreak including the disposal of suspected carriers during and after investigation.

( Note → ) The ten golden rules suggested by the WHO are:

- (1) Choose foods processed for safety.
- (2) Cook food thoroughly.
- (3) Eat cooked foods immediately.
- (4) Store cooked foods carefully.
- (5) Reheat cooked foods thoroughly.
- (6) Avoid contact between raw food and cooked food.

- (7) Wash hands repeatedly and thoroughly.
- (8) Keep all kitchen surfaces meticulously clean.
- (9) Protect food from insects, rodents and other animals.
- (10) Use safe water.

#### **7.1.8            Bacterial Intoxications**

Symptoms are due to the toxins produced by the bacteria and not the bacteria themselves.

Staphylococcal food poisoning is due to the release by Staphylococci of a powerful toxin, which requires considerable heat treatment for its destruction. Typical symptoms occur after an incubation period of 2 to 4 hours / with a range of 1 to 6 hours) and the onset is abrupt and may be violent. Salivation, nausea, vomiting, abdominal pain, diarrhoea, subnormal temperature and sometimes hypotension are seen. A food handler harbouring the organism in the nose, throat, mouth, ear or septic skin lesion almost invariably causes an incident of this type. Organisms are picked up on the hands and go on to contaminate the food. If then left in a warm environment, toxins will be produced most rapidly. The foods, which are usually responsible are those, which are handled, hams and other cold joints, sandwiches, artificial cream and pies included. The staphylococcal enterotoxins cannot be destructed by heating, not even through ultrahigh temperature heating (143,3 °C for 9 sec).

*Clostridium perfringens* food poisoning produces typical symptoms of diarrhoea and abdominal pain following a 10 to 12hours incubation period (range 6 to 24 hours) and vomiting is rare. Most outbreaks are traced to meat dishes and products, especially when they are pre-heated. This is because the causal organism is often found in raw meat and survives heating in spore form unless cooking is very thorough. If the meat is then not kept at a proper temperature, the spores vegetate and multiply, later forming toxins in the patient's intestinal tract. In addition some of the population carry the organism in the bowel and the food handler is therefore a possible source (via his hands) of infection.

Botulism is fortunately very rare. The case fatality rate in food-borne botulism is 5-10% and the toxin of *Clostridium botulinum* causes the condition. Typical symptoms after a 12 to 36 hours interval (range 2 hours to 6 days) include hoarseness, weakness, dizziness, headache, constipation, chest and abdominal pain, double vision and paralysis. Death usually results from respiratory or cardiac failure. Foods responsible are often bottled or canned where inadequate heat destruction of spores has not been achieved. Vacuum-packed smoked salmon may also be suspect.

*Bacillus cereus* food poisoning has an incubation period of 2 to 15 hours and causes vomiting, diarrhoea and abdominal cramps lasting 1 day. The spores of the organism are frequently present in cereals and survive light cooking. If

subsequently stored at lukewarm temperature, the spores germinate into bacilli, which multiply and produce toxin in the food. Suspect foods include custards, cereal products, puddings, meat loaf and fried rice (if re-heated from pre-boiled rice).

#### **7.1.9            Bacterial Infection**

Infection with bacteria of the genus *Salmonella* accounts for the majority of all food poisoning outbreaks, but *Campylobacter jejuni* appears to become a good runner-up in some areas. They are clinically difficult to distinguish from one and other, except with the occurrence of bloody stools, which are uncommon in ordinary Salmonellosis. Numerous serotypes exist, the most common being *S. Typhimurium* and *S. Enteritidis*.

Typical symptoms are, after an incubation period of 12 to 36 hours (range 6 to 72 hours), abdominal pain, diarrhoea, fever, anorexia, dizziness, nausea and vomiting. It is less easy to incriminate responsible foods than in toxin poisoning. Examples are meat products, artificial cream and eggs (especially duck eggs). The main reservoirs however are human intestinal carriers and this must be taken into account with respect to the food-handlers, especially with recurrent outbreaks on a ship. Other bacteria including *Proteus*, *Coliforms* and *Streptococci* cause occasional problems. Symptoms are usually milder, though similar to Salmonellosis and made-up and left dishes are often implicated.

#### **7.1.10          Chemical and Fungal Food Poisoning**

Chemical poisoning is rare. Typical symptoms are nausea, vomiting and abdominal pain following a short interval (usually less than 2 hours). The symptoms are due to irritation of the stomach by chemicals such as insecticides, heavy metals or certain species of fungi, fish and shellfish. Food responsible may have a metallic taste.

Fungal food poisoning is also rare but several moulds and their mycotoxins may produce symptoms of nausea, vomiting and abdominal pain and neurological problems are possible.

#### **7.1.11          Management of Outbreak of Food Poisoning**

( **Note →** ) An outbreak of food poisoning may be recognized by an increase in the number of personnel complaining of the symptoms and early warning of the likelihood of an outbreak may be given by bacteriological investigation of one or two early cases.

( **Note →** ) All cases of food poisoning must be reported to the CO and to the naval medical authorities without any delay.

A full brief of all relevant circumstances and action taken to date is necessary. The various types of food poisoning listed are not always as clear-cut as described from one another because of variation in time between intake of suspect food and onset of symptoms. It is therefore useful to have a general plan of action available to be implemented pending external advice.

The importance of keeping complete records of individual cases and the development of the outbreak cannot be over-emphasized.

#### **7.1.12 Containment of the Outbreak**

Reinforcement of personal hygiene in personnel is of highest importance, especially hand washing after using the heads.

The CO should be advised that galleys must serve only hot food and no food remnants must be used for meals. Remnants of meals consumed just prior to the outbreak should not be ditched until suitable samples have been taken. The highest standards of food hygiene must be observed. Affected food handlers must be relieved of duties in food handling spaces.

**( Note → )** Salmonellosis and similar virulent forms of food poisoning spread more easily in the closed confined space of a ship. Where possible, the patients should be transferred ashore to a naval sick quarters or hospital with a copy of their record card upon which stool sampling and the subsequent results must be recorded. The MO in charge of the receiving unit should first be consulted.

**( Note → )** Symptom-free positive carriers when discharged from establishment or hospital must not be returned to their ship until three consecutive negative stool specimens have been confirmed. They should be drafted to a shore establishment after consultation with the naval medical authorities.

Antibiotic treatment is not indicated in the otherwise healthy symptom-free case.

#### **7.1.13 Investigation to Determine Cause**

Comprehensive information should be obtained from patients concerning symptoms and food or drink taken within the 72 hours prior to those symptoms.

**( Note → )** Menus of the three previous days should be perused food. Clustering of cases should be looked for. Samples of suspect food and water should be taken for bacteriological examination. Evaluation of food hygiene practice can be helpful. Specimens of faeces (and vomitus if applicable) should be taken for bacteriological examination.

It should not, however, be necessary to take faecal samples from the whole ship's company.

Venous blood should be taken from affected personnel for paired serology. Food handlers should be inspected for evidence of sepsis especially on exposed areas. Swabs should be taken from the nose and any suspect skin lesions for culture. Stool and blood specimens should be taken from this group. Food histories should be taken from unaffected food handlers as these may point to one or more food items taken by them, but not by affected personnel thus narrowing the list of suspect foods.

#### **7.1.14        Administrative Sequelae**

In some types of food poisoning especially Salmonellosis, food handlers must provide three negative stools before returning to food handling. Hospital sick leave should not be given to patients admitted without express approval, after first consulting the health authorities.

**( Note → )** Food poisoning generally is not a quarantinable disease and normal leave should be given. Special consideration should be given to the risks of granting leave to men who live at home with a food handler, young children (especially if attending pre-school play grounds) and if old or infirm people live in the same house.

Adventurous training and other activities in which high standards of food and personal hygiene are difficult to maintain should not be permitted.

**( Note → )** Exchange of personnel between ships should be minimised, except where patients are being transferred to a larger ship for investigation and/or treatment.

#### **7.1.15        Other Food and/or Water Borne Diseases**

Typhoid fever may be spread by a variety of food vehicles. Paratyphoid fever has been associated with milk and bakery products, in relation to their egg content, and desiccated coco.

Cholera is classically a water-borne disease but transmission has been attributed to contaminated food, including crustaceans and shellfish.

Hepatitis A has been transmitted in meat and meat products, cream and fruit products. Isolated cases can occur but if secondary cases arise, all members of the ship's company should receive immune serum globulin (0.02 ml/Kg body weight). Infected food handlers should be relieved of their duty until cleared by Laboratory investigation. Prophylactic immunisation shortly before departure to tropical areas with low hygiene standards should be taken into consideration.

Less commonly related to food or water are enteropathogenic E. coli gastroenteritis, bacillary dysentery, brucellosis, tuberculosis, diphtheria, ciguatera and scombroid fish poisonings, Q -fever and viral gastroenteritis. The

risk of acquiring these diseases is, in general, higher when visiting tropical areas or developing countries.

( **Note →** ) Calicivirus (Winter vomiting disease) is very infectious. Shellfish, vegetables, fruits, berries, water and infected stools, infected vomiting and contact can transmit it with infected persons. The incubation time is 1-2 hrs. No treatment is necessary but the affected person can be contagious for 2-3 days after recovery. This virus is the most common cause of food- and waterborne infections in the developed countries

( **Note →** ) It is advisable to give instructions to the ships crew simple preventive hygienic measurements before they go ashore; depending on the country arrived in. It may for this purpose be appropriate to acquire an update of the specific local endemic problems before departure.

#### **7.1.16 Perspective**

Only three diseases (cholera, plague and yellow fever) are covered by the IHR since the amendment in 1981. However, new diseases have emerged and old diseases re-emerged so that the application of the IHR needs to broadened. There will be more emphasis on surveillance, communication and management of diseases or syndromes which may rapidly have impact on international public health, as seen in SARS.

### **7.2 Rules for Quarantine**

#### **7.2.1 Isolation**

Isolation means separation, for the period of communicability, of infected persons or animals from others in such places and under such conditions as to prevent or limit the direct or indirect transmission of the infectious agent from those infected to those who are susceptible or who may spread the agent to others.

Two basic requirements are common for the care of all potentially infectious cases:

1. Hands must be washed after contact with the patient or potentially contaminated articles and before taking care of another patient.
2. Articles contaminated with infectious material must be appropriately discarded or bagged and labelled before being sent for decontamination and reprocessing.

Seven categories of isolation can be distinguished:

1. Strict isolation: To prevent transmission of highly contagious or virulent infections that may be spread by both air and contact. The specifications, in addition to those above, include a private room and the use of masks, gowns and gloves for all persons entering the room. Special ventilation requirements with the room at negative pressure to surrounding areas are desirable.
2. Contact isolation: For less highly transmissible or less serious infections, for diseases or conditions that are spread primarily by close or direct contact. In addition to the 2 basic requirements, a private room is indicated, but patients infected with the same pathogen may share a room. Masks are indicated for those who come close to the patient, gowns if soiling is likely and gloves for touching infectious material.
3. Respiratory isolation: To prevent transmission of infectious diseases over short distances through the air, a private room is indicated, but patients infected with the same organism may share a room. In addition to the basic requirements, masks are indicated for those who come in close contact with the patient; gowns and gloves are not indicated.
4. Tuberculosis isolation (AFB isolation): For patients with pulmonary tuberculosis who have a positive sputum smear or a chest X-ray that strongly suggests active tuberculosis. Specifications include use of a private room with special ventilation and closed door. In addition to the basic requirements, those entering the room must use respiratory-type masks. The use of gowns will prevent gross contamination of clothing. Gloves are not indicated.
5. Enteric precautions: For infections transmitted by direct or indirect contact with faeces. In addition to the basic requirements, specifications include use of a private room if patient hygiene is poor. Masks are not indicated; gowns should be used if soiling is likely and gloves used when touching contaminated materials.
6. Drainage/secretion precautions: For prevention of infections transmitted by direct or indirect contact with purulent material or drainage from an infected body site. A private room and masking are not indicated. In addition to the basic requirements, gowns should be used if soiling is likely and gloves used when touching contaminated materials.
7. Blood/body fluid precautions: For prevention of infections that are transmitted by direct or indirect contact with infected blood or body fluids. In addition to the basic requirements, a separate room is indicated if patient hygiene is poor; masks are not indicated; gowns should be used if soiling of clothing with blood or body fluids is likely. Gloves should be used for touching blood or body fluids. Blood and body fluids precautions should be used consistently for all patients regardless of their blood-borne infection status ("universal blood and body fluid precautions"). These are intended to prevent parenteral, mucous membrane, and non-intact-skin exposure of health care workers to blood-borne pathogens.

Protective barriers include gloves, gowns, masks and protective eyewear.

### **7.2.2 Quarantine**

Quarantine is the restriction of activities for both persons or animals who have been exposed (or are considered to be at high risk of exposure) to a case of communicable disease during its period of communicability (i.e. contacts) to prevent disease transmission during the incubation period if infection should occur.

The two main types of quarantine are absolute or complete quarantine and modified quarantine:

1. Absolute or complete quarantine: The limitation of freedom of movement of those exposed to a communicable disease for a period of time not longer than the longest usual incubation period of that disease, in such manner as to prevent effective contact with those not so exposed.
2. Modified quarantine: Selective, partial limitation of freedom of movement of contacts, commonly on the basis of known or presumed differences in susceptibility and related to the danger of disease transmission. It may be designed to meet particular situations. Examples are exemption of immune persons from provisions applicable to susceptible persons, or restriction of military populations to the post or to quarters. It includes: personal surveillance, the practice of close medical or other supervision of contacts in order to permit prompt recognition of infection or illness but without restricting their movements; and segregation, the separation of some part of a group of persons or domestic animals from the others for special consideration, control or observation, removal of susceptible children to homes of immune persons, or establishment of a sanitary boundary to protect uninfected portions of a population.

### **7.2.3 Use of Isolation and Quarantine on Board**

The clinical distinction between isolation and quarantine is that isolation is the procedure for persons already sick, whereas quarantine is often applied to (apparently) healthy contacts.

( **Note →** ) This has legal and ethical implications if apparently healthy persons must submit to restrictions upon their freedom to move at large in society. Legal issues concerning the quarantine of ships are covered in the IHR (refer to → **Sub-chapter 7.1**).

Universal precautions in personal protective equipment for the treatment of patients range from very basic protective material like surgical face masks, non-sterile examination gloves and basic protective eyewear to protective gowns which are at least fluid-resistant with outer-air independent respirator systems

fulfilling FFP3-standard. The basic material will be on board of every unit with medical assets. Additional material has to be stored and the use has to be trained in advance.

**( Note → )** Collective protection on board can be implemented by using decks or chambers.

When assigning areas of isolation or quarantine some aspects have to be considered as follows:

- Air-conditioning; if possible individually operated for zones or areas, not ventilating into the common air-conditioning system.
- Waste management of fluids; fluids can be disposed into the black-water sewage.
- Waste management of solid material; solid material can be treated by sterilization, sewage-burning or storage in bags fulfilling bio-hazard standards.
- For clinical care of highly infectious patients the treatment area should integrate infrastructural hazard zones for high risk (patient's room), low risk (ante chamber) and no risk, black-zone, grey-zone, and white-zone respectively.

### **7.3 Disinfection**

Disinfection (elimination of insects) on vessels encompasses procedures to prevent the transfer of live disease vectors from infested to non-infested areas. It should always be accomplished on leaving ports where yellow fever, malaria, or plague are endemic. Public Health disinfection requirements are determined by the World Health Organization (WHO) and the Centre for Disease Control (CDC).

COs and their MOs should be aware of and comply with all applicable domestic and foreign quarantine regulations.

#### **7.3.1 Ships**

Disinfection of vessels is always be performed on those vessels departing foreign ports where vector-borne diseases, including yellow fever, malaria, and plague are endemic or epidemic in the immediate port area.

After leaving these areas, the MO or the Sickbay representative trained in shipboard pest control procedures should make a survey to determine whether insects capable of transmitting disease are present aboard the vessel. If disease vectors are present, the CO is to be notified and suitable disinfection procedures initiated.

Such procedures include elimination of all standing water sources where mosquito breeding occurs, space treatments with aerosols or residual application of pesticides.

If a question arises as to whether disinfection has been successful or whether a special problem of insect infestation exists that is not amenable to disinfection procedures herein recommended, a request for assistance should be made by the CO. This request should be to quarantine officials at the sea upon arrival or to the area. The Port Health Authorities may require disinfection beyond those of standard directives if an unusual or emergency situation exists.

## **7.4 Physical Fitness and Weight Control**

### **7.4.1 Introduction**

“Forge the Future with Health Promotion; the New Strategic Weapon of the US-Navy” (Slogan of the Health-Promotion-Programme of the US-Navy).

All navies have significant interest in physical readiness and weight control. Of the Services, navies have historically had the least emphasis on physical fitness. Navies have acted to remedy this situation. Most have instituted their own physical readiness programs. The assumption for a functioning and task performing armed forces is to receive the best instruction, be of good physical and mental health, resulting in a powerful sailor ready for action.

**( Note → )** Physical fitness is one of different vehicles to meet this target of readiness.

The target of any intervention in physical fitness and weight control must be to educate sailors to get, to enhance and to stabilise physical and mental health during their general training at home and onboard, on duty at sea, in the meantime after or between periods of naval Service.

The MO has a definite role in this topic. He is not directly responsible for the fitness of the sailors, but must assist them, the fitness officer/fitness coordinator and the commanders to meet the target. Therefore the MO's main tasks are the overweight and metabolic problematic sailors.

**( Note → )** The MO should realize one of the most important conditions: All health programmes will not work without active command support (Senior High Level Support). They can encourage and create an environment for the sailors to enhance their own initiative.

Most of the overweight and obese people have their own specific corpulent career. To get into contact with them, understand their problems and build a

necessary compliance, take sufficient time to explain the disorder, combination between blood results and risks for especially coronary and metabolic diseases, failures and downs. Convincing the individuals concerned of the necessity for a long-term programme being of utmost importance.

The MO is the one to encourage overweight sailors to lose weight and get physically fit as well as improving the overall quality of life. However, it should be borne in mind that although the MO wants to help sailors lose weight, the individual is the one required to take action and the MO is neither responsible for their being overweight nor for their failure to lose weight, should that occur.

There are different circumstances which will influence weight and physical fitness; nutrition and sports/movement. Further circumstances to consider are the kind of individual duty or private stress, motivation and social competence.

Below the two parts of energy-supply and energy-consumption will be outlined.

#### **7.4.2 Energy Supply and Nutrition**

This subchapter is not intended as a substitute for a textbook of nutrition. It will provide aid for a good energy-supply fit for everybody and help overweight sailors bring their nutritional behaviour to within normal limits. They are summarized in 10 rules combined with a few general remarks of recommended behaviours (refer to → **Annex 7-1**). The wording used in Annex 7-1 is addressed to the sailors directly. The text may be used as a basis for handouts and information sheets.

In general, nothing is completely forbidden; sailors are allowed to eat nearly everything. It depends on the total volume and the appropriate mixture of food groups. Meals full of value keep man healthy, powerful and satisfied. Eating in this way is good for a long life and good quality of life.

( **Note →** ) Diets, working with inhibitions or promises have failed to prove their effectiveness scientifically.

However, the MO is always diet control officer as well. All obese individuals should be counselled on weight reduction methods they can safely accomplish. Weight loss of a kilogram maximum per week is a proven, safe guideline. If properly motivated, most individuals can lose weight at this rate on a 1500 calorie diet. The actual diet prescription will be up to the MO. He should avoid fad diets or recommend those that will cost crew members a lot of money. The idea is for them to lose weight by losing fat.

Progress should be measured by weekly weigh-ins and a monthly report recorded. Weight monitoring, along with following the percentage body fat on a monthly basis, is recommended because it can be done easily and provides two measurements of progress.

#### **7.4.3 Health Programs and Physical Fitness Testing**

The Command Fitness Coordinator is responsible for performing annual physical fitness testing and ensuring the results are placed in the service records. He is also responsible for conducting a remedial physical fitness program for those deemed unfit or who fail to meet body fat standards. This is a demanding task which needs close collaboration between the different individuals involved. Inviting divisional representatives from all over the ship is the most successful way to run this program. All health programs will not work without convincing the leaders and without active command support.

( **Note →** ) The MO's role is to review the training programs and prescribe exercise programs for those who are overweight; design workouts, check up on those people with specific limitations, and decide on waivers for health reasons. Another responsibility of the medical service is ensuring that CPR-trained individuals are present during the physical fitness testing.

#### **7.4.4 Energy Consumption, Movement and Sports**

Systematic sporting activities have positive consequences for organisations depending on different ranges of performance, e.g.

1. Preventive health training.
2. General fitness training (extensive).
3. Special fitness training (intensive).
4. High fitness training (very intensive to maximum).

In order to develop an individual's fitness it is important to look at the target of the training.

The final paragraph will stress on training of overweight and obese crew members: preventive health care and general fitness training.

If the energy consumption is higher than the energy supply a person will lose weight. The higher the insensitivity, duration and frequency of movement the more energy an individual has to spend. The MO should assist individuals to find the best event or sport to enhance the weight loss effect.

( **Note →** ) The right sport is sport-making fun.

To find out an individuals preferred discipline, as many events as possible should be attempted. Individuals should be encouraged by starting to "play" sports with the support of their friends and companions. The following list shows sport events suitable on board for reducing weight:

- Increase daily activities (in the beginning).
- Walking.
- Changing between Walking and Jogging.
- Jogging.
- Ergometer training (cycle and rowing).
- Stepper.
- Basketball.

( Note → ) For sports recommendations for obese crew members refer to → Annex 7-2.

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## **8. Alcohol and Drug Abuse**

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- 8.6.3.1 Effects**
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**8.7. Hallucinogenic Drugs**

**8.7.1 LSD**

- 8.7.1.1 Effects**
- 8.7.1.2 Long Term Abuse**
- 8.7.1.3 Overdose**
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**8.7.2 Other Hallucinogenic Drugs**

**8.8 Other Drugs**

**8.9 Treatment**

**8.10 Drug Screening**

**8.11 Naval Medical Aspects of Drug Abuse**

**8.1 Introduction**

The aim of the chapter on alcohol and drug abuse is to enable the MO to:

- Recognise the symptoms of abuse.
- Determine whether there is any physical and / or psychological dependence.
- Offer adequate help to the patient.
- Recommend treatment and rehabilitation procedures.
- Become familiarized with national drug and alcohol programs.

( Note → ) Most navies have tough drug abuse and prevention programs that are very effective in cutting down on the use of illicit drugs (nil acceptance policy).

The most common illicit drug abuse is recreational use of marijuana and cocaine. Well over 90% of all positive urine analyses will be for THC.

The alcohol abuse programs are having their impacts; however, there are different policies in existence within the navies.

The involvement of the MO in the prevention program is to help identify sailors physically and psychologically dependent on drugs and alcohol in order to provide adequate help.

## **8.2 Definitions**

A drug may be defined as a substance used for its influence on human consciousness. Therefore "drugs" do not, by definition, come from any specific class of substance. Alcohol, as well as some sedatives, may be legal in most countries, but for all practical purposes it is as much a drug as any illicit drug.

WHO abandoned the term drug addiction, which is capable of many definitions, in favour of:

- Drug abuse: The persistent or sporadic excessive use of any drug in a manner inconsistent with or unrelated to recognized medical practice. It is evident this definition implies that the improper use of sedatives, hypnotics and stimulants may in many cases constitute drug abuse.
- Drug dependence: This is a psychological state although sometimes it may also be physical, resulting from the interaction between the drug and the human body. Dependence is characterised by behavioural and other responses and always includes a compulsion to take drugs on a continuous or periodic basis in order to experience its psychic effects and sometimes also avoid the discomfort of lack of the drug. Tolerance may or may not be present and a patient may be dependent upon more than one drug.

The following are Stages in the evolution of drug abuse:

- Experimentation Stage: This is the first step when curiosity and a desire to belong are the stimulus to try out a drug. Most users stop here because of the unpleasant side effects. This particularly concerns very young people.
- Integration Stage: Use has become regular and the user feels only positive effects from the drug and therefore has no motivation to stop. Symptoms of abstinence at this stage are not observed when the user is cut off from his source of the drug (i.e. posting on board ship).
- Excess Stage: The drug dosage becomes increased and the life of the addict often revolves more and more around the drug. The negative social, financial and medical effects of the drug become clear to the user but are often insufficient to motivate him or her to stop at this

stage. Also at this stage, tolerance to high doses and withdrawal symptoms may be seen when supplies of the drug are cut off.

- Addiction Stage: The drug user now clearly demonstrates the effects of the abuse. The addiction perpetrates itself by pharmacological action (for example opiates), cerebral degenerative effects (for example LSD) and psychological and social addiction which is characteristic of all drugs.

### **8.3 Alcohol**

This is the major addiction among seagoing personnel as well as the general population.

The incidence is high, since alcohol plays a large part in the social ritual. Alcohol facilitates uncritical social intercourse and diminishes awareness of the passage of time, thus avoiding boredom. Disadvantage are loss of self control which may result in violence, the unpleasant consequences of taking large quantities including induction of depressive episodes, the features of addiction and the resulting physical and social damage. In such an alcoholic milieu even those without personality or social difficulties may drink too much. However, general prohibition or severe restrictions of the availability of alcohol failed to meet the desired effect in the different populations.

**( Note → )** WHO definition of alcoholics: "Alcoholics are those excessive drinkers whose dependence on alcohol has attained such a degree that they show noticeable mental disturbance or interference with bodily or mental health, their inter-personal relationships and their smooth economic and social functioning, or who show prodromal signs of such development. They, therefore, need treatment".

#### **8.3.1 Symptoms of Alcoholism**

There are medical and social impacts.

The majority of alcoholics still function in their community but evidence of social deterioration including escalating offences, debts and domestic problems should be regarded as prodromal signs. With high tolerance and a partial control of their intake, they are rarely intoxicated when on duty and probably not clinically intoxicated for much if any of the day. A man accused of drunkenness on duty is probably quite severely affected by alcoholism as loss of tolerance is a late feature. Not analogous to the derelict drinking methylated spirits in squalor, the maritime alcoholic still functions around the ship but shows evidence of social, economic, physical or mental stress or disorder.

One bottle of spirits a day (or equivalent) is a dose at which addiction is established or close to that state. Alcohol is a drug with dose-related effects and experiment and experience strongly suggest that taking of half a bottle of spirits (115 grams of alcohol) a stature alcoholic may complain bitterly that he should

not be accused of being an alcoholic because his friends, much bigger than he, can drink more than he without damage.

The "binge" occurs during the excesses of a run ashore or first night in harbour and the alcohol equivalent of more than a bottle of spirits may be consumed in 6 to 8 hours with overt intoxication. Such individuals are unable to control their drinking and exhibit the manifestation of loss of control. They are later able to abstain and use the argument to refute the suggestion of a drinking problem. Nothing is further from the truth and the majority of alcoholics show this pattern of drinking.

Tippling implies a steady intake of alcohol throughout the day with (at least in the early stages) no loss of control. If the tippler abstains, he develops withdrawal symptoms and resumes drinking. There is inability to abstain but no loss of control.

There are seven groups of symptoms in the abstinence syndrome of which the first four are most common. Alcohol causes physical dependence and after receiving the critical dose (approximately 230 grams) for a critical period of usually less than 14 days, abrupt withdrawal brings on the syndrome.

( **Note →** ) Symptoms of alcohol withdrawal syndrome:

- Tremulous reaction occurs within 8 hours, manifested by 'shakes'. It is first noticed after sleep and is associated with anorexia, morning nausea and vomiting (toothbrush heaves).
- Amnesic episodes (blackouts of alcoholism) are an early sign of problem drinking occurring at the end of a day's binge or more commonly as the subject sober up. In retrograde amnesia of the later stages of a binge the drinker carries out apparently coherent actions including conversation but is subsequently unable to recall such events.
- Difficulties occur with sleep since alcohol is a soporific and its action is missed. Dreaming is increased and nightmares may occur.
- Anxiety and depression, amounting to agitation or even terror.
- Hallucination is usually visual and often associated with aural experiences. It is as if a dreaming state breaks through into waking time.
- Delirium.
- Fits (grand mal) usually within 24 hours of a binge.

The longer the episode of drinking and the greater the amount taken, the more likely are hallucination, delirium and fits. These symptoms continue to the classic picture of delirium tremens but combinations are more common and atypical reactions occur more often than delirium tremens.

( Note → ) Diseases closely associated with problem drinking are trauma, vitamin deficiency, liver damage, myopathy, cardiomyopathy, pancreatitis, peptic ulcer, bronchitis, anaemia and hypoglycaemia.

Sooner or later those with a drinking problem will be in difficulties because of intoxication which can result in social and family problems, driving offences ashore, civil and seagoing difficulties and disciplinary offences. Injuries and accidents are commonly seen.

The expense of heavy drinking tells on the finances, particularly of the married man and either the family accepts a lowered standard of living or debts occur. Even the single man may have to borrow from one pay day to the next and becomes unable to pay his debts.

Behaviour deteriorates as drinking increases and in addition to financial problems or inhibition from alcohol, a particular form of instability develops leading to physical violence which when ashore is directed towards the spouse and children. Failure of sexual performance combined with suspicion and accusation of the spouse's fidelity results in family disruption.

The drinker may suffer acute spells of depression and anxiety requiring medical treatment, and as a result, self poisoning may take place, which is attributed to domestic stress rather than problem drinking. Marked mood changes of depression, melancholy and anxiety are often given as the reason for heavy drinking but the drinking has usually been first and caused the mood change. A vicious circle is established if depression leads to further drinking.

Diagnosis depends on sources of information other than history, examination and investigation. Personal medical documents, conduct sheets, welfare reports and descriptions of behaviour from ship's officers, chaplains, shipmates, spouses and relatives all help.

The early symptoms are those of developing tolerance and complications are not conspicuous. Suspicion is aroused by promises or resolutions about drinking, minimising or lying, gulping to get sufficient dose for effect, getting ahead of the group, having a drink before joining in, impulse drinking at set times, adhering to a fixed drinking schedule in spite of inconvenience, using events as excuses for drinking, drinking on socially inappropriate occasions, using alcohol to forget worries or to get rid of depression, needing alcohol to be able to partake in group activities, occasional blackouts and occasional drunkenness. Social damage becomes obvious.

When problem drinking is established, early symptoms are accentuated and signs of the abstinence syndrome are increasingly in evidence. Frequent promises to control or lies about the extent of drinking and resulting behaviour lead to all kinds of subterfuges to get enough drink even on social occasions. Alcohol is constantly required to buck him up or calm him down and depression tends to be a constant companion. He is plagued by worries and fears, is obviously intoxicated at times, frequents pubs and bars rather than returning home and takes to drinking alone, in severe bouts with a morning drink to get rid

of nausea, anorexia and shakes. He becomes irritable and tense if short of alcohol or temporarily abstaining, has difficulty in talking about drink and neglects food. There are marked feelings of guilt, fear, inferiority, foreboding and isolation. Gulpng or rapid drinking to achieve effect because of rising tolerance often leads to rapid intoxication with the true alcohol intake concealed. Severe hangovers occur with loss of time from work and blackouts become more frequent.

( **Note →** ) Late in the syndrome, the patient is often drunk at work, drinking throughout the day with marked emotional instability and aggression, paranoid reaction, melancholy, anxiety and irritability. His working efficiency declines, he abuses his family and has severe financial problems.

### **8.3.2 Treatment of Alcoholism**

( **Note →** ) One should always keep in mind that alcoholism is a disease and the alcoholic is a patient in need of help. The MO should never have to act as a law enforcement officer.

#### **8.3.2.1 First Contact**

Alcohol has not been a predominantly male problem for quite a while. The only way to help an alcoholic is to get him to admit he drinks too much and needs help. Even if there is evidence that a patient has a drinking problem never confront such a patient with the fact. The most likely result was vehement denial, righteous indignation and the demand for proof. Since most of the time circumstantial evidence will be available only, threats of complaints because of defamation may follow and may put the shipboard MO in the defensive – not an advantageous position to offer help.

It is more efficient to confront the patient with objective personal observations. These could be for instance:

- An alcoholic fetor.
- Frequent tremor.
- Being late for work.
- Loss of memory or unconsciousness after a binge.
- Deteriorating performance, lack of concentration.
- Or any of the other symptoms described above.

The consequent question whether the cause could be a drinking problem, will probably still be denied by the patient. He will nevertheless be aware of the MO's knowledge, and suspect that others have observed it as well. In

many cases this is sufficient to make him admit the problem at least to himself and reconsider his drinking habits. Try to offer help, even if he "definitely does not need it".

### **8.3.2.2                  Further Procedure**

If nothing changes, repeated confrontations with facts are recommended. Information about required further steps should be given. Repeated offer for help is mandatory, e.g. counselling with Alcoholics Anonymous or similar groups. On no account threaten to tell his superiors. This will result in losing the confidence of the patient and most likely that of many other sailors onboard.

### **8.3.2.3                  Alcohol Withdrawal**

Once physical dependence occurs, unpleasant and sometimes dangerous symptoms of withdrawal may occur, particularly delirium and fits. An added stress can be the presence of physical illness or alcohol induced damage. Alcohol should be withdrawn in hospital or well-equipped sick quarters and covered with drugs which inhibit development of withdrawal symptoms.

**( Note → )** Do not attempt detoxification on your own unless you have an ICU on board and plenty of experience. Alcohol withdrawal may develop lethal complications.

It is essential that the MO separates his moral judgments from his clinical ones. Where alcohol presents moral problems, the only real success is total abstinence. It must however be treated as a clinical problem and any reduction in the intensity and frequency of drinking, any slowing in the progress of deterioration, any improvement in the patient's or the family's emotional, physical, mental or economic state is something achieved.

For long term-abstinence, treatment in an alcohol rehabilitation centre after detoxification is advisable. Most alcohol addicts need to join a self-helping group to keep abstinent for good.

## **8.4      Cannabis**

Possession of cannabis is illegal in most countries. However, legislation in a number of countries is rather lenient. In the Netherlands, for instance, the sale of small quantities in so-called coffee-shops is legal. In Germany, the possession of small quantities, i.e. up to 30 g of Cannabis products, is illegal but will not be prosecuted as a rule. In a military setting, however, cannabis is always illegal!

Apart from alcohol, cannabis is the most commonly used drug worldwide. The psychoactive agent is tetrahydrocannabinol (THC). The two main preparations are:

- Marijuana:

The dried leaves and flowers of female plants. The males are sometimes also used but are much less potent.

- Hashish:

The resin of the female flowers. It contains between 5 and 7 times the amount of THC of marihuana. There is also hashish-oil, which is not very common and even more concentrated.

Both Marijuana and Hashish are mostly smoked, either as "joints" – mixed with tobacco and rolled into cigarettes – or in water-pipes. Oral intake is less common (e.g. hash-cookies).

Although cannabis is the most common illicit drug, it may not be the most common illicit drug onboard. Marijuana is bulky and has a strong characteristic smell. When smoked, the smell is even more pungent. Since the smell is known to too many people, there will be the constant threat of exposure.

( Note→ ) The main danger of sailors high on cannabis on board lies in the fact that, unlike drunken sailors, they are not easily spotted. There is no slurred speech, no loss of coordination or fetor.

Thus, a "high" sailor on watch seems reliable, but may not recognize a dangerous situation at all, or if he does, will react too slowly or cannot be bothered to react at all. "This ship seems on collision course.....but it is far away.....and so pretty....I can hear the lights twinkling....."

#### **8.4.1                  Effects**

The main effect is a relaxed, mildly euphoric state of well-being, coupled with a vivid colourful imagination. After about 2 hours, the user will get into a more contemplative mood with a marked lack of drive. In high doses, mild hallucinations may occur, but the user will be able to keep a certain distance to his abnormal perceptions and not lose contact with reality. He will lose interest in his surroundings and seem apathetic. Red eyes are seen in the addict 'high' on marijuana and hashish, especially with regular smokers.

#### **8.4.2                  Long Term Abuse**

There is only minimal physical damage. Cannabis is not very addictive if at all. Users are generally in a good physical condition and there is no social decline. It can trigger a psychotic syndrome, but there are indications that a latent psychosis must be present for it to do so. There are no "flash-backs". While most adult users use cannabis as "recreational drug" and do not increase their intake over the years, very young people with unfinished personalities may

use the drug to suppress problems and escape stress. Thus a behavioural pattern may be established, where drugs – legal or illegal – are used to "cope" whenever difficulties occur.

#### **8.4.3                    Overdose**

In very high doses, circulatory problems, anxiety, and nausea may occur. Severe complications or death caused by cannabis are unknown.

#### **8.4.4                    Withdrawal**

No physical withdrawal symptoms are observed. There may be craving similar to that for a cigarette, but no irresistible urge to take the drug.

### **8.5      Stimulants**

Stimulants are probably the most likely drugs to be encountered onboard. They are easily concealed, have no smell and can be taken orally or sniffed secretly, e.g. in a washroom. During long night watches, they can "help" sailors to stay awake and alert.

Again, a sailor on stimulants is not easily spotted. There are the wide open eyes and dilated pupils, but on a dark bridge for instance, dilated pupils are normal. Sailors with stimulant-dilated pupils are easily dazzled though, as the pupils will not contract normally. Dangerous situations will be recognized and assessed correctly. The user tends to be overly confident of his and his ships abilities and importance and therefore may not react appropriately. "We are so much bigger, faster and armed – why should we make way for a piffling trawler?"

#### **8.5.1                    Ecstasy, XTC**

XTC is the generic term for a number of synthetic psychoactive substances. They are taken orally, mainly in the form of pills or capsules, most often in discotheques and music events such as techno or rave parties. Therefore most of the users are fairly young.

#### **8.5.1.1                 Effects**

Typical for all stimulants are dilated pupils and wide open eyes, a rapid pulse, high blood pressure, and increased respiratory rate. The user will feel wide awake, very active and slightly euphoric. The need for sleep or food is repressed. Most of the substances have also an "empathogenic" effect: "Everybody loves and understands me and I love and understand everybody". After the drug wears off,

there will be a state of exhaustion which can last for several hours to more than a day, depending on the dose taken. With high doses, mild hallucinations are possible.

#### **8.5.1.2                  Long Term Abuse**

Cerebral damage with the destruction of synaptic terminals in the serotonergic system is possible. This will lead to depression and damage of short-term memory. Latent psychosis may be triggered.

#### **8.5.1.3                  Overdose**

A state of anxiety with severe visual, acoustic and tactile hallucinations may occur. On the physical level, there are muscle cramps, tachycardia and high blood pressure, which may lead to hyperthermia, collapse, cerebral haemorrhage, and ultimately death.

**( Note → )** Provided the patient has not taken any other hallucinogenic drug (e.g. LSD, Mescaline), do not try to treat the hallucinations with neuroleptic drugs such as chlorpromazine, which can lead to cramps and respiratory arrest.

The combination of XTC with other drugs such as alcohol, cannabis, tranquillizers, and even heroin is common. These drugs are used to calm down, "chill out". A carefully taken history of the patient and, if at all possible, his peers, is of the utmost importance before any decision can be made on therapy.

#### **8.5.1.4                  Withdrawal**

No physical withdrawal symptoms are observed. There is a psychological addictive potential, however, which is comparable to that of amphetamines, though less marked than in cocaine.

#### **8.5.2                  Cocaine**

Cocaine is extracted from the leaves of the coca-bush, which is mainly grown in the mountainous regions of South America. The purified product, Cocaine-HCl, is a white powder with a bitter taste. Because of its high price, cocaine used to be the "upper-class-drug" and a status symbol, many users were professionals or artists. Since the eighties, prices have dropped considerably so that now it is no longer confined to the well-to-do.

In addition there is crack, cocaine-base, which is much cheaper and in some countries has become the "slum drug". It is dirty white to light brown and comes in small irregular lumps.

In the producer countries, coca-leaves are chewed with a bit of lime. The main effect is an increase of endurance, and the ability to disregard fatigue and discomfort. The users pay for this with a shortened life span. Cocaine is mainly sniffed, but can also be smoked, taken orally or injected intravenously or subcutaneously. Crack is usually smoked, often in small pipes.

#### **8.5.2.1                  Effects**

Typical for all stimulants are dilated pupils and wide open eyes, a rapid pulse, high blood pressure, and increased respiratory rate. Blood sugar will go up.

When the drug is sniffed, the "kick" is felt about three minutes later; with intravenous injection or smoking, it takes only seconds. At first there is a euphoric phase which lasts about 30 minutes. The user will feel quick-witted, fit, confident and productive. He tends to be rather talkative and excited or restless. After this initial phase the positive feelings will give way to feelings of anxiety, unpleasant agitation or even a depressive mood. Sometimes there are tactile hallucinations – "bugs or crystals under the skin". The "high" ends in a depressive phase with feelings of guilt, fatigue, headaches and sometimes vomiting. High doses often cause genuine hallucinations. A temporary psychosis with paranoid tendencies may occur.

**( Note → )** Even with a single dose of cocaine, a hypersensitivity reaction is possible, even if it is rare.

The patient goes into a state of deep shock after a short period of anxiety, hallucinations and excitation. Apart from high blood pressure, rapid pulse, high body temperature, sometimes pallor, profuse sweating, respiratory distress, hypotension and a slow and often irregular pulse are noted. The respiratory and circulatory centre in the brain may become paralysed.

Death may occur by respiratory or cardiac arrest, epileptic fits due to high temperature or even cerebral haemorrhage.

#### **8.5.2.2                  Long Term Abuse**

Many of the cocaine users are "social-recreational users", who sniff the drug only from time to time. Others are "situation users", who take cocaine occasionally to improve their performance or to cope with demanding situations. Both types will, provided they do not change their habits, suffer no major long term damage. Cocaine is the drug of the ambitious and successful rather than that of drop-outs. These users tend to be socially well adjusted and are often social climbers. Damage to the nasal mucosa and perforation of the septum are observed.

When the drug is injected or smoked, especially as crack, the picture is a totally different one. After a period of three to six months, concentration and memory will suffer. The addict will lose weight, become cachectic and unable

to cope with infections. Eventually, there is danger of deprivation and even dementia setting in. Neurological disorders like Parkinson's disease can develop. A small percentage of consumers will get psychotic episodes with hallucinations, anxiety and paranoia. An individual predisposition is likely. On the physical level, damage to the heart and circulatory system, impaired vision, strokes and cerebral haemorrhage may occur. In smokers, the lung tissue is damaged.

Mainly because of the vasoconstrictive properties of the drug, in pregnant women damage to the unborn child is frequent.

#### **8.5.2.3            Overdose**

An overdose solely due to sniffing is rare. In most cases the drug was injected.

The symptoms are those of the hypersensitivity reaction described above: Anxiety, hallucinations and excitation, high blood pressure, rapid, often irregular pulse, high body temperature, epileptic fits, coma, respiratory and circulatory collapse. Two thirds of all intoxications are lethal within the first five hours.

( Note → ) There is no specific antidote, treatment is symptomatic.

#### **8.5.2.4            Withdrawal**

Occasional 'sniffers' – "social-recreational users" – show virtually no withdrawal symptoms.

When the drug is more frequently taken but exclusively sniffed, there are few physical withdrawal symptoms, such as sleeplessness, loss of REM sleep, palpitations and physical exhaustion. There will be a more or less strong craving to take the next dose, however, which may dominate the whole life of the addict.

With crack-smokers or cocaine injections, withdrawal symptoms are more severe. A delirious state dominated by fear and paranoia, tachycardia, vomiting and diarrhoea may occur. The addictive potential is high, if not quite as high as that of heroin. Therefore there will be a strong and lasting craving for the drug.

#### **8.5.3            Amphetamines (Speed)**

Amphetamine and its derivates are synthetic drugs. Speed is mainly taken orally, either as pills or powder. It can also be inhaled or sniffed and some preparations can be dissolved in water and injected.

**8.5.3.1                  Effects**

If consumed orally, speed makes the user feel wide awake and active. The need to sleep or eat is suppressed. The physical symptoms are comparable to those of XTC or cocaine. The injection of amphetamines causes a "rush" with orgiastic happiness and omnipotent fantasies.

**8.5.3.2                  Long Term Abuse**

As with cocaine, the consequences are more serious and will occur sooner when the drug is injected. The addict will lose weight, become cachectic and unable to cope with infections. The mucous membranes of nose and throat will dry out. Part of the face, especially chin and cheeks, will be swollen. Wounds will not heal properly. There may be kidney-damage, peripheral neuropathy, fever, and tremor of the hands. Eventually, there may be depressive phases coupled with anxiety or fear or increased aggressiveness. A small percentage of consumers will get psychotic episodes with hallucinations, anxiety and paranoia which will subside within a month.

**8.5.3.3                  Overdose**

The symptoms are similar to those of a cocaine overdose: Anxiety, hallucinations and excitation, high blood pressure, rapid, often irregular pulse, high body temperature, epileptic fits, coma, respiratory and circulatory collapse.

**8.5.3.4                  Withdrawal**

There are no withdrawal symptoms in the classic sense. The addict is merely more easily exhausted and needs to eat and sleep more. There is, however, an addictive potential which is similar to XTC, but not as high as with cocaine.

**8.6                  Narcotics**

**8.6.1                  Heroin**

Opium is the sap of poppies, which are commercially grown in the middle and Far East. Morphine is extracted from raw opium and converted into heroin.

In the producing countries, opium is taken orally or smoked. In the industrial nations, mainly heroin is used. It is an off-white or brown powder which can be dissolved in water for injection, usually with the aid of some lemon juice. As a

rule addicts who inject themselves will be found in possession of a needle and syringe, lighter or candle and spoon to dissolve the drug in.

Beginners often start with smoking or sniffing heroin, but the effect is much less pronounced, the "kick" is missing, and more heroin is needed to produce the desired effect. Sooner or later the user will start injecting.

( **Note →** ) Heroin addicts are not likely to be found as part of the crew. Even if they are not spotted before, they will hardly make it through the initial training – or be interested in making it. It would also be difficult to hide needle marks in the confined living conditions onboard amongst the board society.

Furthermore, a heroin addict needs his drug and will not risk prolonged absences at sea with doubtful supply lines.

#### **8.6.1.1                  Effects**

When the drug is injected, a sudden state of euphoria will set in, which will last for several minutes. After that, the addict will be in a calm, perfectly happy, carefree state of mind for several hours. Problems, demands and conflicts lose their importance, social contacts are not necessary. The facial expression of the opiate user is blank with vacant expressionless eyes.

When the effects wear off, the addict will need the next shot.

Physically most noticeable is the pinpoint-like myosis of the pupils. Blood pressure and pulse tend to be low.

Even without an actual overdose, when the drug is injected too hastily, the respiratory centre may become paralysed and respiratory arrest may occur.

#### **8.6.1.2                  Long term abuse**

As a rule after about two to three months, but in predisposed people much earlier, the user will become addicted. His interest in his surroundings and other people will increasingly be reduced to his drug and how to get it. In the end, after several years, the "high" will not occur any more, and the addict keeps injecting just to escape withdrawal symptoms. While there is a high incidence of crime in male addicts, females often work as prostitutes.

Because of dirty needles and prostitution, addicts suffer from a variety of infections. In addition to AIDS and hepatitis, endocarditis, osteomyelitis, phlebitis, and septicaemia are common.

( **Note →** ) The addict becomes increasingly apathetic and emaciated. He suffers from sleeping disorders, impotency, and tremor. Cerebral fits, coordination disturbances and cerebral oedema may occur.

#### **8.6.1.3            Overdose**

Most deaths by an overdose of heroin are accidental. They occur when the addict gets purer heroin than usual without knowing and injects his normal dose. In quite a few cases, the addict wants to commit suicide, because his situation becomes unbearable but he can't stop taking the drug.

The symptoms of an overdose are pinpoint pupils, muscle relaxation, weak or no reflexes, absent bowel sounds and paralytic ileus, hypothermia, slow respiration and gasping breath, deep coma. Death occurs by respiratory arrest.

**( Note → )** Naloxone is the specific antidote for opiate intoxications.

Artificial respiration may be necessary initially. Naloxone causes an abrupt withdrawal syndrome, which may lead to circulatory collapse and shock.

#### **8.6.1.4            Withdrawal**

About 8 hours after the last dose of heroin, there will be anxious agitation with profuse sweating, tremor, joint pain, muscle pain in the back and abdomen, nausea and dilated pupils. Later, pulse, blood pressure and body temperature will rise. Muscle cramps, vomiting, diarrhoea, hyperglycaemia, cerebral fits and leucocytosis may occur. The patient will be unable to sleep. In rare cases circulatory collapse, shock and ultimately death may result.

**( Note → )** Even if heroin withdrawal is not anywhere near as dangerous as alcohol withdrawal, do not attempt it without intensive care facilities at your disposal.

#### **8.6.2                Tranquilizers**

These comprise a group of synthetic drugs that can be legally prescribed by a doctor in case of sleep disorders or psychological disorders such as anxiety or panic attacks. In the drug scene, tranquilizers are frequently used as "downers" to calm down, "chill out" and make sleep possible after the use of stimulants. Heroin addicts use pills to alleviate withdrawal symptoms until the next dose of heroin can be procured.

**( Note → )** All Sedatives may be found on board, either legally prescribed or otherwise.

#### **8.6.2.1            Effects**

Tranquilizers have a relaxing effect on the mind as well as the muscles. They relieve anxiety and induce sleep. In medical doses there are virtually no side effects except a possible "hang-over", a dazed feeling and slower

reflexes in the morning. Patients should not drive in the morning when on tranquilizers. The same goes, of course, for standing watches or other responsible jobs and jobs requiring balance.

#### **8.6.2.2                  Long Term Abuse**

Users remain socially well adjusted and inconspicuous over years. Since the anxiety-relieving effect will wear off when tranquillizers are taken regularly, there is the danger of increasing the dose. In that case, the physical and mental performance of the patient will decrease and even personality changes are possible.

#### **8.6.2.3                  Overdose**

Most of the tranquilizers do not produce serious symptoms in high doses, unless taken in extremely high doses in an attempted suicide or in connection with alcohol. Then shock and respiratory arrest are possible. There have also been cases of prolonged coma and lasting brain damage.

#### **8.6.2.4                  Withdrawal**

Most of the withdrawal symptoms are part of a "rebound syndrome": Nervousness, anxiety, sleeplessness, but also tremor, rapid pulse, and lack of concentration. In extreme cases, a delirious state with epileptic fits and hallucinations has been observed. In addition there is a strong craving for the drug which lasts much longer than the physical symptoms. The addictive potential, when taken longer than a few weeks is quite pronounced if not as high as with barbiturates.

### **8.6.3                  Barbiturates**

Barbiturates are a group of synthetic drugs derived from barbituric acid. They used to be prescribed by doctors in case of insomnia. These days, in most countries barbiturates are only used legally in the treatment of epilepsy or in anaesthetic procedures. In the drug scene, barbiturates, even more than tranquilizers, are frequently used by heroin addicts to alleviate withdrawal symptoms until the next dose of heroin can be procured. Even if not meant for injection, they are sometimes dissolved and injected.

#### **8.6.3.1                  Effects**

Barbiturates are the classical sleeping pills: They induce sleep. Their hypnotic properties are much stronger than those of tranquilizers. They are not anxiolytic in that sense, but since the user gets dazed, he will cease to find his problems threatening.

#### **8.6.3.2 Long term abuse**

Currently there is hardly any abuse of barbiturates alone but usually in connection with other drugs, which then determine the long term damage. If only barbiturates are taken, the symptoms are similar to alcohol: Tremor, ataxia, slurred speech, profuse sweating and low blood pressure. In the end, the addict will suffer from lack of concentration, impaired memory, irritability, lack of muscular coordination and even delirium.

#### **8.6.3.3 Overdose**

While barbiturates were easily available, they were frequently used for suicides. The patient is comatose. Breathing will slow down and death will occur due to respiratory arrest.

#### **8.6.3.4 Withdrawal**

There is a strong physical as well as psychological addictive potential. The withdrawal symptoms are again similar to alcohol: The addict is restless, suffers from anxiety and sleeplessness. There may be fits, delirium, disorientation and hallucinations.

**( Note → )** Do not attempt detoxification on your own unless you have an ICU on board and plenty of experience. Barbiturate withdrawal may produce fatal outcome.

### **8.7 Hallucinogenic Drugs**

This is another group of drugs that is not likely to be used onboard. During a trip the user is quite incapable of functioning normally. His altered behaviour is very noticeable. He may betray himself by weird actions such as talking to the radar screen or feeding the nearest lifeboat. He may be totally inactive, contemplating the colourful slow motion universe that surrounds him. If talked to he will either not react at all or will "describe" what he sees.

#### **8.7.1 LSD**

LSD is the most powerful of all hallucinogenic drugs. It is made from rye smut, a parasitic fungus growing on rye. It was the main psychedelic drug used by hippies in the sixties and early seventies.

It is mainly taken orally, but can be injected. "Trips" are usually sold as small pieces of blotting paper or thin cardboard saturated with the drug dissolved in water.

#### **8.7.1.1                  Effects**

Initially, there are vegetative side effects such as rapid or slow pulse, low blood pressure, sometimes sweating, and a buzzing in the ears. The user will feel vaguely uncomfortable and tends to stagger. These effects will wear off after a while. After one hour or more the actual "high" will set in. This phase lasts 5 – 12 hours and is characterised by vivid visual, but also acoustic and tactile hallucinations, altered perception of space and time, and sometimes mystical "inspirations". The user is totally absorbed in his experiences, although he will know in most cases that they are not real. The pupils are dilated.

If the user is worried or emotionally down when taking a trip, "horror-trips" are possible. Conflicts and problems will seem insurmountable and fear and panic may result.

Characteristic for LSD are so-called "flash backs", a state similar to former trips but without any drug. A "flash-back" can last from minutes to several hours and can occur up to months after the last LSD has been taken. It is usually fear-tinged and the victim is confused and disoriented.

#### **8.7.1.2                  Long Term Abuse**

If LSD is taken every day, the effect will wear off after 3 – 4 days and cannot be increased with higher doses. After a few days' interval the drug will be effective again. Therefore most users will take LSD not more than once or twice a week.

There is the danger that especially young users will lose their ability to deal adequately with their surroundings and social contacts. Acute drug induced psychosis, which can last for several months, have been described. Latent psychosis, such as paranoia and schizophrenia, may be triggered.

#### **8.7.1.3                  Overdose**

The lethal dose of LSD is not known, but it is probably higher than three thousand "trips". Therefore, dangerous intoxications are not likely.

#### **8.7.1.4                  Withdrawal**

There are no physical withdrawal symptoms. On the psychological level there is an urge to take the drug, but it is not anywhere near as strong as with most other drugs.

### **8.7.2            Other Hallucinogenic Drugs**

There are many plants worldwide with hallucinogenic properties.

Among the most popular is the Peyote-cactus, whose hallucinogenic agent is mescaline. Mescaline is widely used by the native population of Middle and North America in religious contexts.

The effects of mescaline are very similar to those of LSD, and so is the addictive potential. There are no physical withdrawal symptoms.

As opposed to LSD, mescaline is slightly toxic. High doses may lead to liver damage, an overdose may result in respiratory arrest.

Many mushrooms, about 80 to 90 species worldwide, are hallucinogenic. The major agents are psilocybin and psilocin. Mushrooms are also taken to induce religious trance, but are also quite common in the "techno-scene".

Effects and addictive potential are again similar to LSD and mescaline, except that the psychedelic effect sets in after about 15 to 20 minutes and will end rather abruptly after six to eight hours. Horror trips are rare. There are no physical withdrawal symptoms, but a psychological addiction is possible. Organic damage has not been observed.

A variety of other plants, such as henbane, datura, mandrakes, angel's trumpet, and even nutmeg, are hallucinogenic. In the attempt to take more natural "bio" drugs, young people will sometimes experiment with plants.

## **8.8.      Other Drugs**

There is a number of legal medical drugs other than the above mentioned that are also sold on the black market.

All sedatives can be used to counteract the effects of stimulants. They are also used by heroin addicts to alleviate withdrawal symptoms until the next dose of heroin can be procured. Strong analgesics and any cough medicine containing codeine are used for the same purpose. All of these have quite an addictive potential in themselves.

### **8.8.1            Inhalants**

Anything containing solvents will be used to inhale or sniff: Paint and paint thinner, nail varnish remover, gasoline, lighter fuel, hairspray, insecticides, glue, stain remover, deodorant, camping gas.

Sniffing is predominantly a slum problem, especially in third world countries. Most sniffers are in their teens or even younger.

A piece of cloth is soaked in the substance which is then inhaled. Often a plastic bag is pulled over the head till the high sets in. Suffocation or strangulation with the bag is a frequent cause of death.

Intoxication is frequent as there is a very narrow margin of error, that is to say the lethal dose is very close to the usual dose taken by the addict. It is characterised by a delirium with hallucinations, slurred speech, lack of coordination, arrhythmia and respiratory distress. Often it is possible to smell the substance used on the breath of the patient. The mucosa of the upper respiratory tract is often irritated.

Nitrous oxide is also sometimes inhaled. Here the high is short, serious intoxications are not known.

### **8.9 Treatment**

As there are no specific antidotes for most drugs, treatment of an intoxicated, comatose patient is not any different from any other coma. In addition, even if there is evidence that drugs have been taken, it cannot be confirmed that the causes of the coma are drug related.

The one exception is opiates, for which there is an antidote:

( Note → ) Naloxone is the specific antidote for opiate intoxications.

One must be aware that the effect of the Naloxone will usually wear off before the intoxication. The patient has to be monitored for at least 24 hours.

If heroin is likely to be the cause for the coma, look for pinpoint pupils. All other drugs cause dilated pupils. So does any other type of deep coma. Needle marks may be visible in heroin users.

Try to talk with the peers of the patient. Usually they know or suspect something, and when faced with a comatose and maybe dying friend, will be less hesitant to tell the truth.

( Note → ) Keep in mind that more often than not, more than one drug, or drugs in combination with alcohol, have been consumed.

### **8.10 Drug Screening**

Generally, drugs can be detected in urine, blood samples or hair.

The analysis of blood and hair is done by gas chromatology and mass spectrometry, often in combination. Neither the equipment nor the know-how will be available onboard of the average ship. These samples will have to be tested in specialized laboratories ashore.

On the other hand, test kits for drug-screening in urine samples are easy to use and will not occupy much space.

Hair grows 1 mm a day on the average. Depending on the length of the hair, drug abuse can be detected for a long time.

**( Note → )** With urine test kits false-positive results are not uncommon.

If at all possible, send a blood sample to a laboratory, or at least test several times over the next few days. Unless the culprit faced with the test result, admits his guilt.

For time limits in urine and blood refer to → **Annex 8-1**.

### **8.11 Naval Medical Aspects of Drug Abuse**

Naval vessels are complex technical systems. Most of the personnel have to be highly qualified. Even the less qualified jobs need a higher level of mental alertness and concentration than most jobs ashore. Therefore, drug abuse, regardless if legal or illegal, poses considerable problems.

Illicit drugs are of course just that in all navies. While some will do no more than inform their sailors of this fact and maybe the consequences of drug abuse, others have rigorous drug screening programs, with dire consequences if anyone is caught.

As far as alcohol is concerned, the differences are even more pronounced. There are "permissive" nations, where a certain amount of alcohol is allowed even at sea. Other nations consider alcohol as much a drug as any other and naval vessels will not (at least officially) carry alcohol.

**( Note → )** Alcoholism is a disease; the alcoholic is a patient in need of professional MOs help. The MO is not acting as a drug enforcement officer. He must make it quite clear that the punishment part will be left to others. The most likely situation is that the MO will be obliged to perform the drug screening and may be ambivalent and not free from conflicting problems. In summary the MO should keep his role strictly medical, acting as a consultant for the affected crew members.

## **9. Occupational Hygiene**

### **9.1 Maritime Occupational Health and Related Programs**

- 9.1.1 Ship's Design and Habitability**
- 9.1.2 Noise Stress and Hearing Conservation**
- 9.1.3 Ventilation and Air Conditioning**
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### **9.2 Safety of Personnel**

- 9.2.1 Prevention of Injuries and Casualties**
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- 9.2.3 Respiratory Protection**
- 9.2.4 Eye Protection**
- 9.2.5 Ear Protection**
- 9.2.6 Maintenance and Repair**

### **9.1 Maritime Occupational Health and Related Programs**

When trying to determine if someone is occupationally exposed to a physical or chemical hazard, the MO will need to rely on the results of the Industrial Hygiene Survey (IHS) and the Industrial Hygienist's (IH) interpretation of those results. The IH reports on which individuals are occupationally exposed to the various hazards and need to have occupational physical examinations and medical surveillance. If there is no IH on board, which will be the case at most units, the MO must contact and consult the responsible IH in order to obtain detailed information about the previous survey.

**( Note → )** Once at sea the MO takes over the responsibilities of the IH, if no IH is on board.

Some medical surveillance requirements are based on job description.

Other requirements are based on location, e.g., all personnel working in the fire-room are on the hearing conservation program.

Other requirements are based on actual exposure levels that the IH obtained during surveys.

### **9.1.1            Ship's Design and Habitability**

The term "habitability" is used to describe all the factors that form the environment in which the ship's company is required to live and work efficiently without hazards to health and causes of ill health.

Success in the design of any warship is the result of endless compromise, but it is essential that the overall well-being of the seamen is not jeopardized. Particular attention is paid to maintaining standards in line with the ever increasing expectations of sailors and to the possibility that sophisticated technological innovations may overtake the abilities of operators and maintainers resulting in an over stressful situation. The main problems in ship habitability are excessive noise and vibration, inadequate or inappropriate climatic environment and lack of space and privacy. Of increasing importance is the relationship between man-machine design and their interaction in the modern war ship, and the psycho-mental strain (or stress) resulting from it.

When a MO considers that any item of design or function of compartments or equipment is placing the men's health at risk he should attempt to resolve the situation in collaboration with the relevant Head of Department. The facts should be reported to the CO, so that the situation may be assessed in other ships of the class and that expert assistance may be provided on request.

### **9.1.2            Noise Stress and Hearing Conservation**

Noise aboard ships arises principally from the propulsion machinery, auxiliary equipment, and ventilation system. Continuous high-level noise results in permanent high frequency nerve deafness. Personnel at risk for hearing loss from high noise exposure levels are engineers, machinist mates, deck personnel who are grinders, scrapers, or chippers, and flight deck crewmen.

The purpose of the hearing conservation program is to identify individuals exposed to noise hazardous environments and monitor their hearing to prevent progressive hearing loss. As part of this program, the Medical Department is responsible for issuing hearing protection in the form of earplugs to all personnel potentially exposed to hazardous noise. On a ship, this encompasses the entire crew. All earplugs are to be fitted and issued by the Medical Department, not given to each department to fit its own. Earmuffs are generally made available through the Safety Department. As high cost items they are not provided by the Medical Department.

On aircraft carriers, noise levels on the flight deck approaching 150 dB(A) and below decks often in excess of 100 dB(A) are hazardous to the health of the crewmembers and can result in reduced performance to the point of fatal accidents. In specific classes of ship, noise source comes from the ship's propeller exciting the ship's structure. The resultant noise and vibration then re-radiates as airborne noise.

Background noise, which would be considered unacceptable at home, is considered quite normal at sea. This condition however provides no audio-logical recovery time for ship personnel who are exposed to noise during off duty hours as well as their on duty time.

Active noise reduction and protection is an important matter in ship design.

A total systems engineering approach should be conducted in order to have effective acoustic solutions. Total ship systems engineering evaluates what is appropriate to integrate, as a function of location, into the acoustic design of a ship. No noise sources can be ignored, since all will potentially contribute to the shipboard overall noise level. The entire ship should be measured and mapped for noise levels and sources. The vessel must be analyzed completely before a course of action is taken. A digital model should be constructed to depict structure, vibration and acoustical pathways.

The following are the basic noise reduction and protection approach:

1. Reduce noise at the source (mufflers, baffles, etc.).
2. Isolate and insulate the noise source from the structure and/or the living/working spaces from the noise source or structure.
3. Improve personal hearing protection when the crew must be exposed to a high noise environment.
4. Limit crew exposure to high noise levels (change current mode of operation).

#### **9.1.2.1                  Definition of Airborne Noise Categories**

Airborne noise criteria for navy ships and submarines are expressed as acceptable compartment noise levels. They are categorized according to personnel functional requirements and apply under all ship operating conditions. These criteria apply to steady-state noise and do not apply to impact or impulse-type noise.

There are 5 definition categories:

- Category A: Spaces in which direct speech communication must be understood with minimal error and without need for repetition. This corresponds with a less than 60 dB(A) noise level.  
Acceptable noise levels are based on approximate talker-listener distances of either 1 metre or 3 metres. Category A-3 shall be assigned when extreme talker-listener distance is less than 2 metres. Category A-12 shall be assigned when the extreme talker-listener distance is 2 metres or greater. A-3 or A-12 designators are dependent on compartment size and arrangement which influence talker-listener

distances.

- Category B: Spaces in which comfort of personnel is the primary consideration and where communication considerations are secondary.
- Category C: Spaces in which it is essential to maintain especially quiet conditions.
- Category D: High noise level areas in which voice communication is not normally important and prevention of hearing loss is the primary consideration (refer to → (your national) hearing conservation program requirements in high noise level environments).
- Category E: High noise level areas in which voice communication is at high vocal effort and short distance and where amplified speech mechanisms and telephones are normally available. This corresponds with a maximum of 84 dB(A) noise level.

#### **9.1.2.2                  Noise Category Assignments**

Airborne noise categories are based upon the functional requirements of shipboard spaces. Typical assignments are identified in → Annex 9.1. Ship spaces not specifically listed shall be assigned the same airborne noise category as a listed space which supports a similar function.

#### **9.1.2.3                  Acceptable Airborne Noise Levels**

→ Annex 9.2 indicates acceptable dB(A) weighted airborne noise levels for all shipboard categories.

A noise level survey should be available for all potentially hazardous areas to identify areas and tools producing dB(A) readings above acceptable levels (84 dB(A) for single hearing protection and 115 dB(A) for double hearing protection). All such spaces should be posted as “noise hazardous areas” with the recommended type of protection needed in that space (single or double). These tags and posters should appear everywhere a hazard exists and on everything that produces hazardous noise.

**( Note → )** It falls within the MOs responsibilities to ensure that the warnings are posted properly and the crew is wearing the appropriate protection. This can only be achieved by frequent inspections on scene. The compliance of some of the crew may be low.

**( Note → )** For detailed information on the hearing conservation program including the audiograms refer to your national documents. They are not included here.

Anyone showing progressive high frequency hearing loss, despite compliance with hearing protection guidelines, may need to be permanently removed from noise hazardous areas. This is not the MOs decision alone but must be made with the concurrence of an audiologist or ENT specialist. A stable, high frequency loss in one or both ears does not necessarily preclude working in hazardous environments, as long as double hearing protection is worn and annual audiograms show no changes.

### **9.1.3              Ventilation and Air Conditioning**

The purpose of air conditioning for personnel in ships is to provide acceptable working and resting conditions with respect to maintenance of a suitable thermal environment, supply of a sufficiency of oxygen, removal of metabolic and other gaseous products from within the ship.

Special arrangements for maintaining the desirable level of oxygen are not required in surface ships where the amount of fresh air admitted to the interior of the vessel and introduced into the ventilation system is sufficient to meet this need. The fresh air entering the system is filtered to remove dust and other particulates, then warmed so that condensation within the piping is minimised. It may be mixed with re-circulated air from various compartments.

#### **9.1.3.1              Requirements for Fresh Air**

The amount of fresh air, and under closed down conditions of decontaminated air, introduced by ventilation to keep gases, vapours, dust and fumes within the limits of healthy conditions are usually specified in national regulations, but exceed  $10 \text{ m}^3 / \text{h} / \text{person}$ . The concentration of  $\text{CO}_2$ , which is commonly used as an easily measured indicator of the ventilation effectiveness, should not exceed the following limits:

- Combat significant operational spaces 0.15 %.
- Berthing and living spaces 0.15 %.
- Wardrooms 0.25 %.
- Workshops, where heavy physical work is done only for short time 0.5 %.

If  $\text{CO}_2$  values exceed 0.15 % the atmosphere may however be experienced as "not fresh".

Fan-assisted exhaust ventilation may be required directly at the source of noxious fumes, odours and heat such as in galleys, laundries, engine rooms, and to compartments where steam and/or malodours may be present. This exhausted air and that from Sickbays must not be allowed to enter the re-circulation system but instead is discharged directly outside the ship. Forced exhaust arrangements may also be required to eliminate pockets of stale air

in living and other spaces. Engine and boiler rooms may present a heat problem beyond the capability of the air conditioning system to control economically and, where any cooling is provided for these compartments, it is usually by means of a sea water cooler and by providing watch-keeping positions with high velocity ventilation terminals.

Natural ventilation by way of grilles and ports in bulkheads and doors is quite acceptable, provided that it does not interfere with the watertight integrity of the ship. It is imperative that the air flows from living compartments towards the re-circulation fan and that the resistance of the system is low.

In very warm areas of the ship and especially in warm climates where the centralised air conditioning system may be inadequate to produce acceptable conditions and in older ships without such a system use of a self contained air cooler which requires only a supply of electricity, sea water for cooling and condensate drain connections may be considered as helpful.

#### **9.1.3.2                  Spot Cooling**

Spot cooling is a method of providing cooling and fresh air to personnel in specific locations within a larger, very hot area. The ship's fire-room, engine room and laundry presses are examples of very hot areas that can use spot cooling to provide comfort for sailors working in those spaces.

Effectively placed spot cooling is an extremely efficient means of cooling personnel because it directs a high velocity blast of outside air exactly where it is needed. Spot cooling is effected by delivering an envelope of outside air via ventilation ducts and adjustable blast terminals to the respective stations. Due to the high velocity, the incoming air does not rapidly diffuse and mix with the room air. A "cone" of air is provided to personnel, even though the effective temperature outside the "cone" of air is very high.

The key element in spot cooling is an optimal effective air velocity flowing over the worker. This can be best accomplished by positioning the adjustable blast terminal so as to assure a direct, unobstructed air stream at an equitable distance (1 to 1.5 m) from the individual's torso.

#### **9.1.3.3                  Uneven Airflow Distribution**

Uneven supply airflow distribution throughout a ship often creates hot or cold spots in several places.

New ships are using textile ductwork (made of fire-retardant material), which has been included in new Navy ships designs to replace traditional metal supply air ductwork and air diffusing terminals. Textile ducting provides even air distribution throughout the space. The system is able to achieve this by

virtue of the fact that the entire length of the duct is used for discharging the supply air into the conditioned space. This also helps to eliminate unauthorized ventilation system alteration throughout the ship. Fabric duct reduces the ship's weight. It does not need to be internally cleaned since it is regularly replaced. It can be easily discarded in the ships plastic recycle system.

#### **9.1.3.4 Air Velocity produced by Ventilation and Air Conditioning**

Air discharge should as a rule not be directed on personal and should stay within limits, to prevent draughts at all places which are (semi-)permanently occupied by personnel; air velocity below 0.15 m/sec usually provokes no draughts or complaints about dry mucous membranes (cornea).

In spaces where the temperature exceeds 28°C, the air velocity may be raised, preferably not higher than 0.33 m/sec.

Air velocity higher than 0.33 m/s may be required to provide effective spot cooling of personnel.

#### **9.1.3.5 Considerations for Medical Officers**

MOs should study the operation of the system in the ship(s) in which they serve, and be aware that air condition and ventilation systems may become dirty and microbiologically contaminated beyond acceptable limits, especially where the air is humid or humidified by dispersion, and therefore need regular inspection (filters need maintenance and a schedule for it adhered to). This may not only be a cause for infections, allergies or non-specific irritation of the (upper) airways, but also give rise to growth of Legionella bacteria.

Other complaints or problems from insufficient ventilation may be inadequate temperature. This may not be limited to feelings of discomfort, but when warmth is involved, cause an irritable atmosphere and, when present at night, sleep loss. When (excessive) sweating is induced, combined with high levels of relative humidity, loss of salt in this way may cause fatigue, or in severe acute cases, will result in (heat) cramps.

In combination with physical exercise or strenuous work the sweating may induce dehydration and heat stroke, at times provoked by inadequate (sweat-jackets in exercise activities) or sometimes inevitable protective (NBC) clothing and excessively rigid drinking-regimes.

#### **9.1.3.6 Conditioning of the Thermal Environment**

Regular monitoring of the thermal environment is necessary to ensure that it is maintained within design limits and to detect malfunction of the control system and its associated equipment. Measurement of air temperatures alone is insufficient for assessment of the degree of physiological stress imposed by a thermal severe environment. The body does not heat up or cool down passively, however, by adjustment of its heat losses or gains through peripheral vasoconstriction or vasodilatation according to heat and sweating. It can maintain thermal equilibrium in a very wide range of ambient conditions. Further control may be achieved by adjustment of energy expenditure and food intake. Additionally, acclimatisation, which results in profound physiological adaptations to the thermoregulatory system may be of the greatest importance and takes usually about a week.

The thermal environment is made up of four variable factors:

- Air temperature.
- Humidity.
- Radiant heat.
- Rate of air movement.

These may be measured on a dry-bulb thermometer, wet-bulb thermometer, globe thermometer and anemometer or kata-thermometer, respectively.

Air temperature is measured using a mercury-in-glass or mercury free thermometer and the wet-bulb temperature is derived from the reading of thermometer exposed to the environment with its sensor covered by a cotton wick kept constantly moist with distilled water. Unless the ambient air is saturated with water vapour, evaporation of water will occur from the wetted wick which will therefore cool the thermometer bulb and this will be reflected in the reading of that thermometer. The combination of temperature of the dry-bulb and wet-bulb thermometer can be used as a measure of subjective environmental comfort using suitable psychometric charts, provided the air movement is low. This thermal index is called effective temperature.

The ratio of the amount of water vapour in a given sample of air to the amount it would hold if saturated at the same temperature is the relative humidity (RH) of the environment. This is important since the evaporation of sweat depends upon the environment being capable of holding more moisture, the RH being a measure of this, and also because, if the environment is too dry, it may cause respiratory embarrassment as well as producing a situation in which static electricity could become a serious problem. The RH of an environment is usually expressed as a percentage value (RH %).

The radiant heat load of a given environment is measured with a globe thermometer, a thermal sensor at the centre of a hollow metal sphere of standard diameter and painted matt black, allowed to reach equilibrium with

the environment. The globe will absorb heat incident upon it, heating the air within the globe and causing the thermal sensor at its centre to register a temperature higher than the dry bulb temperature of the environment. If the surroundings are cooler than the air temperature then the globe will radiate heat away from itself.

#### **9.1.4            Heat Stress**

Medically, the heat stress program involves measuring heat stress at the workspace and calculating proper exposure times for the personnel in those areas. This area of responsibility is shared with the Engineering Department, who usually conducts the measurement.

**( Note → )** The MO is responsible for prevention of heat stress casualties. The idea behind a good heat stress program is to prevent heat casualties by monitoring the thermal conditions and limiting exposure times to allow personnel to “cool down.”

In most navies there are monitoring programs for thermal conditions in existence.

Ideally, the thermal environment should be such that most people working there are feeling comfortable. So far as normal circumstances in living accommodations and working spaces used for offices and similar purposes are concerned, the question of the desirable temperature will depend upon several factors including such parameters as work rates, clothing, personal preference, state of acclimatisation to heat, physical activity, and many others.

There are several ways of determining effective temperatures experienced by personnel. For instance, in lower temperatures the effect of air movement is a very important factor whereas in the upper regions air movement has rather less significance. Different ways of measuring and taking into account the various parameters such as temperature, humidity, air movement and heat radiation are available. The results are compared to tables containing known exposure effects and temperature limits.

#### **9.1.4.1        Environmental Considerations**

Relative humidity (RH) ought to be between 35% and 65%. If RH is higher, there is growing risk of condensation water and fungal growth.

An environment saturated with water vapour at a temperature of 52.8°C is painful to exposed skin. It is not possible to work in an environment even several degrees lower than this owing to uncontrollable coughing caused by the condensation of water vapour in the respiratory tract. Below the pain threshold, however, it is possible to survive either by wearing suitable protective clothing or by limiting exposure to a time dependent upon the climate, work rate, clothing, and personal tolerance. Temperatures in these

high ranges may be found in engine rooms or in accident conditions and it is clearly advantageous to have some method of estimating safe tolerance times for personnel exposed to them.

If the humidity is lower than 35%, however, mucous membranes in eyes and respiratory tract will become irritated.

Temperature differences between head and deck level should preferably be smaller than 3°C in living and working spaces.

The lower the temperature, the greater the incidence of respiratory tract infection. In temperatures below freezing, fingers, ears and nose have to be protected and, depending on working conditions, warm-up breaks may be necessary.

High temperatures can be compensated by sweating, provided enough liquid is taken in and the sweat can evaporate. If this is not the case, or the temperatures are too high, heat exhaustion or even the potentially lethal heat shock with cerebral damage may occur. To prevent this, limited exposure times may be necessary.

To improve working conditions, heat radiation shields can be put up, steps to dry and cool the air and increase air movement can be taken. In addition, acclimatization with short exposure times to start with, suitable clothing, cooling down breaks, and regular drinking are important.

#### **9.1.4.2 Monitoring Heat Stress**

Medically, the heat stress program involves measuring heat stress of the workspace and calculating actual performance/exposure times for the personnel in those areas. Anytime the dry bulb temperature in engineering spaces exceeds 37.7°C (100°F), engineering will measure a WBGT reading to determine heat stress levels (Medical department takes the readings for the rest of the ship). This is submitted to the CO through the MO.

A WBGT meter (heat stress monitor) uses a dry bulb, a wet bulb, and radiant heat measurement simultaneously to arrive at a "WBGT index."

This number is then referred to the Physiologic Heat Exposure Limits chart (the PHEL chart), which consists of a series of curves labeled A, B, and C, corresponding to physical activity levels, "C" being the most active. The curve has a WBGT number on the ordinate<sup>1</sup> and time in hours and minutes on the abscissa<sup>2</sup>. By referring to this chart, one can find the exposure time of an individual in the area in question at a particular WBGT reading and activity level. The activity duration will be adjusted to achieve those

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<sup>1</sup> Ordinate is the Cartesian x coordinate of a point.

<sup>2</sup> Abscissa is the distance from a point to the vertical, or y axis.

recommendations. The MO makes any additional health recommendations to the CO that may be necessary.

#### **9.1.4.3 Minimizing Heat Stress Conditions by Design**

When designing ship ventilation systems, it is imperative to take into consideration the needs of personnel living and working aboard ship as well as the work processes performed in particular spaces. Design should focus for interior air conditioning temperatures of 25.5°C (78°F) DB, 18.3°C (65°F) WB (50% RH). A preferred WBGT of 78°F applies to prescribed hot-weather operational conditions in: laundries, galleys, sculleries, passageways not open directly on weather decks, and food serving lines. For radiant heat sources aboard ship, it is necessary to insulate the radiating surfaces wherever possible.

For ship galleys, installation of new grease interceptor hood design, which has a front supply air plenum and provides cool and fresh air as needed, should be considered. The supply air is distributed at a low velocity forming an air curtain between the cook and the hot grease. This air curtain helps to reduce the effect of the radiant heat on the cook. In ship's fire and engine rooms, provide built in sound and temperature control booths, which use air-conditioning units to re-circulate air and provide comfort for personnel on watch. Use spot cooling to provide comfort for ship personnel working outside these control booths.

Replace equipment that generate high temperature in the workplace. For example, the majority of naval ships have steam-heated distilling plants. Replace flash type distilling plants with reverse osmosis units capable of treating potable water. The reverse osmosis units are easier to maintain, more reliable, and do not create high temperatures in work spaces, which reduces heat stress and improves shipboard quality of life. Sensors can be used to remotely monitor machines and equipment in overheated areas such as engine rooms. Proper design and placement of such remote monitors can prevent ships' personnel entering heat stress situations for extended periods to manually monitor equipment.

#### **9.1.5 Vibrations**

Protecting sailors from hazardous Whole-Body Vibration (WBV) means minimizing vibration source generation together with providing a protective whole-body cocoon for exposed workers with follow-up by regularly monitoring the vibration environment while employing sensible work practices. These include:

- Purchasing platforms with suspension systems that minimize vibration and, where possible, mechanical isolated/floating cabs.
- Purchasing "air-ride seats," (seats provide a protective cushion of air), as applicable, either as part of an original equipment manufacturer purchase

of platforms and/or.

- Removing non-protective seats from existing platforms and replacing them with air-ride seats.
- Using air-ride seats for applications such as hovercraft at sea and in fixed work station situations where the floor vibrates due to functioning equipment processes.
- Adding or designing 'isolators' under machinery to reduce source vibration in some fixed facility situations. This would include foundation mounts that prevent vibration transmission to other structures.
- Incorporating shock mount stand plates, chairs, and vibration damped controls in acquisition design stages.
- Using good work practices, which include sailors taking periodic rest breaks for every one to two hours of continuous WBV exposure and not lifting objects immediately after prolonged WBV exposure, leaving the vehicle using simple egress motions, walking around for a few minutes, and performing other non-lifting tasks before attempting any lifting tasks.
- Making sailors aware of signs and symptoms of WBV-induced back problems and the need to see their safety managers and health care providers if signs and symptoms occur.

Protecting sailors from hazardous Hand-Arm Vibration is multifaceted and begins with minimizing vibration source generation together with providing effective personal protection for exposed sailors, regularly monitoring the vibration environment, and employing sensible work practices. These include:

- Using only power tools which are designed to reduce vibration (called Anti-Vibration, or A/V) and reduce musculoskeletal injuries.
- An ergonomically designed power tool does not mean the tool has reduced vibration attributes and vice versa; thus power tools which are either A/V designated alone or ergonomically designated alone are not the best choice. The former solution alone, while reducing HAV, can leave tool workers at possible risk for Carpal Tunnel Syndrome (CTS: a syndrome of the median nerve and flexor tendons of the hand and wrist). The latter solution alone, while reducing CTS, can leave tool workers at risk for irreversible HAVS.
- Not using so-called "vibration reducing tool wraps" which are merely tool handle sleeves that attempt to reduce vibration of conventional power tools. These wraps are generally ineffective and do little to reduce vibration. They also pose an added problem by increasing tool handle diameter, which can possibly lead to cumulative trauma disorders (CTDs) of the forearm, elbow, and shoulder.

- Using only full-finger protected Anti-Vibration gloves:
  - Must be full-finger protected (no exposed fingers);
  - Must fit well (allowing maximum finger tactility and proper grip);
  - Must keep the fingers and hands warm and dry (to avoid cold-triggered HAVS attacks).
- Using good work practices, including:
  - Letting the power tool do the work;
  - Holding the power tool with the lightest grip possible consistent with safe work practices;
  - Keeping hands and body warm and dry;
  - Not smoking (nicotine, cold, and vibration all constrict blood vessels impeding circulation).
- Maintaining power tools & associated implements in good condition. Otherwise, vibration levels will eventually increase. Thus, regularly scheduled HAV tool monitoring is necessary.
- Making sailors aware of HAVS signs and symptoms and the need to see their safety managers and health care providers if signs and symptoms occur.

#### **9.1.6            Asbestos**

Asbestos is a fibrous mineral that because of its fireproofing, heat and electrical insulating capabilities, and high tensile strength has been used in numerous products found on ships. Examples are thermal and acoustic insulation, pipe lagging, gaskets, brake and clutch linings and flooring materials.

It cannot definitively be established that a ship is completely free of asbestos containing material (ACM). Therefore, it is some navies policy that all ships are required to have an asbestos control plan. The type of asbestos control plan required is based on the type of ACM present ( friable or non-friable) and whether the ship has a mission to provide asbestos repair and/or removal services to other afloat commands.

Personnel performing ACM repair or removal work are trained in the specific work requirements for the type of work and material disturbed.

General policy is that an industrial hygienist shall survey all work places as part of the industrial hygiene survey. During this survey, the industrial hygienist shall identify any hazards associated with asbestos and provide recommended actions to the ship to eliminate or minimize the asbestos hazard. Information from this survey shall also be used in development and implementation of the asbestos control plan.

Adequately wet ACM during removal and maintain wet through disposal. Dispose of the wet waste material in double, heavy-duty plastic bags or other suitable impermeable containers.

### **9.1.7            Fuels**

Otto Fuel is used as a liquid propellant found in torpedoes (Otto fuel II).

This fuel is extremely aggressive and can be absorbed through the skin or inhaled, and exposure can be fatal. When personnel are working with this chemical, they must use positive pressure air breathing equipment, neoprene aprons and gloves, and freshly laundered coveralls. The room should also be well ventilated.

Personnel working with Otto Fuel II must have a pre-placement and annual physical check. The occupational history must inquire about previous occupational exposure to nitrates. The medical history review must check for cardiovascular disease, hypo- or hypertension, and frequent or severe headaches, particularly migraines. The clinical physical examination emphasizes the cardiovascular and neurological systems.

### **9.1.8            Heavy Metals**

#### **9.1.8.1            Mercury Control**

Any ship with a Dental Officer or a calibration laboratory will have free mercury as a component of the amalgam base used for restorative dentistry or for the calibration of gauges.

On safety surveys and command inspections, the MO checks how the mercury is handled. The working area must be well ventilated with a fresh air exchange and an outside exhaust. By regulation, the air should be sampled periodically for mercury vapour. The department responsible for the space will probably do this, but you should be aware of the regulation. The mercury should be kept in tightly sealed containers away from heat and flame. Last, but not least, there should be some form of mercury clean-up procedure to be followed in case of a spill, e.g., spill kits. Dental units on some of the smaller ships will have mercury in self-encapsulated containers. Mercury is broken out only as each unit is mixed, preventing the dangers and hazards of a mercury spill.

( Note → ) The MO's role in mercury control program is to ensure proper handling procedures for elemental mercury in dental facilities and calibration laboratories to minimize personnel exposure and environmental contamination.

The MO must also look for other sources of mercury aboard ship, such as old King gauges, old manometers in calibration labs, mercury thermometers, etc. If present in any of these places, there must be a warning sign in the space or attached to the item. Routine medical surveillance for mercury exposure among dental/calibration laboratory personnel is not required but may be prescribed based on biological monitoring in a spill situation.

Biological monitoring must be done by urine mercury analysis.

#### **9.1.8.2 Lead Control**

Lead is a material that is long recognized as a health hazard leading to kidney and nervous system damage, reproductive hazards, and blood disorders.

While much work has been done to reduce the amount of lead materials on ships, there is still plenty of lead in routine use. Lead is found in some of the lead-based paints still in use or in paint already present, also in foundry work, welding solders, radiation shielding, batteries, ballast, small arms ammunition, and weights.

The sailors who are generally exposed are foundry workers, some painters, and some welders. The industrial hygienist can inform which areas and jobs are lead exposure areas so that proper protective measures (respiratory, ventilation, protective clothing, etc.) can be taken.

Personnel who are exposed to lead are required to be in a lead surveillance program. This consists of a pre-placement physical with emphasis on the gastrointestinal, renal and neurological systems. Laboratory analysis includes CBC, BUN, creatinine, blood lead levels, and zinc protoporphyrin level (ZPP).

Lead levels are monitored every six months. A physical examination is done only if a blood lead level is 30 micrograms/100 ml or higher.

#### **9.1.9 Halogenated Hydrocarbons**

Halogenated hydrocarbons are included as a specific entity because most personnel are unaware of their toxic potential.

There have been documenting halogenated hydrocarbon-related casualties onboard naval vessels. Special attention must be paid to refrigerants, solvents, and gases in liquid form such as Freon, Isotron, and TCPFE. They are widely

used as paint thinners, refrigerants, fumigants, propellants, pesticides, dry cleaning solvents etc.

Halogenated hydrocarbons can cause severe kidney and/or liver damage by low-grade chronic exposure through contact or vapours. An acute, heavy exposure can result in hypoxia and death (these elements are heavier than oxygen and may displace oxygen completely). Skin and eye exposure can be very irritating and cause conjunctivitis or severe contact dermatitis. High temperatures will degrade vapours to extremely toxic and irritating gases.

The following precautions are to be checked by the MO to ensure the safety of all personnel. He should monitor and advise. Engineering and other departments involved should obtain the necessary protective equipment and conduct training.

The MO should check for:

- Proper labelling of containers.
- Adequate ventilation.
- Oxygen breathing apparatus utilization during fires where vapours may exist.
- Use of an approved organic vapour cartridge respirator when handling organic agents by all personnel. Departments may ask the Sickay for surgical masks. They are not adequate and should not be provided.
- Air breathing equipment in any closed space where these materials are utilized.
- Goggles, skin coverings, gloves, boots, and head-covers must be worn, especially when handling liquid halogenated hydrocarbons.

On inspection, the MO should occasionally ask to see the protective equipment and ensure that people are aware of its use, i.e. refrigeration mechanics are sometimes lax in their dealings with refrigerants. Casualties have been reported from Freon gas inhalation, usually from asphyxiation. Freon can also cause a cardiac sensitization leading to ventricular fibrillation.

All personnel who are authorized to work with halogenated hydrocarbons may require annual physicals to ensure that they have received no ill effects from them.

Personnel who handle pesticides must also have their pseudocholinesterase levels checked regularly.

#### **9.1.10            Radiation Health**

On nuclear-powered ships, ships with nuclear weapons, or if x-ray equipment is held onboard, there will have to be a radiation health program. The medical responsibility is with the MO, but if there is a radiation health officer or radiation health technician, he or she will run the program.

There are various dosimetry measurement requirements: radiation measurement badges, reporting, and inspection criteria. There are national regulations laid down in radiation health manuals for x-ray, nuclear power and the nuclear weapons program, some of which may be confidential.

Before a dosimeter is issued, personnel are required to be trained and have a radiation medical examination. Personnel also require internal monitoring prior to entry into the radiation health program, upon termination from the program, and upon transfer from the command. The MO needs to make sure that examinations are undertaken and reports filed in the person's medical record. All radiation exposure received will be recorded and filed in the individual's health record. Even if the radiation exposure is zero, it must be entered.

There is also a monthly report to the CO via the XO and the Radiological Controls Officer listing all the radiation exposure for the month and any dangerous levels of exposure. Transferal letters and situational reports for personnel transfer or over-exposures will be conducted by the MO. All these reports are time-critical.

There are also internal and external audits that must be undertaken on the radiation health program. The XO does the internal audit regularly. Another ship or command with a radiation health program will do the external audit.

## **9.2 Safety of Personnel**

Most industrial-related work activities will be in the following areas: welding, painting, metal cleaning, hazardous materials, working in an enclosed space, machining, metal casting, electrical and electronics maintenance, battery recharging, and sewage treatment. Each has some common safety points, such as protective eye gear, protective clothing, protective headgear, and respiratory protection.

### **9.2.1 Prevention of Injuries and Casualties**

The prevention of injury may be achieved by:

- Elimination of dangerous substances and machinery.
- Substitution with safe or less hazardous substances and machinery or entire processes ensuring that the new, lesser hazards are controlled within acceptable limits.

- Suppression or removal of dusts, gases, fumes, vapors, e.g. wet processes, exhaust ventilation.
- Enclosure of processes, e.g. fume cupboards.
- Enclosure of operators, e.g. remote control booths in engine rooms.
- Personal protective clothing.
- Training, supervision, inspections.

Frequently it will be necessary to use a combination of the methods, e.g. when welding zinc primed steel plates the zinc along the edges of the metal to be welded will be eliminated by grinding, the operator wearing goggles, ear protection and possible respirator and/or helmet (personal protection). Welding electrodes will be chosen to ensure the minimum fume and gas emission (substitution). The welder will prevent others approaching the hazard area (segregation) and erect screens to shield the arc from the gaze of passers by thus reducing the size of segregation area. He will use exhaust ventilation to remove pollutants when natural ventilation is insufficient and will wear a welding helmet and other clothing to prevent spark and ray burns.

Minimum benefit may be achieved with all protective and safety clothing as it is within the control of the sailor to disregard it. Nevertheless such clothing has an important role to play in shipboard safety. Although great progress has been made in the design of such clothing and equipment it is often bulky, uncomfortable, restrictive and hot to wear. There is also a psychological barrier in some groups of personnel to accepting such protection. Users should therefore be involved when determining the design of items which are to be provided.

### **9.2.2            Protective Clothing**

Many toxic materials are handled aboard a ship. The spectrum runs from Argon to Xenon. Many of these materials (mostly the halogenated hydrocarbons) are absorbed readily through the skin and can cause widespread systemic symptoms and problems.

Protective clothing is essential in handling hazardous substances. In most cases, a good pair of well-fitting coveralls is adequate. If a spill occurs, the garment can be shed quickly, and the individual can wash the substance off to reduce exposure. Use of special rubber suits is unnecessary in most situations.

- Rubber boots are needed when working with contaminated water, sewage, or chemicals that cannot permeate rubber.
- Protective shoes or boots are designed to prevent injuries to the feet, and in particular the toes, by provision of a reinforced toe cap. They should also prevent slipping on decks such as galleys, flight decks and engine

rooms, by the use of special soles. They also can protect against water, corrosive liquids and hot materials. Some protective footwear combines one or more of these facets.

- Steel-toed shoes should be standard in all machine shops, welding areas, and for anyone working around heavy equipment.
- Welders basic protection must include eye goggles, welder's mask, coverall and steel-towed safety shoes.
- Hand protection includes not just corrosive-resistant gloves but also shields on saws and machinery. These items are common sense measures, but there is a tendency towards lack of regard for even the simplest protection. Gloves and gauntlets to protect the hands may be made of one or more materials according to their function.
- Specialized forms of protective overalls are required in particular situations. Nylon or other man made fibers must not be used where there is a risk of fire or spark burns, such as welding.
- Aprons are normally worn to prevent soaking from wet processes, soiling, like by oil lathes or as a protection against splashes of corrosive acids and alkalis.
- Head protection: While any cap or head covering will give some protection against minor accidental knocks, protective headgear must be the rule in areas of above average risk. The safety helmet should be worn in all areas where there is foreseeable risk of falling or flying objects. The bump cap is not a safety helmet but a cap with a protective skull plate and is ideal between decks where the headroom is low. The nylon or terylene skull cap is worn to prevent contamination of the hair. Head protection is often neglected when overhead work is being done. Cranes, booms, and personnel working aloft are all potential hazards of falling debris. Personnel working in these areas should always wear hardhats. Be sure there are enough functional hard hats to go around.

( Note → ) MOs should not be inspecting such an area without a hardhat, not least because it sets a poor example.

### 9.2.3        Respiratory Protection

Protection of the respiratory system may be required in exposure to certain dusts, gases, fumes and vapors. It may arise due to either their intrinsic hazardous nature or the lack of oxygen in the atmosphere.

Respiratory protection may be provided by respirators with a filter system, air curtains, air fed hoods and respirators, self-contained breathing apparatus. Respirators with filter systems rely on a single or double cartridge or pad through which all air admitted to the breathing zone is filtered. Some models may be used with either a dust or a fume

cartridge and it is important to check that the filter is appropriate for the contamination against which it is to be used. In air curtain, a flow of fresh air is passed across the breathing zone at such a velocity as to prevent noxious substances entering the breathing zone. Air fed helmets and respirators are worn over the whole head or the face and provide a supply of fresh air to the breathing zone through a hose connected to a lower pressure air supply and a filter system. Self-contained breathing apparatus has a supply of compressed air from cylinders carried by the wearer and supplied through a demand valve to a mask.

( **Note →** ) One of the biggest onboard abuses is the lack of respirator protection. Crew members are often asked to work in a poorly ventilated enclosed space, using paint and solvents that give off noxious, organic vapors, some of which are highly flammable. Approved respirators with organic vapor cartridges must be provided for this type of work. If not provided, the work should not be done. When in doubt as to what type of respirator or cartridge to use, MO should check with the Safety Officer to make sure that the individual is using the correct respirator/cartridge.

The Sickbay is not responsible for procuring respiratory protection. Each department must provide its own equipment and should be monitored closely on a day-to-day basis by its own personnel.

Respirators should be selected according to the specific hazard and cleaned between each use.

( **Note →** ) The MO is, by regulation, to determine if a person is medically fit to wear a respirator. This determination is made based on the worker's health, the type of respirator, and the conditions of respirator use. In essence, a young and healthy sailor is fit to wear a respirator or should not be aboard the ship.

#### **9.2.4            Eye Protection**

Eye protection must be suitable to the task and the wearer. Goggles may provide protection from impact, dust, chemical, UV, laser and IR radiation, depending on their construction.

The MO should perform periodic inspections of the industrial spaces to make sure sailors are using their eye personal protective equipment (PPE).

Individual departments are responsible for obtaining and issuing proper eye protection, not the Sickay.

- A ship's standard instruction outlining and enforcing eye protection guidelines should be available.

- All personnel who routinely work in eye hazardous areas should be issued personal eye protection devices (goggles, safety glasses etc.).
- Corrosive chemical work necessitates the use of goggles and a plastic face shield whenever possible.
- Emergency eye wash stations that provide a 15-minute continuous flush are required in industrial shops, particularly in areas where corrosive liquids are used.
- An eye hazardous area must be clearly marked "Eye Hazard Area."
- Any welding operation is to be properly screened to prevent arc flash or burn to people not directly involved in the welding operation. Personnel who are in the space where welding is done, either as a fire sentry or just working, need to be aware that flash burns can result from a reflected arc off a white bulkhead.
- Eye hazardous machinery and equipment should be properly guarded whenever possible. Face shields and plastic protective guards should be placed over the machines to prevent foreign bodies from flying into the eyes of the operator.

( Note → ) Spaces that use portable eye wash stations must flush them weekly and refill. This is to prevent the potential colonization, which can cause a severe keratitis that is extremely difficult to treat.

#### **9.2.5 Ear Protection**

Ear protection can be provided by several devices. Ear protection appropriate to the noise level and attenuation required must be selected. Fibreglass is satisfactory only for short periods. Preformed ear plugs of this material have less risk of pieces of fibreglass breaking off in the ear and are more likely to provide effective protection than those rolled by the sailor. They are used on one occasion only then discarded. Ear plugs must be properly fitted by trained personnel, be a personal issue and kept clean. Ear muffs (defenders) are the most efficient means of hearing protection. It is vital to ensure that the external ear is completely enclosed within the seal.

#### **9.2.6 Maintenance and Repair**

Physical safety in refitting ship is of paramount importance. By the very nature of the refitting task, pieces of the vessel are removed for repair and replacement. These may include ladders and companion ways, hatches, doors and guard rails. Holes are cut in decks and bulkheads to remove and refit equipment, carry out structural alterations, or replace defective plating. Temporary ladders, hatch covers, guard rails and lighting are in use. Miles of

trailing hose and electric cable snake in and out of the various compartments. Machinery, equipment, tools and fittings are stacked both in the vessel and on the dockside. Cranes plumb their loads over the deck. These multiply the possible causes for physical injury, ranging from the trivial to the fatal.

The cardinal rules which must be followed are:

- Access to and from the ship must be kept clear and safe at all times.
- All hatchways and similar openings must be adequately guarded and covered.
- Temporary guard rails must be rigged as required.
- Temporary ladders must be adequate and securely fastened.
- A clean ship routine with good housekeeping is necessary at all times and in all places.
- Safety helmets to be worn at all times.
- Electrical leads and temporary lighting circuits should be tied, out of the way of personnel.
- Everyone onboard should know the easiest safety exit route from where they are working, in case of fire. It is the duty of every member of the ship's company to ensure that nothing is done that will interfere with the safety precautions instituted in the dockyard

( **Note →** ) Safety during repair and maintenance during refit either on pier or in dockyard needs special attention of the MOs inspections.

## **10. Lighting**

### **10.1 Introduction**

### **10.2 Purpose of the Lighting Installation on Board**

### **10.3 Visual Requirements**

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### **10.8 Additional Considerations on Visibility and Well-Being**

- 10.8.1      Visibility**
- 10.8.2      General Well-Being**

( → Note ) Definitions of the terms used in this chapter are provided in → Annex 10-1.

### **10.1 Introduction**

This chapter covers general and specific requirements and additional considerations concerning illumination for surface ships. It contains information for assessing the lighting environment onboard as it affects performance and well-being. The basis of this chapter is chapter 5 - Standard of Illumination - of the Allied Naval Engineering Publication 25 (ANEP-25) "Guidelines for Environmental Factors in NATO Surface Ships". This ANEP was compiled in 1998 by Subgroup 6 "Influence of Human Factors on Ship Design" of the NATO Naval Group 6 on Ship Design. Further

information with reference to technical aspects of the lighting design and to measurement issues may be found in that publication.

## **10.2 Purpose of the Lighting Installation on Board**

The purpose of the lighting installation onboard is to:

- Provide conditions for optimum visual performance, particularly in the sphere of work.
- Facilitate work in order to achieve optimum performance.
- Aid the avoidance of lapses in performance.
- Contribute to the prevention of accidents.
- Increase the safety of the ship.
- Sustain and promote the general well-being of all those onboard, both in their work and their recreation

It has to be assured that the design and the construction of the lighting installation must not constitute a hazard to the crew's health.

## **10.3 Visual Requirements**

The visual requirements for a given compartment are dependent on the types of operation to be performed in that compartment. On ships it may occur that different operations must be performed in the same space simultaneously by different persons or subsequently or intermittently by one person. These circumstances can result in conflicting visual requirements. Careful analysis of these requirements is needed in order to find the best possible compromise.

Generally, the recommended lighting should be based on the critical (smallest to be seen) detail in a task, taking into account (low) contrasts, risks resulting from making errors and – whenever applicable - age (over 45) of the operator, which may require greater performance. Short-term tasks may allow less lighting. Working conditions can be divided into classes according to the "delicacy" of the task in critical detail.

The lighting benefits mentioned in Subchapter 10.2 with reference to performance and well-being will only be obtained if additional considerations concerning visibility and well-being are met ( refer to → Subchapter 10.8).

## **10.4 Lighting Criteria**

Important criteria for lighting are

- Illumination.
- Luminination ratios in the visual field.
- Limitation of direct and indirect glare.
- Apparent colour and colour rendering index of the light source.

## 10.5 Measurement

Usually, measurements of lighting are undertaken with an lighting metre which meets specific requirements given in national and international regulation. ANEP-25 "Guidelines for Environmental Factors in NATO Surface Ships" contains information concerning not only the instrument but also the method, the conditions and the documentation of the measurement.

## 10.6 Recommendations

### 10.6.1 Lighting

- (1) Table I gives the range of recommended service lighting for different applications of lighting. **Annex 10-2/3** provides more detailed recommendations.

Range of recommended service illumination (lx)	Application
10 – 20	<u>Lighting for orientation.</u> Applicable in areas where the visual field is not critical and mostly confined to movement. In general, it is necessary to add locally normal lighting for reading printed matter or for tasks with comparable details and contrasts.
200 – 800	<u>Normal lighting.</u> Most visual tasks can be carried out in this range of illumination, in which performance is only slightly affected by the lighting.
800 – 3000	<u>Special lighting.</u> This is sometimes needed for special situations. These situations arise with: weak contrasts with small reflection factors, very accurate colour judgement, avoidance or stimulation of effects of gloss or shadow. This situation can be avoided by taking other (ergonomic) measures.

The lower values of the ranges represent the minimum requirements, the higher values the optimum requirements. The latter should always be the target values.

(2) Uniformity of lighting

For the reference surface uniformity of lighting is important. Sudden changes of lighting in this region are likely to cause distraction and dissatisfaction and may affect task performance.

The following uniformity ratios (UR) apply:

For all spaces including living, recreational and sanitary spaces:  $UR_1 \geq 0.4$

For desks and vertical front panels in machinery control rooms:  $UR_1 \geq 0.7$

For passageways:  $UR_2 \geq 0.1$

It should be noted that, in particular in living and recreational spaces, it may be neither necessary nor desirable for lighting to be uniform throughout the whole interior. Therefore it may be appropriate to divide large spaces into different lighting zones taking into account the various tasks/activities to be fulfilled in these zones. The mean lighting in adjacent rooms should not vary from each other by a ratio exceeding 5.

### **10.6.2 Lighting Ratios in the Visual Field**

(1) Lighting ratios in the visual field of the working person should not be too high. The lighting ratio should not exceed the ratio of 10. Above this ratios may work obtrusive or cause distraction and may affect task performance. Between the area of the visual task and its immediate surround a ratio of 3 is generally preferred.

(2) Because of the relationship between illumination and reflection characteristics of (matt) surfaces in creating light, some design recommendations on (diffuse) reflections can be given:

a)	Working plane	0.2 - 0.5
b)	Ceilings	0.7
c)	Bulkheads	0.5
d)	Decks	0.2

### **10.6.3 Limitation of Indirect and Direct Glare**

**(1) Limitation of indirect glare (veiling reflections).**

- a) Contrast in the visual task can be reduced by veiling reflections. This occurs when a high illumination is reflected by the task towards the worker's eye and thus veils, or interferes with the perception of the visual task.
- b) In particular, reflections of light sources (lights, windows) in detailed visual tasks (printed matter, VDU-screens, glass panels) can result in substantial losses of contrast.
- c) The most effective method of dealing with indirect glare is to locate the worker or the light source in such a way that reflections of the latter are directed away instead of into the worker's eye. If this is not possible the illumination from the light sources must be reduced. A complementary method is to reduce the glossiness of the materials used.

(2) Limitation of direct glare (discomfort):

- a) Glare is experienced if the brightness of lights or windows is excessive compared with the general brightness in the interior. In interiors discomfort glare is likely to be more a problem than disability glare. Health complaints due to glare conditions may be that of "tired" or burning eyes (sometimes with concomitant blepharitis) or headache.
- b) The discomfort is greater the higher the illumination of the sources, the greater the solid angle they form, and the greater their number within the visual field. The discomfort is lower the greater the angle formed by the direction of the source and the visual axis is and the higher the illumination of the background.
- c) Discomfort glare must be limited through restriction of the parameters mentioned. This means the light from a lamp where the illumination is not directly or indirectly (that is reflected from light-reflective surfaces) visible should be used.

#### **10.6.4 Apparent Colour and Colour Identification Index of the Light Source**

- (1) The colour and colour rendering of the light produced by the lamp is of importance in the design of ship interiors. In an engine room the colour rendering is likely to be of little importance compared with the need for good illumination and contrast, whereas in an office there will need to be good general lighting with correctly-rated and efficient local lighting at points such as desks and the colour will be of some concern, preferably neutral. In a Sickbay or hospital, in workshops or food preparing areas the lighting should be not only of adequate intensity but of the correct colour temperature, i.e. neutral-white and with high colour identification index. For recreational spaces, however, a warm white colour may contribute to a feeling of well-being.

- (2) The choice of an appropriate apparent colour of light source for a compartment is determined by the function of the compartment.
- a) For working interiors in general a neutral white light source colour should be used; colour temperature  $3300 \text{ K} \leq \text{CT} \leq 5300 \text{ K}$ .
  - b) For recreational interiors in general a warm light source colour should be used; colour temperature  $\text{CT} \leq 3300 \text{ K}$ .
  - c) For special applications, such as on the bridge during the night, light with a specific spectral composition should be used.
- (3) Five colour rendering groups are distinguished:
- Group 1 with colour rendering index  $\text{Ra} \geq 90$  = good;
- Group 2 with colour rendering index  $90 > \text{Ra} \geq 80$  = sufficient;
- Group 3 with colour rendering index  $80 > \text{Ra} \geq 60$  = doubtful or moderate;
- Group 4 with colour rendering index  $60 > \text{Ra} \geq 40$  = poor;
- Group 5 with colour rendering index  $40 > \text{Ra} \geq 20$  = very poor.
- (4) For tasks involving accurate colour judgement light of colour rendering group 1 should be used (Example: perception of colour-coded warnings or of coloured objects on maps. For recreational interiors and in general for working interiors light of colour rendering group 1 or 2 should be used. For work indoors where colour rendering is of no importance, light of colour rendering group 3 may be used. For lighting applications where safety or security are the major requirements, light of colour rendering group 4 or 5 may be used, provided that safety colours can be perceived.

## **10.7 Lighting Systems**

### **10.7.1 Ship Service Lighting System**

- (1) A ship service lighting system should be installed. This system should meet the requirements as specified in this document.

- (2) The system includes lights which should meet the CIE and CEE specifications as applicable for the circumstances under which they will be used.
- (3) The system includes the installation of lights which are permanently installed and the assembling of lighting, cables and plugs for portable lamps or lights.
- (4) The system includes the wiring, outlet boxes and sockets.

#### **10.7.2 Lighting, Dark Adaptation**

- (1) Adaptation to low light (dark adaptation) requires more time than the adjustment of the visual system to relatively high light.
- (2) The greater the light's ratios the longer the time required. On transition from daylight to a very dark environment for example, some initial adaptation occurs very quickly during the first five minutes, after which the rate of further adaptation greatly decreases. Complete adaptation may only be reached after an hour, 90 % being obtained in about 30 minutes.
- (3) Dark adaptation is disturbed when the eye is exposed to higher illuminations.. Red lighting reduces this interference to dark adapted vision. Where high demands on night vision exist, as on the bridge, red lighting at low intensity is preferred.
- (4) Some national regulations require also red lighting in mess decks, wash rooms, heads, passageways, hangars and special compartments to facilitate safe and rapid movement of personnel while maintaining night vision.
- (5) Red lighting disturbs colour perception and supports long-sightedness. That is why additional lighting is used when perception of colour is important, providing locally a fluorescent (filtered: blue excluded) or incandescent (dimmed) white light at very low level in order to limit the disturbance of dark adaptation.

#### **10.7.3 Lighting of Spaces in which Visual Display Units are Installed**

- (1) In ship control stations containing work stations with VDUs (e.g. CIC, Machine Control Centre, and Bridge) visual tasks with different visual requirements have to be performed simultaneously, often in narrow spaces. In addition to the tasks at VDUs, which normally require dimmed lighting other work has to be done, e.g. reading, writing, or looking at the map which require higher illumination. In these spaces the service lighting is designed so that single lamps can be dimmed or switched off, as required.
- (2) If this is not sufficient a specific procedure has to be performed which takes into account

- The various tasks with different visual requirements.
- The maximum allowable luminance.
- The characteristics of the VDUs.
- The design of the work stations.

#### **10.7.4 Back-up Lighting**

- (1) Back-up lighting (emergency lighting, substitute lighting, auxiliary lighting) should be provided in areas in which illumination is critical for personnel escape, or in which uninterrupted illumination is critical.
- (2) It should be provided through a secondary power supply system which is independent of the main power system (e.g. auxiliary power supply, batteries). It should be secured that the back-up lighting is available immediately after loss of vital lighting.
- (3) The level of illumination should be sufficient to direct the immediate task. Lighting for perceiving detail should be provided in engine starting areas, in hangars, on catwalks, in machinery switchboards or consoles and on operating tables. In addition to the second lighting, portable rechargeable battery lights, hat lights and flashlights which give sufficient illumination for damage control operations should be provided.

### **10.8 Additional Considerations on Visibility and Well-Being**

#### **10.8.1 Visibility**

- (1) The visibility of an object is a measure of the ease, speed and accuracy with which the object can be detected or recognized visually.
- (2) Visibility is dependent on many factors of which the most important are:
  - a) Apparent size of the critical detail.  
The apparent size of a detail is usually expressed in minutes of arc of the angle subtended by the detail at the observer's eye. The critical detail of the object is the detail with the lowest visibility that must be seen in order to detect and recognize the object visually. The smaller the apparent size the more it is determinative for visibility. The visibility of a detail of 2 minutes of arc and a good contrast with its background can be perceived

by almost all men. In general, a detail of 1 minute of arc is the smallest that can be perceived.

b) Illumination contrast in the visual task.

For the light contrast in the visual task the ratio of the illumination of the detail to the background light is used. The smaller the light contrast the more it is determinative for visibility. Light contrasts should range between 3 an 10.

c) Adaptation lighting.

The adaptation lighting is a measure for the state of the visual system when it has become adapted. For central vision it is the average illumination of the central part of the visual field. As adaptation illumination increases from very low level up to about  $30\text{ cd/m}^2$  there is a steady improvement in the detail and threshold contrast that can be resolved, the colour discrimination that is possible and other visual capabilities. Above  $30\text{ cd/m}^2$  no further improvement of practical importance can be expected. Changes in the adaptation illumination can occur for instance, when an observer is moving from one place to another or when he is changing his viewing direction or when the lighting is switched on or off.

d) The available observation time.

The smaller ( $< 1\text{ sec}$ ) the available observation time the more it is determinative for visibility.

e) Colours and colour contrasts.

In general only light contrasts contribute to visibility. Colour contrasts alone have approximately 5 times poorer visibility.

f) Location of the object in the visual field.

The further the critical detail is seated away from the line of sight the lower will be its visibility.

g) Amount of information to be processed.

The smaller the amount of information to be processed the easier and the faster the process of detection or recognition will be terminated and consequently the greater will be the visibility. For instance when the detail to be seen is one surrounded by many others, especially when these are similar ones, visibility is less than when it would be surrounded by a uniform field. When the location of the detail to be seen in the visual field is unknown its visibility is less than when the location of its appearance is known. When a person has built up great experience in perception of a specific detail his level of visibility will be greater than that of an inexperienced person.

### 10.8.2 General Well-Being

- (1) Just like other factors of man's environment such as temperature, sound, moisture etc. light affects general well-being. For example: lamps of high colour temperature produce light that is associated with a cool climate, lamps of low colour temperature cause impressions of warmth and relaxation.
- (2) Another aspect of the light environment that may affect general well-being is the lighting contrasts in the compartment. If these are too small, a feeling of dullness may result due to lack of stimulation, which might affect performance adversely after some time. If on the other hand the lighting ratios are too great, adaptation of the visual system will be adversely affected leading to undue fatigue, decreasing task visibility or causing a feeling of discomfort.
- (3) The last aspect of the lighting environment that will be considered here is the colour rendering of surface colours. Depending on the spectral properties of the source of illumination, the colours of people, objects and room surfaces will appear more or less distorted. The colour rendering index of a light source is used as a measure for the degree to which colours when illuminated by that source appear accurately. When the colour rendering especially of the human skin and of organic products is poor, people will in general be dissatisfied.

## 11. Hazardous Materials (Poisons) and Workplaces

### 11.1 Hazardous Materials (Poisons)

#### 11.1.1 General Management of Exposure to Hazardous Materials (Poisons)

- 11.1.1.1 First Aid and Unspecific Treatment
- 11.1.1.2 Primary Detoxification (Prevention of Further Absorption)
- 11.1.1.3 Secondary Detoxification (Enhanced Elimination)
- 11.1.1.4 Antidotes

#### 11.1.2 Fire Smoke

- 11.1.2.1 Constituents of Fire Smoke
- 11.1.2.2 Diagnosis of Intoxication
- 11.1.2.3 Treatment and Management
- 11.1.2.3.1 Patients Presenting No or Few Symptoms
- 11.1.2.3.2 Severely Injured Patients

#### 11.1.3 Hydrocarbon Fumes

- 11.1.3.1 Toxicological Profile
- 11.1.3.2 Diagnosis
- 11.1.3.3 Chemical Analysis and Monitoring
- 11.1.3.4 Treatment and Management

#### 11.1.4 Diesel Exhaust

- 11.1.4.1 Toxicological Profile
- 11.1.4.2 Diagnosis
- 11.1.4.3 Chemical Analysis and Monitoring
- 11.1.4.4 Treatment and Management

#### 11.1.5 Chemical Warfare Agents

- 11.1.5.1 Recognition of Chemical Operations
- 11.1.5.2 Chemical Warfare Agent Detection and Identification
- 11.1.5.3 Treatment and Management
- 11.1.5.4 Classification of Chemical Agents
  - 11.1.5.4.1 Nerve Agents
  - 11.1.5.4.2 Blister Agents (Vesicants)
  - 11.1.5.4.3 Lung Damaging Agents (Choking Agents)
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**11.1 Hazardous Materials (Poisons)**

( Note → ) Management of poisoning is a rather dynamic, changing area requiring good referencing and updating of protocols. It is recommended to review the guidelines provided on-line by the American Association of Poison Control Center (<http://www.aapcc.org> or [www.acmt.org](http://www.acmt.org)).

**11.1.1 General Management of Exposure to Poison**

The treatment of a poisoned person consists of:

- First aid and unspecific treatment.
- Prevention of further poison absorption.
- Procedures to enhance elimination of absorbed poison.
- Use of antidotes (only in rare cases).

**11.1.1.1      First Aid and Unspecific Treatment**

If the victim is exposed by inhaling or has a skin exposure, the patient must be removed from the environment of exposure. Intoxication or contamination of the rescuers must be prevented by using respiratory protection and protective wear. Vital signs must be assessed (level of consciousness, breathing, and pulse). If the victim is not breathing and has no pulse, cardiopulmonary resuscitation must be started immediately. If the victim is unconscious or sedated, endotracheal intubation and respiratory assistance is indicated.

**( → Note )** A rapid sequence induction (“crush intubation”) is required to prevent aspiration in emergency patients.

Further sedation and relaxation should be used only if necessary for effective ventilation, or for organizational reasons, in the case of a larger number of casualties.

If intubation is not possible for any reason, and spontaneous breathing is insufficient, respiration must be assisted by mask. If intubation is not possible and spontaneous breathing is sufficient, the victim should be laid on his left side with his head slightly lower than his trunk. An unconscious patient must be monitored at all times, unless this requirement becomes impossible because of a large number of casualties.

If the victim has a skin exposure (e.g. from an acidic solution), all contaminated clothing must be removed. The skin must be thoroughly rinsed with tap water. To remove oily materials, soap may be used. Chemical burns are treated as for thermal burns of like severity.

**( Note → )** If the victim has an eye exposure, the eye(s) should be thoroughly rinsed with clean tap water. If corneal erosion is present, the casualty should be transferred to the care of an ophthalmologist if possible (or as soon as possible).

The injuring substance should be identified, if possible by any means. All containers, not ingested tablets, or anything else that might help in identifying the agent causing injury or illness, should be saved for identification purposes.

**11.1.1.2      Primary Detoxification (Prevention of Further Absorption)**

If the victim is exposed by ingestion (swallowing), absorption from the stomach and gut can be prevented by

- Administering activated charcoal to bind the poison.
- By emptying and rinsing the stomach using a tube.
- By inducing vomiting using syrup of ipecac.

**( → Note )** Decontamination using gastric lavage could be considered, although little is known concerning its advantage with respect to patient outcome. It is mostly useful within 1 hr of ingestion.

Activated charcoal will adsorb many different compounds onto its surface, preventing their absorption into the body. The dose required is 0.5 – 1.0 g/kg body weight, in a solution of 250 ml of water. Activated charcoal should be given as soon as possible after poison ingestion to prevent poison absorption. Sodium sulfate (NaSO<sub>4</sub>) 0.25 g/kg (10-30 g) should be administered after activated charcoal to speed up passage of material through the intestines, decreasing the amount of time the poison is in contact with the lining of the gut, thus further limiting its absorption. Sodium sulfate is sometimes used following acetaminophen but was never proven effective.

**( → Note )** The administration of activated charcoal has few side effects and is considered to be very effective in preventing absorption of poisons. It is the procedure of choice that should be used in all cases of suspected poisonings by ingestion in non-symptomatic patients at admission. Activated charcoal can be used multi-dose.

In severe intoxication by ingestion, stomach content can be evacuated by inserting a tube (diameter: 18 mm) through the mouth into the stomach. The correct positioning must be ascertained by auscultation of the epigastrium while insufflating air into the stomach using a large syringe. The stomach content should be evacuated at first by aspiration, and the aspirate saved for analysis if possible. The stomach should be rinsed by inserting and evacuating small amounts of fresh tap water (about 300 ml) until rinsing solution seems clean (total water volume: > 10 litres). The procedure should be followed by the administration of activated charcoal as described above.

Ipecac syrup is a liquid preparation that induces vomiting in most people within 15-30 min of ingestion. The adult dose is 30 ml (2 spoons) followed by 2 glasses of water. If vomiting does not occur after 30 min, half of the initial dose may additionally be given. If vomiting does not occur after the second dose, additional doses must not be administered as Ipecac syrup contains emetine that has toxic properties (tachycardia, muscle weakness).

**( → Note )** Ipecac should not be routinely administered, certainly not in any patient with reduced consciousness.

In cases of poisoning with highly toxic compounds, and if the evacuation of stomach content is not feasible for any reason, vomiting may be rapidly induced by apomorphine (0.1 mg/kg, maximum 10 mg im or sc). The

additional application of a vasoconstrictor is mandatory to avoid severe hypotension.

( → Note ) Stomach rinse procedures or the induction of vomiting should never be performed in the following cases:

- If the victim is unconscious, lethargic or sedated, because of the danger of aspiration. However, after endotracheal intubation, the stomach contents may be evacuated through a tube, and/or activated charcoal may be administered through the tube.
- After ingestion of petroleum distillates, low viscosity hydrocarbons, because vomiting may cause the material to be inhaled causing severe chemical pneumonia. The use of paraffin solutions is also not recommended anymore as it is considered to be ineffective.
- After swallowing of caustic solutions. Victims who have swallowed strong acids or alkalis should be given large amounts of water for dilution as soon as possible. It should not be attempted to neutralize acids by alkalis (or reverse). Analgesics and corticosteroids in high doses (e.g. Prednisone 1000 mg initially) may be administered empirically. However, in randomized prospective studies this treatment has not been shown to be more effective than non treated groups.

#### **11.1.1.3 Secondary Detoxification (Enhanced Elimination)**

Many compounds have been shown to be secreted into and re-absorbed from the gut, undergoing a hepato-enteric, gastro-enteric or entero-enteric cycle. Poison elimination can often be efficiently enhanced by repetitive administration of activated charcoal to disrupt these cycles (20 g every 4 h).

Forced diuresis to enhance renal elimination of drugs is an invasive procedure, as it requires a large diuresis to be effective (3-6 ml/kg h 10-20 l/d). Effectiveness may be enhanced by influencing urine pH. It requires laboratory examination capabilities (electrolytes, acid-base status), and monitoring should preferably include central venous pressure measurements to prevent volume overload and pulmonary oedema.

( → Note ) Forced diuresis is an option on board of ships equipped medically according these requirements. It should be considered for chlorophenoxy herbicides, cyclopeptide-containing mushrooms, diquat/paraquat, pentachlorophenol and thallium poisonings. Extracorporeal elimination techniques (haemoperfusion, haemodialysis and plasmapheresis) are normally not options available onboard ships.

#### **11.1.1.4 Antidotes**

It is a common misunderstanding that there are many antidotes available reversing or neutralizing the effect of a poison. In fact, they appear few in numbers.

In some cases, the use of an antidote is optional (e.g. intoxications with opiates, benzodiazepines etc.).

An overview of available antidotes including indications and dosage requirements is given in → Annex 11-1.

### **11.1.2 Fire Smoke**

#### **11.1.2.1 Constituents of Fire Smoke**

Fire smoke is made of a large number of gases, vapors and particles, depending on the burning material, oxygen content of the ambient air and temperature. Fire smokes composition change over time. The precise composition of fire smoke in the field cannot be predicted theoretically. For practical purposes three groups of compounds must be considered:

- Carbon monoxide:  
Carbon monoxide (CO) is a colorless, tasteless and odorless gas. Asphyxiation is caused by the inactivation of blood haemoglobin through a combination with CO (formation of Hb-CO).
- Hydrogen cyanide:  
Hydrogen cyanide (HCN) causes asphyxiation by inhibiting cellular respiration. The resultant cellular hypoxia may rapidly produce nervous system damage and death.
- Pulmonary toxicants:  
Fire smoke contains irritant gases and vapors as hydrogen chloride, aldehydes, nitrous oxides etc. They may induce local irritations of the airways and pulmonary oedema, even if initial symptoms are mild.

#### **11.1.2.2 Diagnosis of Intoxication**

Victims may have no or very mild symptoms (weakness, headache, vertigo, poor visual acuity). Seriously injured victims may be unconscious or need resuscitation. Victims with CO intoxication very rarely show a cherry red color skin or mucous membranes in practice.

Exposure to irritants may cause severe local irritations with choking and burning in the chest, violent coughing and vomiting. These symptoms may be initially mild or entirely absent. All persons exposed to fire smokes must be

registered, even if they initially show mild or no symptoms due to a latency period of several hours till development of pulmonary oedema. Additional injuries must be noted (burns, blast injuries etc.).

( → Note ) The diagnosis is made from the circumstances. Fire smoke analysis is very rarely done. If high concentrations of CO, HCN or pulmonary toxicants have been recorded, results may indicate severe poisoning. However, single or few measurements showing low concentrations of these gases never exclude a serious intoxication (the composition of fire smokes changes over time).

#### **11.1.2.3           Treatment and Management**

First remove the victim to fresh air.

( Note → ) All persons that have possibly inhaled fire smoke must be registered even if they do not show symptoms of intoxication (delayed development of toxic pulmonary oedema).

##### **11.1.2.3.1       Treatment of Patients Presenting No or Few Symptoms**

If fire smoke inhalation is suspected, victims should be kept at rest. Oxygen, if available, should be given by a facemask using high O<sub>2</sub>-flow (>10 l/min), and preferably using a reservoir to permit a high FiO<sub>2</sub>.

Victims may be treated by inhaled corticosteroids:

- Dexamethasone-21-Isonicotinate: Initially 5 metric doses (d.), followed by 2 d. every 5-10 min

Or alternatively

- Budesonide: Initially 10 d., followed by 5 d. every 10 min (1. hour), 5 d. every 30 min (2-4. h), 5 d. every 1 h until aerosol container is empty.

(→ Note ) The appropriate application technique is of the utmost importance. If available a spacer should be used. The use of steroids to prevent pulmonary complications is controversial, as there may be an increased incidence of infections associated with that.

After massive fire smoke inhalation, intravenous corticosteroids at high doses are indicated even in non-symptomatic patients (e.g. prednisone 1000 mg). Bronchodilator drugs ( $\beta_2$ -mimetics inhalations or injections) (inhaled theophylline) should be used in cases of bronchospasms. Antibiotics should not be given routinely without suspicion of an infection.

Fluid application should be handled restrictively, in the case there are no burns.

**(→ Note )** As pulmonary oedema may develop after inhalation of pulmonary toxicants with a latency of 24-(72) hours, all patients should be monitored in the ships hospital for at least for a period of 24 hours after suspected inhalation.

#### **11.1.2.3.2 Treatment of Severely Injured Patients**

Vital signs must be assessed. If the victim is not breathing and has no pulse, cardiopulmonary resuscitation must be started immediately.

If the victim is unconscious or lethargic, endotracheal intubation and respiratory assistance is indicated (100% oxygen). If intubation is not possible for any reason, and spontaneous breathing is insufficient, respiration must be assisted by mask (100% O<sub>2</sub>, high flow >10l/min, if possible with a reservoir).

**(→ Note )** If a hyperbaric chamber is available, hyperbaric oxygenation is indicated to hasten CO-elimination and to rapidly improve tissue oxygenation. Use the CO-table (P<sub>abs</sub>: 2.8 bar) or the Boerema-table (P<sub>abs</sub>: 3.0 bar), alternatively 3 times 30 minutes oxygen at 2.5 bar each time interrupted for 5 minutes compressed air breathing.

Inhaled or intravenous corticosteroids at high dose (Prednisone 1000 mg or equivalent) are indicated as prophylactic measure against pulmonary oedema.

Fluid application should be handled restrictively (Ringer-lactate/Hartmann's solution 500 ml/24hours). However, haemodynamic parameters must be kept stable. Note: A burned patient may require much more fluids.

**(→ Note )** It is extremely difficult to diagnose hydrogen cyanide intoxication after fire smoke inhalation on board. Measuring the HCN-concentration in the expired air of the patient using detection tubes is not a sensitive method.

**(→ Note )** The antidote DMAP (Dimethylparaminophenol) induces the generation of Methemoglobin (MetHb) and may severely worsen a CO-intoxication (Hb-CO and MetHb cannot bind O<sub>2</sub>).

**(→ Note )** DMAP should be administered only if the patient is in a critical (unconscious) condition at a dose of 1-2 mg/kg (not 3-4 mg/kg as in isolated HCN-intoxication). Decision must be taken at an early stage, as time is critical.

If available, hydroxocobalamine (precursor of vitamin B<sub>12</sub>) should be preferred to DMAP as an HCN-antidote. High doses are required

intravenously (4-8 g). The full dose should be administered as CO-intoxication is not worsened by this. This treatment is primarily used in Europe. In the US the standard for HCN intoxication would be Sodium nitrite followed by sodium thiosulfate.

If HCN-intoxication is suspected, the administration of sodiumthiosulfate ( $\text{Na}_2\text{S}_2\text{O}_3$ ) is indicated to enhance cyanide elimination (100 mg/kg). However,  $\text{Na}_2\text{S}_2\text{O}_3$  alone is insufficient to treat a severely poisoned patient.

(→ Note) Hydroxocobalamin must not be mixed with  $\text{Na}_2\text{S}_2\text{O}_3$  (inactivation by complex formation).

### **11.1.3            Hydrocarbon Fumes**

Fuels and diesel engines are widely used in military settings and onboard ships. Petrol, diesel and kerosene vapors may be encountered in fuel tanks or in spaces where fuels are stored. In spaces where engines are operated, fumes from the combustion of fuels may be expected. Acute intoxication, as well as health impairment by the continuous exposure to hydrocarbon fumes and/or diesel exhaust must be considered.

#### **11.1.3.1        Toxicological Profile**

Fuels consist largely of hydrocarbons. Diesel and paraffin (kerosene) fuels have a lower volatility. They are therefore less dangerous than petrol (gasoline).

Hydrocarbon fumes generally have narcotic effects. In the case of petrol fumes, concentrations above 1% may cause unconsciousness and death. Depending on the individual's metabolism pathways, additional toxic actions on parenchymatous organs must be considered, or may even prevail (e.g. liver toxicity of  $\text{CCl}_4$ ). The inhalation of hydrocarbon fumes at high concentrations may also induce pulmonary oedema.

Some additives contained in fuels have carcinogenic properties (e.g. benzene).

#### **11.1.3.2        Diagnosis**

Exposure may cause dizziness, headache, concentration disturbances, nausea, and vomiting and muscular co-ordination impairments. Acute emotional disturbances following hydrocarbon poisoning have been reported.

In severe poisoning, unconsciousness proceeding to death is encountered.

### 11.1.3.3        **Chemical Analysis and Monitoring**

In the case of an acute poisoning, air analysis in the contaminated compartment may confirm the diagnosis, but must not delay first aid and medical treatment.

For a rapid on-site assessment detection tubes may be used.

On-line monitoring can be done using devices based on spectrophotometry, electrochemical detection or gas chromatography – mass spectrometry.

**(→ Note )** The mean concentrations of organic substances over time can also be assessed by sampling on (charcoal) tubes using air flow pumps, followed by desorption and chemical analysis by laboratory means.

### 11.1.3.4        **Treatment and Management**

**(→ Note )** All personnel involved in rescue operations must wear personal protection before entering suspicious compartments. Victims must be removed to fresh air.

In case of severe poisoning oxygen should be administered. Respiratory assistance by facemask, or even endotracheal intubation, may be necessary.

If hydrocarbon fumes at higher concentrations have been inhaled, victims should be given corticosteroids (inhalative or intravenous, refer to → **Subchapter 11.1.2.3.1**), and discharged from medical care after 24 hours if they are still asymptomatic.

A final medical examination and a comprehensive laboratory examination should be conducted if feasible to exclude or document parenchymatous organ damage, even in clinically asymptomatic persons after exposure.

If the on-site evaluation reveals concentrations of hydrocarbons exceeding threshold limit values, personnel must use respiration protection with adequate filters during activities in the contaminated space. A reduction of air contamination by technical means should be targeted.

### 11.1.4        **Diesel Exhaust**

#### 11.1.4.1        **Toxicological Profile**

Diesel exhaust contains several hundreds of chemical compounds that can be divided in a vapor and a particulate phase.

The vapor phase contains carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), sulphur dioxide (SO<sub>2</sub>), nitrous oxides (NO x), ammoniac (NH<sub>3</sub>) and low

molecular organics ( $C < 18$ ) as aldehydes (formaldehyde, acroleine) and diesel fuel constituents (aliphatics, methanol, benzene).

The particulate phase (soot, aggregate of carbon particulate) consists of elemental carbon (30 – 90 % of the mass) and organic carbon (5 – 50 % of the mass, high molecular weight organics,  $C > 18$ ).

Diesel exhausts may contain a large number of metals: lead (Pb), mercury (Hg), arsenic (As), cadmium (Cd), chrome (Cr), cobalt (Co), manganese (Mn), nickel (Ni) and antimone (Sb).

**(→ Note )** In acute intoxication carbon monoxide and pulmonary toxicants are of major importance. Chronic exposure to diesel exhausts is known to cause cancer.

#### **11.1.4.2 Diagnosis**

For acute intoxication by diesel exhaust refer to → **Subchapter 11.1.2.2.**

Exposure to lower concentrations of diesel exhaust may cause irritation of the mucous membranes and/or unspecific complaints (concentration disturbances, headaches, fatigue) Symptoms may be mild or absent. An exposure to diesel exhaust can be suspected, but not diagnosed clinically.

#### **11.1.4.3 Chemical Analysis and Monitoring**

Vapor phase monitoring: Detection tubes are available for many inorganic and organic compounds. They permit an easy and rapid (half-quantitative) measurement of the concentration of suspected air contaminants.

Inorganics and organics can also be monitored on-line using devices based on spectro-photometry, electrochemical detection or gas chromatography – mass spectrometry. The mean concentrations of organics over time can also be assessed by sampling on (charcoal) tubes using air flow pumps, followed by desorption and chemical analysis at the laboratory. The analytical tools must be chosen depending on the compounds of interest and the detection limits in consideration of possible analytical interference.

Particulate phase monitoring: Monitoring is done by collecting particulates on a filter, using an open face system or a pre-filter (respirable combustible dust, gravimetric  $< 4.0 \mu\text{m}$ ; submicrometre particulate  $< 0.8 \mu\text{m}$ ). Chemical analysis is performed at the laboratory. Depending on the method used, the measured concentration may refer to elemental carbon, organic carbon or total carbon (= elemental + organic). Elemental carbon is the preferred method. Results correlate well with respirable combustible dust, submicrometre particulates and total carbon. The proposed threshold limit

value (TLV) for elemental carbon only is 20 µg/m<sup>3</sup> (ACGIH, 2001). If required, a semi-real time assessment of the particulate phase is possible with an aethalometre that measures carbon black (optical method).

#### **11.1.4.4 Treatment and Management**

For the treatment of acute intoxication by diesel exhaust refer to → **Subchapters 11.1.2.1 / 11.1.2.2.**

If the on-site evaluation reveals that the concentrations of constituents of the vapour or particulate phase exceed threshold limit values, personnel respiration protection with adequate filters must be used during work in the contaminated space. A reduction of air contamination by technical means should be targeted, for example, install local exhaust ventilation to collect and remove contaminants. If a system already exists then evaluate the existing system for discrepancies and repair as necessary.

#### **11.1.5 Chemical Warfare Agents**

(→ Note ) For more detailed information about chemical warfare agents refer to AMed P-6.

##### **11.1.5.1 Recognition of Chemical Operations**

A possible chemical casualty must be assumed if an individual becomes a casualty without being wounded, or if he is suffering a greater degree of incapacitation than is compatible with his conventional injuries.

(→ Note ) In particular, a chemical attack must be suspected in the case of any sudden increase in numbers of unexplained casualties.

Further indications on a possible chemical operation and on the agent used can be obtained by questioning casualties:

- Was there any evidence of spray, liquid droplets or smoke?
- Was any unusual smell noted?
- Did the detection equipment respond positively?
- Was there a delay between exposure and the onset of symptoms?  
(How long ?)

##### **11.1.5.2 Chemical Warfare Agent Detection and Identification**

The following simple devices can be used to detect and identify chemical warfare agents:

- Chemical agent detector papers (VGH ABC-M8 or M9E1 detector papers can be used to detect nerve agents and blister agents. They do not detect chemical agent vapors. The M9E1 does not distinguish between the types of agents. Several solvents and decontaminating solutions, or extremely high temperatures (M9E1), may cause false-positive reactions.
- The Chemical Agent Monitor (CAM) detects agent aerosols and vapors.
- Detector kits (M256 Chemical Agent Detector Kit) permit detection and identification of vapors of nerve, blister and blood agents.

It must be emphasized that even in chemical operation conventional casualties must be considered. Conventional casualties may be additionally intoxicated, or they may be contaminated without being intoxicated. Alternatively, symptoms may be caused by adverse effects of antidotes, or they may be the expression of a combat stress reaction.

#### **11.1.5.3 Treatment and Management**

Decontamination is mandatory as soon as possible. Decontamination consists of either agent removal and/or chemical neutralization. After skin exposure with nerve agents or blister agents it must be carried out within a few minutes to be effective. Skin can be decontaminated using the M291 Skin Decontaminating Kit (decontamination powder) or the M258A1 kit (pre-wetted wipes, DECON-1 and 2 packets). Decontamination powder or wipes must be kept out of the eyes, mouth and open wounds.

The eyes are decontaminated with copious amounts of water.

In a cyanide or phosgene only environment, decontamination is not required.

In the case of an unconscious casualty, the victim must be masked first, and then the exposed skin must be decontaminated.

(→ **Note**) Antidotes should be administered depending on the identified, or suspected agent, refer to → **Subchapter 11.1.5.4**. Non-specific first aid measures may be necessary (breathing assistance, circulation support etc.) in addition to antidote treatment.

#### **11.1.5.4 Classification of Chemical Agents**

#### **11.1.5.4.1 Nerve Agents**

Tabun (GA), Sarin (GB), Soman (GD), GF, and V-agent (VX) inhibit the cholinesterase enzymes, causing an accumulation of acetylcholine at cholinergic synapses.

(→ Note ) Nerve agents are fast acting agents (no relevant latency between exposure and onset of symptoms).

Typical symptoms are myosis, salivation, bronchoconstriction, bradycardia, hypotonia, abdominal pains, nausea, diarrhoea, muscle fasciculation, muscle weakness, seizures.

Antidotes available:

- Atropine, preferably iv, otherwise im, repetition doses of 2 – 5 mg till heart-rate > 90/min.
- Oximes (Pralidoxime-methansulphonate 500 mg im or Obidoxime 250 mg im).
- Benzodiazepines in case of seizures.

#### **11.1.5.4.2 Blister Agents (Vesicants)**

Mustards (HD, HN, slow acting agents), arsenical blister agents (e.g. lewisite, L), and phosgene oxime (CX).

Blister agents produce reddening and blistering of the skin. Mustards are alkalinizing agents and may cause myelodepression (leucopenia, anemia, thrombocytopenia). Mustard agents are carcinogenic. Inhalation of blister agents damages mucous membranes in the respiratory tract and may cause lung edema.

(→ Note ) There are no antidotes to prevent blistering of the skin. Systemic effects of mustards might possibly be reduced by early administration of sodiumthiosulphate in high doses ( $\text{Na}_2\text{S}_2\text{O}_3$ , 500 mg/kg iv). In cases of suspected inhalation, corticosteroids should be administered.

After exposure to arsenicals, decontamination should be followed by a topical application of 10% BAL (British Antilewisite) preparation. The elimination of absorbed arsenical can be enhanced by Dimercaptopropanesulphonate (DMPS intravenously or orally).

Blisters should be punctured, but the skin should not be removed.

#### **11.1.5.4.3 Pulmonary Toxicants (Choking Agents)**

Phosgene (CG), diphosgene (DP), and chloropicrin (PS).

These agents produce injury to the mucous membranes of the respiratory tract, and cause pulmonary oedema. Symptoms may be mild or even absent after exposure. Pulmonary oedema may develop with a latency of 24-36-(72) hours (slow-acting agents).

Victims should be kept at rest. Oxygen, if available, should be given by a face mask using high O<sub>2</sub>-flow (>10 l/min), and preferably using a reservoir to permit a high inspiratory FiO<sub>2</sub>.

Victims should be given inhalative corticosteroids. Administration should start early after exposure:

- Dexamethasone-21-Isonicotinate: Initially 5 metric doses (d.), followed by 2 d. every 5-10 min  
Or alternatively
- Budesonide: Initially 10 d., followed by 5 d. every 10 min (1. hour), 5 d. every 30 min (2-4. h), 5 d. every 1 h until aerosol container is empty.

(→ Note ) The correct application technique is important. If available a spacer should be used.

After massive inhalation, intravenous corticosteroids at high doses are indicated (e.g. prednisone 1000 mg). Bronchodilator drugs ( $\beta_2$ -mimetics inhalations or injections) (inhalative, theophylline) should be used in case of bronchospasms. Antibiotics should not be given routinely without suspicion of an infection. Fluid application should be handled restrictively.

(→ Note ) As pulmonary oedema may develop with a latency of 24-72 hours, all patients should be monitored for at least 24 hours after suspected inhalation.

#### **11.1.5.4.4 Cyanogens (Blood Agents)**

Hydrogen cyanide (AC) and cyanogen chloride (CK).

These agents block the oxygen utilization in cells. Their action is practically instantaneous (fast acting agents). Cyanogen chloride has also an irritating action on mucous membranes and may induce lung oedema.

Typical symptoms are dyspnoea, tachypnea, tachycardia and nausea, in severe poisonings unconsciousness and seizures proceeding to death.

Antidotes available:

- Dimethylparaminophenol (DMAP 3-4 mg/kg i.v.) inducing methemoglobinemia to bind and inactivate cyanide ions (30-40% MetHb).
- Sodiumthiosulphate ( $\text{Na}_2\text{S}_2\text{O}_3$ , 100 mg/kg iv) to enhance cyanide metabolism.
- Hydroxocobalamin (precursor of vitamin B12) in high doses (4-8 g iv) may be used as an alternative to DMAP to rapidly bind cyanide.

(→ Note ) Hydroxocobalamin must not be infused mixed with sodiumthiosulphate (chemical inactivation). After inhaling cyanogen chloride, patients should be treated with corticosteroids (by inhalation or intravenously) to prevent lung oedema.

## 11.2 Hazardous Workplaces

### 11.2.1 Toxicological Workplace Evaluation

#### 11.2.1.1 Toxicological Assessment of a Workplace

Onsite workplace evaluation may be performed:

- As a part of a periodic workplace inspection schedule.
- In response to a specific crew member's complaints or concern.
- To investigate an apparent cluster or pattern of related complaints in two or more crew members.

In preparation for an onsite workplace evaluation, the investigator should be familiar with all relevant data previously recorded:

- The medical surveillance recommendations for workers in similar workplaces.
- Previous results of physical, biological and chemical hazard assessments (concentrations of air contaminants previously reported).
- Previous ventilation system evaluation report/test data for both supply and exhaust air and any local exhaust system if they exist (data should

include air volume, airflow patterns, room pressure in relation to surrounding spaces and local exhaust hood air flow if a hood exists).

- Previous results of hazards assessments, recorded at similar workplaces on board of other ships/boats.
- General health assessment of the affected or complaining crew members by the physician in charge.

#### **11.2.1.2            Exposure Assessment Program**

A workplace evaluation should be based on an exposure assessment program and include the following steps.

##### **11.2.1.2.1        Basic Characterization (Walk-Through Survey)**

The operations, tasks and work practices that take place at the workplace must be described, along with the number of persons assigned to the operation/ task, and the specific work areas occupied. The frequency and duration of events taking place should be noted.

A list of hazardous materials used in the workplace that present risk must be established. The use of the hazardous materials must be described. Physical conditions that may be (temporarily) associated with the generation of toxic compounds must be noted (e.g. thermal decomposition of non-toxic materials to toxic compounds).

The existence and effectiveness of protective devices must be noted (e.g. ventilation of the workplace including any local exhaust systems, ambient pressure, ambient pressure gradients in the ship, personal protective equipment). It is necessary to ascertain that the protective equipment is actually in use or to get information why it is not used. If feasible, onsite evaluations should be made without command representatives, thereby permitting a freer exchange between personnel and investigators.

##### **11.2.1.2.2        Medical Assessment of Complaining Crew**

If a particular crew member complaint is being investigated, or if an apparent cluster of related complaints are being investigated, the medical records of the affected person should be assessed on their overall health status or specific diseases.

The specific circumstances surrounding the complaints should be thoroughly evaluated in a personal interview of the complaining or affected worker by the investigator.

#### **11.2.1.2.3 Qualitative Risk Assessment and Setting of Priorities**

The list of hazardous materials used in the workplace, or being possibly generated in the workplace, as well as the toxic properties of these compounds, permits to conclude on a potential health hazard (qualitative risk assessment).

Complaints and/or medical findings in affected crewmembers must be assessed considering the toxic properties of hazardous materials used. It must, however, be considered that serious hazards to health may arise from the presence of chemical agents that do not cause acute symptoms (e.g. low benzene concentrations).

#### **11.2.1.2.4 Quantitative Exposure Assessment**

The risk associated to the toxic action of a chemical agent depends on its concentration and the time period of exposure. Thus, a quantitative exposure assessment, and a concentration measurement of potential air contaminants, is mandatory for a comprehensive risk assessment.

Quantitative exposure assessment plans must include the following information:

- Conditions at the workplace (e.g. workload of engines in an engine room).
- A list of potential air contaminants (that must be sampled).
- On-line measurements or the time of individual sampling (mean concentration over time).
- The total time of sampling.
- The number of samples that are needed.

**(→ Note )** Analytical methodology used depends on the chemical agents of interest and the concentrations relevant from a toxicological point of view.

Simple and rapid measurements on board can be done using detection-tubes (e.g. Draeger-tubes).

For a more comprehensive screening, analytical equipment not routinely available on board is necessary (e.g. sampling on charcoal tubes, on-line measurements using electrochemical detectors, spectrophotometers, GC-MS, etc.). The chemical agents of interest and the concentration ranges of interest must be clearly defined to permit a rational decision on the appropriate analytical tools.

#### **11.2.1.2.5 Evaluation of Data and Decision-Making Support**

Evaluation of data and risks should be descriptive, as the decision whether a risk is acceptable or not is a normative/political decision.

The measured concentrations should be compared to TLV (threshold limit values) used in occupational medicine, or concentration limit values set up by navies for particular workplaces (e.g. submarines).

An assessment should be made whether the complaints of the crewmembers, or their clinical conditions, are sufficiently explained by the identified agents, the measured concentrations and the time of exposure (concentration-effect relationships in human). It is of great importance to differentiate between mean concentrations over time (time of sampling, how many hours?), current concentrations and peak concentrations.

**(→ Note )** Additional or synergistic effects of two or more agents must be taken into account

The time course of concentrations should be considered to conclude on the danger of cumulation or whether steady-state conditions are achieved.

In case of cancer inducing agents, “no effect levels “do exist. The attributable risk (excess risk, rate of disease in the exposed group attributable to the exposure) should be estimated using unit risk values from the literature and exposure data (measured concentrations, time of daily exposure, time of service on a ship).

#### **11.2.1.3 Immediate Actions Required**

In the case the measured concentrations of a chemical agent exceeds the permissible concentrations, or in any case a toxicological hazard from air contaminants cannot be excluded, the workplace should be entered using respiration protection equipment independent on the ambient atmosphere.

Respiration protection equipment with filters may be used only after air contaminants have been clearly identified, and filters must be chosen accordingly.

### **11.2.2 Potentially Hazardous Workplaces**

#### **11.2.2.1 General Remarks**

Shipboard life is one of the most hazardous working and living environments that exist. The existence of hazardous materials, substances and equipment, in addition to the fact that a ship is a constantly moving platform subject to conditions such as weather, collision, damage and grounding contribute to an accident prone environment.

(→ Note ) Prescribed safety regulations must be strictly followed to prevent injury and illness.

Most industrial-related work activities will be in the following areas: welding, painting, metal cleaning, hazardous materials, working in an enclosed space, machining, metal casting, electrical and electronics maintenance, battery recharging, and sewage treatment. Each has some common safety points, such as protective eye gear, protective clothing, protective headgear, heat stress programs, hearing conservation and respiratory protection.

For maritime occupational health and personnel safety programs refer to → **Chapter 9.**

Safety is a ship-wide responsibility. Although the CO has the ultimate responsibility, a Safety Committee (composed of departmental safety officers, usually senior enlisted, and the Safety Officer) and a Safety Council (composed of the department heads and Safety Officer) are appointed to identify safety hazards and correct them. The MO serves on the council for maximum impact on safety practices. His direct responsibilities are those of monitor and inspector. Some programs, such as heat stress and asbestos surveillance, are primarily medical in nature.

This sub-chapter is not intended to outline every specific hazard but instead present topics the MO need to know and be aware of.

#### **11.2.2.1            Dry Cargo Operations**

Dry cargo is any cargo that is carried in its own container and is not in bulk form, such as fuel, i.e. stores, equipment and machinery. Handling evolutions are extremely dangerous, even though they appear routine. Cargo being handled in any manner can fall or shift, causing injury to personnel. Additionally, hazardous material cargo that is damaged often causes illness or death in extreme conditions. Cargo handling gear (ropes, nets, slings, pallets, etc.) or even cranes can fail, causing physical damage.

#### **11.2.2.2            Underway Replenishment Operations (UNREP)**

Several operations involved with UNREP are unique and require special attention and safety precautions, such as helicopter operations and vertical replenishment operations (VERTREP). Fuelling-at sea (FAS) and replenishment-at-sea (RAS) involve the transfer of cargo, personnel, and fuel between two or more ships while underway. Thus, this involves not only the dangers normally found with cargo transfers but also adds the problem of heavy weather, motion, streaming operations, and the possibility of collisions. For avoiding these special threats, special precautions and practices exist, and special personal safety equipment must be provided and worn.

#### **11.2.2.3            Small Boats**

Several types of small boats are utilized by the navies. All can be used for emergency evacuation, emergency situations, such as search and rescue, personnel and patient transfer and small amounts of cargo.

The most dangerous operations involving small boats are the launching and retrieval of them. It is during these periods that weather and sea state have its worst effect, and mechanical failure of the launching/retrieval systems or human error can produce physical damage or man-over-board situations.

#### **11.2.2.4            Helicopter Operations**

Helicopters at sea are used for various military operations, including Search And Rescue (SAR) and patient transfer. Using helicopters on a moving ships platform creates special hazards. Helicopter accidents are likely to be catastrophic events. They can happen at any time and can involve injury to ship's personnel from numerous areas, such as, static electricity discharge during hoisting evolutions, inadvertent external cargo release or injury from debris blown about by rotor wash.

#### **11.2.2.5            General Surface Maintenance**

The decks, hull, bulkheads, and overheads are constantly being cleaned, primed, and painted. Hazards associated with these activities include noise (grinders and chippers), vibration, noxious fumes, and skin irritations (from paint and paint solvents). Eye hazards, from both paint and tools, are also present, as well as respiratory hazards.

#### **11.2.2.6            Electrical and Electronic Safety**

The Electrical Safety Officer (ESO) is in charge of making sure all electrical appliances, extension cords, and plugs are electrically safe. He will conduct the regular electrical safety training. The MO ensures personnel are trained in CPR, first aid, and general electrical shock hazards and supports the ESO by making sure that all electronic gear in the Medical Department, both medical and personal, is safety checked when brought on board and when required. This means periodically checking that the electrical safety tag is on and current.

Practically every piece of equipment onboard ship requires electrical power. Many are high-powered. Electrical equipment is so commonplace that hazards involved with electricity are often taken for granted. Compared to other environments, the potential for electrical shocks aboard ship is increased.

Although ship's electrical/electronic systems are ungrounded, personnel and equipment may easily become a path to ground in cases of faulty wiring, resulting in burn injury or death.

Radio frequency radiation (RFR) and microwave radiation hazards are also present with radar systems and high frequency gear. The MO makes sure that these hazardous areas are marked and clearly posted as special hazard areas.

#### **11.2.2.7              Shipboard Fuels**

Fuels are used to power the ship, emergency auxiliary equipment, aircraft, vehicles, small boats, and a multitude of smaller pieces of machinery. There are several types of fuels in use, each with its own characteristics and traits.

The biggest hazard with shipboard fuels is explosion and fire. Other hazards include asphyxiation, body burns, eye and respiratory difficulties, and environmental hazards.

A special hazard, however, is Otto Fuel II.

#### **11.2.2.8              Otto Fuel II**

This fuel can be absorbed through the skin or inhaled, and exposure can be fatal. When personnel are working with this chemical, they must use positive pressure air breathing equipment, neoprene aprons and gloves, and freshly laundered coveralls. The room should also be well ventilated.

Otto Fuel 11 is a distinct-smelling, reddish-orange, oily liquid used as a fuel for torpedoes and other weapons systems. It is a mixture of three synthetic substances:

- Propylene glycol dinitrate [PGDN] (the major component -75%).
- 2-nitrodiphenylamine [Sudan Yellow] (2%).
- Dibutyl sebacate (23%).

Propylene glycol dinitrate is explosive and evaporates very easily. Skin exposures must be prevented. 2-nitrodiphenylamine (used as a stabilizer) and Dibutyl sebacate (used as a desensitizer) do not evaporate easily and are not soluble in water.

The components of Otto Fuel may be breathed in either as a vapor or mist, enter the body by direct contact with the skin or are ingested as contamination in water or food. The components of Otto Fuel are broken down in the body within 24 hours and the breakdown products are either

excreted in the urine or used in the catabolism of other substances (fats and proteins).

Personnel exposed to Otto Fuel report a number of effects, which include headaches, loss of balance, poor eye-hand coordination, eye irritation, congested noses, nausea, dizziness and difficulty breathing, the most common symptom being headache. Mild headaches are not uncommon even with small exposures, but most people find that they become acclimatized to any minor symptoms after working with Otto Fuel for several weeks. Those who have become acclimatized may develop palpitations, chest pain, angina or even myocardial infarction when regular exposure to Otto Fuel ceases. All these symptoms can be attributed to the effects of propylene glycol dinitrate, which is a vasodilator and central nervous system depressant that is also irritant to the respiratory tract.

Personnel who will be working with Otto Fuel II must have a pre-placement and annual physical examination. The occupational history must record previous occupational exposure to nitrates. The review of medical history must search for the presence of cardiovascular disease, hypo- or hypertension, and frequent or severe headaches, particularly migraines. The clinical physical examination emphasizes the cardiovascular and neurological systems. Further details of this program can be found in the relevant national documents.

#### **11.2.2.9.           Welding, Cutting and Brazing**

The convenience of metal arc and gas welding and cutting lies largely in the fact that the equipment can be taken to the job. This convenience leads to the performance of construction or repair jobs in locations that have not been designed for such concentrated heat, or mixtures of toxic or explosive gases. The failure to take proper precautions presents a serious fire, explosion, electric shock, and health hazard. Health hazards common to welding, cutting, and brazing are numerous. In addition to electric shock, burns to the eyes and skin can cause by sparks, molten metal, and UV and IR radiation. Fumes and gases generated by welding can produce poisonous ozone and oxides of nitrogen. Lead, zinc, chrome, and cadmium in alloys produce toxic fumes. Paints and coatings may produce toxic gases and fumes when heated by the flames of the welding torch. Local exhaust ventilation is a must to remove excessive concentrations of air contaminants. Welding in closed, unventilated spaces can result in respiratory irritation or poisoning of personnel.

#### **11.2.2.10           Machinery**

Machinery is located everywhere in the ship, from the more obvious examples of propulsion equipment in the engine room, to the less than obvious example of galley equipment. All machinery has moving parts with the potential of personnel injury.

( Note → ) There is little difference between machinery areas and other industrial areas.

#### **11.2.2.11                  Ordnance**

Most naval vessels carry some type of ordnance for offensive or defensive operations: shells, warheads, torpedoes, nuclear weapons etc. The greatest danger from ordnance is explosion. Due to built in safety devices, ordnance requires outside intervention to set it off unintentionally. Improper handling, fire, excessive heat, or simple misjudgment or mistakes can cause a weapon discharge.

#### **11.2.2.12                  Heavy Weather**

Heavy weather is any weather condition that results in high winds, extreme sea states, and heavy rain, snow and/or hail. Weather of this type results in extremely uncomfortable conditions onboard ship. Excessive rolls, yaws, pitches, coupled with taking on water make work and living dangerous. There are a multitude of hazards that occur in heavy weather. Objects can slide or fall on personnel, causing injury. Personnel can fall into machinery or equipment. Personnel working exposed to the weather can be washed overboard or against fixed objects. Heavy weather can be extraordinary dangerous.

#### **11.2.2.13                  Painting and Preservation**

Most paints, varnishes, lacquers, cleaners, solvents, and other finishing materials contain flammable solvents and, therefore, present a fire hazard. In addition, these same products frequently give off toxic vapors which are harmful. Chipping causes scale to be dislodged, presenting possibility of eye or facial injury. It is necessary to take proper precautions when handling and using these products, such as safety goggles, full face-shield, long sleeve shirts, etc.

#### **11.2.2.14                  Diving Operations near Ships**

Diving operations near ships can be accomplished for underwater inspection of the hull, screws, rudder or sonar domes, minor underwater ships repairs not requiring dry-docking or underwater hull cleaning operations. Routine ships evolutions, such starting or stopping of sea-water pumps, operating sonar, turning screws, and moving the ship's rudder can be extremely dangerous to a diver in the water.

## 12. Food and Water

### 12.1. Food Requirement and Hygiene

#### 12.1.1 Food Requirements

#### 12.1.2 Hygiene

### 12.2 Delivery and Storage

#### 12.2.1 Delivery

#### 12.2.2 Storage

### 12.3 Preparation

### 12.4 Potable Water

#### 12.4.1 Water Provision at Sea

#### 12.4.2 Water Provision Alongside

#### 12.4.3 Water Quality

#### 12.4.4 Control of Legionella

( Note → )The importance of good nutrition, food safety and potable water management must not be underestimated. The supply and production of nutritious safe food and water is essential in helping to sustain Armed Forces.

### 12.1 Food Requirement and Hygiene

#### 12.1.1 Food Requirement

Eating a variety of foods that give a good balance of nutrients is vital for the repair and maintenance of the body throughout life. The food we eat gives us the energy and nourishment to live and enjoy life. Current medical and scientific evidence suggests that dietary factors are mainly responsible for, and play a significant part in, the development and prevention of many illnesses and diseases and the adoption of a healthy diet is in the best interests of member countries.

A variety of foods from which personnel can select to meet their dietary needs within recommended nutritional guidelines should therefore be available.

A widely recognised healthy eating principle is known as 5:4:3:2. This states that daily nutrition should comprise at least 5 portions of fruit/vegetables per day; at least 4 portions from the bread and cereals group per day; 3 servings from the milk and dairy foods group per day and 2 servings from the meat and fish group

per day. Fatty and sugary foods should only be eaten in moderation, and not instead of a balanced and nutritious diet, in order to minimize obesity.

### **12.1.2            Hygiene**

Food handlers are a potential source of bacterial and physical contamination of food, and so personal hygiene is a key element in ensuring that food is prepared safely. Staff training is to include all the basic elements of personal hygiene and personnel are to understand the relevance of the precautions. Food safety training must ensure that new and existing staff are aware of safe food handling practices.

#### Food Handlers with Infections:

Every person working as a food handler, including those employed in other galley/food hall related duties are to maintain a high degree of personal cleanliness. Any person suffering from a disease that is likely to be transmitted through food must inform the person in charge of the galley. Medical Officers should consider the occupational aspects of a patient's job when deciding on an illness management plan. Infected persons are not to be permitted to work in any food handling area, in any capacity, where they might contaminate food.

#### Hand Washing:

The hands of food handlers are the principal agents in the transference of bacteria to food. Hand washing facilities are to be provided in galleys and heads/toilets are to include hot and cold running water, soap, and a suitable means of drying the hands. Regular checks by senior staff are to be made to ensure these facilities are available and are being used effectively. As a minimum, hand washing is to take place:

- On entering a food preparation area.
- Between handling raw and cooked food.
- After handling waste food or refuse.
- After smoking or eating.
- After visiting the WC.

#### Cuts:

Open cuts harbour bacteria and must be covered with clean waterproof dressings. Stocks of these are to be available in food preparation areas and readily accessible to food handlers.

#### Jewellery:

The wearing of wristwatches, ear rings ('Studs' are acceptable) and other exposed body piercing, bracelets and rings, is not acceptable as they harbour

bacteria and there is a risk of physical contamination of food. The wearing of a plain wedding ring is acceptable.

Smoking:

Smoking should not be permitted in food areas as it transfers bacteria from the mouth to hands. Cigarette ends and ash also pose physical contamination risks.

Protective Clothing and Changing:

Food handlers must wear suitable clean protective clothing (including appropriate footwear and hats) to prevent contamination of food from normal clothing. Such clothing is to be changed at the end of a shift, or sooner if the situation requires, in order to maintain hygienic standards. It is not to be worn outside food areas and associated premises. Adequate changing facilities must be provided, with locker space for clean and soiled protective clothing. Changing facilities must be kept clean and tidy at all times.

Visitors:

All visitors to a food preparation area are to be viewed as potential sources of contamination. They must therefore be provided with protective clothing and briefed upon good food hygiene practices before entering the food area. Before entering a food preparation area, visitors must confirm that they are not suffering from diarrhoea and/or vomiting, or heavy cold. If they are, they are not to be allowed to proceed.

Eating/Drinking:

Food handlers are not to eat or drink in food rooms. It is acceptable for cooks to taste dishes during preparation in a manner that does not contaminate the food i.e. a clean spoon each time.

## **12.2 Delivery and Storage**

### **12.2.1 Delivery**

No raw materials or ingredients shall be accepted upon delivery if they are known to be contaminated with parasites, pathogenic micro-organisms, and toxic, decomposed or foreign substances.

Routine but thorough checks must be made by catering staff on deliveries of food for signs of damage, contamination and the presence of pests. The general condition of the food is to be checked, together with more specific checks such as date marks ("best before" and "use by") and temperature.

Frozen food that appears to be (or to have been) defrosted must be rejected regardless of delivery temperature.

The delivery temperatures are to be recorded. Unfit food or food past its "Use By" date must not be accepted and should be immediately returned.

### **12.2.2 Storage**

Food must be stored in appropriate conditions, designed to prevent harmful deterioration and to protect food from contamination. Adequate stock rotation must also be applied to ensure food does not exceed its shelf life.

#### Dry Provisions Store:

These storerooms are to be kept clean and orderly to prevent potential hazards from contamination and to prevent harbourage of pests. Stores should be proofed against pest ingress and part used packs of food re-sealed to prevent contamination. Dry goods should be raised off the ground and stored on suitable racking. High ambient temperatures and high humidity are to be avoided.

#### Chilled Storage:

Cool rooms and refrigerators are to be kept clean and tidy. Broken packaging must be avoided. Refrigerator temperatures must be checked and recorded at least 3 times daily with the first reading being taken upon commencement of work.

#### Frozen Storage:

Freezers are to be kept clean and tidy at all times. Freezer temperatures are to check and recorded at least 3 times daily with the first reading being taken upon commencement of work.

#### Fresh Fruit and Vegetables:

These are likely to be contaminated by soil bacteria and are to be stored away from other foods in a cool area, with adequate ventilation.

Food that is spoiled or past its "Use By" date must be removed from food storage areas and disposed of in accordance with paragraph 11.2. All food is to be kept in covered, dated and labelled containers during storage and before service.

### **12.3 Preparation**

#### Defrosting:

It is essential that frozen meat and poultry be thoroughly thawed in a designated and specific defrosting cabinet, before cooking. Frozen vegetables must be cooked directly from frozen.

#### Cross-Contamination:

Cross-contamination is the process whereby pathogenic bacteria present in raw food, such as meat, poultry, and vegetables, come into contact with ready to eat food, either directly or indirectly, through contact with surfaces, equipment, splashes, drips, utensils, hands and cloths.

Cross contamination must be avoided. Good management planning of food flow through the galley may prevent cross-contamination. The flow of waste is also to be considered, along with raw products and prepared food. Additionally it is to be ensured that:

- Where possible there are separate designated preparation areas for raw and cooked foods. If limited space means preparation surfaces are used for both high and low risk foods then these activities must be separated by time (ideally low risk foods prepared first). Surfaces must be thoroughly cleaned and disinfected between the two operations.
- If raw and cooked food is to be stored in the same refrigerator, raw food must be stored and adequately covered below cooked or salad foodstuffs.

Cooking:

It is essential that food be cooked thoroughly to destroy any bacteria on or within it. All food is to be cooked to a core temperature adequate to ensure the destruction of any pathogens both on the surface and within the product. This should be confirmed with a calibrated digital probe (disinfected with bactericidal wipes). It is important that food such as rolled joints, burgers and chicken is cooked adequately at its thickest part.

Chilling Food:

When chilling cooked food for later cold or hot consumption, it is essential that the food be cooled as quickly as possible to a temperature that does not result in a risk to health. Hot food must therefore be covered and reduced through the “danger zone” (the temperature zone between 60°C and 8°C which is favourable for bacterial growth) as soon as possible, and subsequently refrigerated. Kitchen prepared chilled foods should be consumed within 24 hours.

Reheating Foods:

It is advisable to avoid reheating cooked food but if this is not possible it must only be reheated once and the following steps are to be taken:

- Ensure that the food is thoroughly cooked and use a digital probe thermometer to confirm that this is the case (the probe should be disinfected with a bactericidal wipe between each use).
- The food should be served and eaten as soon as possible.
- After reheating, any leftover cooked food should be thrown away.

## 12.4 Potable Water

A wide range of contaminants can be present in drinking water. Contamination is of two major types:

Microbiological contaminants:

These include protozoa, bacteria and viruses. Many micro-organisms are naturally present in water but some, derived from faecal material, are pathogens and can cause severe illness in persons drinking contaminated water. The protozoa include Giardia and Cryptosporidium. These are gut parasites, which, if ingested, cause severe illness.

#### Chemical contaminants:

A wide range of chemicals can be present in water although water made at sea by correctly operating de-salination plants should be free from contamination. Shore supplies may, very rarely, contain chemical contamination. Chemicals can be either natural constituents at unusually high levels, or chemicals reaching the water supply from industrial or agricultural sources. Unusually, contamination may result from accidental or deliberate poisoning of a water source.

#### **12.4.1 Water Provision at Sea**

Medical personnel are to make regular enquiries as to the quality of the water being produced with the engineering department to ensure that it is potable. Medical personnel are to offer advice on health precautions and undertake the medical examination and clearance of personnel proceeding into fresh water tanks. It is to be ensured that engineering personnel suffering with an infectious disease or condition are excluded from fresh water duties.

#### **12.4.2 Water Provision Alongside**

Medical personnel should liaise with local health authorities prior to arrival to assess the source and quality of the local water supply. Many countries do not routinely test for the presence of gut parasites, so evidence of successful quality analysis should not be solely relied upon. As a general rule, in developing countries if the water is supplied from surface sources e.g. rivers, lakes or reservoirs, then the presence of gut parasites is likely. If the water is supplied from de-salination plant or from deep boreholes then gut parasite contamination is unlikely. If the presence of gut parasites is suspected they can be removed by filtration, as routine disinfection will not remove the risk of gut parasites.

#### **12.4.3 Water Quality**

Routine disinfection of drinking water (e.g. chlorination or bromination) will ensure that bacterial quality is maintained. Daily checks should be undertaken to ensure free levels of disinfectant are present in all parts of the fresh water system. The furthest distribution points are to be regularly flushed to ensure the disinfectant is present throughout the system.

Afloat standards are different from established public health standards overseas.

#### **12.4.4 Control of Legionella**

Proper disinfection, effective filtering and correct storage of water will prevent contamination with *Legionella pneumophila*. In order to cause disease, contaminated water must form an aerosol that can be inhaled, for example, air-conditioning systems and showers. Routine (6 monthly) cleansing and disinfection of showerheads should further minimise the potential risk from Legionella. It is important to keep cold-water cold (<20°C after 2 minutes at the tap) and hot-water hot (>50°C after 1 minute at the tap), and to avoid dead ends in pipes.

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## **13. Sanitation and Waste Management**

### **13.1 General Remarks**

### **13.2 Garbage and Refuse**

#### **13.2.1 Medical Hazardous Waste Issues**

### **13.3 Sewage**

#### **13.3.1 Medical Issues**

### **13.4 Biomedical Waste**

### **13.5 Hazardous Waste**

#### **13.5.1 Medical Issues**

### **13.1 General Remarks**

Waste management has evolved primarily to protect human health and to prevent pollution to the environment. Everyone who produces, carries, keeps, treats or disposes of wastes has a responsibility and a general duty of care to protect themselves and others from the risks of managing wastes, and be conscious of the possible adverse effects to land, sea and air environments.

If wastes are not disposed of correctly, the potential risk for disease is greatly increased. Furthermore, waste not properly managed provides ideal breeding sites for flies, rats, and other vermin.

There are a number of definitions relating to certain types of waste, but this chapter focuses on Refuse, Sewage, Biomedical waste and Hazardous waste. Under International Health Regulations each port is required to provide an effective system for the safe removal and disposal of human excrement, refuse, waste water, condemned foods and other articles dangerous to health. Each country will have its own legislation relating to wastes and if ships intend to dispose of items ashore then enquiries will need to be made via Port Authorities.

While at sea wastes should be managed in accordance with local procedures and disposed of in a manner that reflects current UN Convention for the Prevention of Pollution from Ships (MARPOL) and the International Maritime Organisation guidance. It is widely considered good practice to not dispose of any waste at sea but to bring it back to port so that it can be managed as a particular waste stream.

When wastes are held onboard, ships should ensure that it is stored in a safe and hygienic manner. This will entail separate storage areas for different types of waste (to avoid the risk of fire or toxic gas arising from incompatible materials), suitable

containers that are protected against damage, corrosion or wear (which would cause a loss of the contents) and regular checks of the areas for spillage, gases, pests and so-forth.

All waste containers, i.e. garbage and refuse must be properly covered to prevent entry of flies, rats, and other vermin.

### **13.2 Garbage and Refuse**

Garbage is defined generally as domestic, operational, virtual waste, plastics, wrappings and items generated by the normal operation of a vessel. Ships should ideally have a waste/Garbage Management Plan (GMP) that includes aspects such as limiting packaging brought onboard, segregating waste types, and recycling. The GMP must list the person in charge of the plan and key personnel involved in the garbage management process. Additionally, GMP must include a description / types of waste processing machinery to be utilized, types of waste generated and training requirements of personnel.

Ships over 400 gross tons or which are certified to carry 15 persons or more should maintain a current Garbage Management Log Book to record and track waste amounts generated and disposal routes / methodology. The disposal of this type of waste is usually to landfill or by incineration, but some wastes can be disposed of at sea, where necessary, under strict guidelines drawn from MARPOL as follows:

Plastics/synthetic waste. Not to be discharged at sea under any circumstances. This includes garbage sacks. Plastics are detrimental to marine life and fragile marine environments where sea-birds and marine mammals live, i.e. may become entangled, suffocate and/or drown.

Special areas. Designated areas of environmental importance or fragile environmental areas will be damaged by non-food wastes and ungrounded or comminuted food wastes. As such these items are not to be disposed in 'special areas'. These areas include the North Sea, Baltic Sea, Black Sea, Red Sea, the Mediterranean, the Gulfs, the wider Caribbean and Antarctica. If food wastes have to be disposed of around 'special areas' then they should be ground to less than 25mm pieces and disposed of more than 12 nautical miles from the area.

Ground/Macerated Food wastes. Where food waste has been ground so that it will pass through a 25mm mesh then it can be disposed at sea providing the ship is outside 3 nautical miles of the coast, unless in a 'special area'.

Unground Food Wastes/Domestic Wastes. These should only be disposed at sea when absolutely necessary and then at least 12 nautical miles from the coast, unless it is a 'special area'.

Cooking Oils. The prevention of oil pollution is tightly controlled under international agreements and as such cooking oils should be disposed of via

shore-side facilities. Waste oils should be kept in the original containers and disposed via the Port Agent. Many oils can be recycled or used to power incineration plants and therefore should not be mixed with, or contaminated by, other waste types.

No garbage is to be discharged within 500m of an offshore platform or support ship. Particular care should also be taken when at anchor for long periods or when passing over shallow depth areas.

### **13.2.1 Medical Hazardous Waste Issues**

Medical personnel should ensure that staffs handling wastes are aware of the risks to their health, including hazards from manual handling, sharps injuries and hygiene. Particular emphasis should be placed on ensuring safety with garbage macerators, compactors or incinerators. All medical personnel handling medical hazardous waste shall be trained and familiar with medical waste disposal equipment, personal safety, i.e. sharps injury prevention, and personal protective equipment use.

## **13.3 Sewage**

Sewage (black water) and non-oily waste water (grey water) can have a major impact on the aquatic environment; as such their discharge is only permitted under particular circumstances. Ships need to make themselves aware of individual country's regulations for discharges in territorial waters. As a general rule grey waters should not be disposed of within 3 nautical miles and black water discharge is only permitted when:

- Within 4 nautical miles of the coast if the ship is operating an International Maritime Organisation (IMO) -approved sewage treatment plant (STP).
- Between 4 and 12 nautical miles from the coast if the ship is operating an IMO-approved comminution and disinfection system.
- Over 12 nautical miles from the coast.

### **13.3.1 Medical Issues**

It is recommended that anyone working with medical hazardous waste be properly protected with personal protective equipment, i.e. impermeable gloves or over-garments, eye or respiratory protection if indicated depending upon the type and level of waste disposal operation.

( Note → ) Personnel protection equipment is critical to safety and waste handling practices.

Personnel working with STP are likely to be exposed to various microbiological agents including virus, bacterium and protozoa. General protection measures such as protective clothing, gloves and goggles can provide adequate control measures if worn correctly. There is no requirement for additional immunisations for these personnel providing that they are in-date for Hepatitis A, Poliomyelitis, Typhoid and Tetanus. Hepatitis B immunisation is not usually warranted because of the infrequent nature of this type of work and the low-risk of transmission.

Medical staff should be aware of the symptoms of general faecal borne diseases and take steps to check that STP personnel do not work in food, water or medical environments without changing their protective clothing. Additionally, medical staff should ensure that STP personnel are conversant with basic personal hygiene requirements in order to protect themselves and others from disease/illness transmission.

Due to the nature of STPs a variety of noxious gases may be given off as a product of bio-degradation or as a result of inefficient plant operation. Where works are to be carried out on the plant, atmosphere checks should be carried out within the compartment prior to works commencing and during the work period. Such checks should be capable of detecting oxygen levels and noxious gases, such as hydrogen sulphide, as with 'confined space' checks, and there should be practiced personnel evacuation/rescue procedures in place. Similar checks should also be carried out when there are complaints of sewage or rotten-egg smells around the ship, and appropriate remedial measures taken.

### 13.4 Biomedical Waste

Biomedical waste/clinical waste incorporates a wide range of elements from human tissues to pharmaceutical products. These items are not to be disposed of at sea but should be landed ashore for disposal, usually by incineration via a licensed waste contractor. Ships can undertake incineration of products only if their incinerator has been certificated for such activities under MARPOL. Until landed ashore, biomedical wastes should be managed in a manner to protect individuals from the contents and to protect against accidental disposal at sea. As a guide the wastes should be packaged for disposal in a manner that is described below:

Clinical waste sacks. Usually yellow plastic sacks printed with an appropriate bio-hazard warning. These are used for human tissues/body fluids/wastes, soiled surgical dressings/swabs/etc or non-sharps waste where they may be a risk of infectious disease contraction. When  $\frac{3}{4}$  full, these should be 'double-bagged', sealed with a plastic tie or similar, and clearly labelled with the ship's name and date of sealing.

Plastic sharps disposal boxes. These are usually yellow and also printed with an appropriate bio-hazard warning. They are used to contain sharps originating from medical use, such as needles, glass vials, scalpel blades or canulae.

When  $\frac{3}{4}$  full the boxes should be changed with the full box labelled with the ship's name and date, and sealed in a manner to prevent access to the contents.

Cardboard boxes. These are often used to contain non-contaminated glass items or used empty aerosols and will be clearly labelled as such. These will usually be disposed of via recycling facilities or to landfill as with refuse disposal.

Maceration to sewage. If facilities are present onboard, items such as disposable bedpans/urinals containing urine, faeces or other bodily secretions will be disposed of via this route. Alternatively dispose of contents via the sewerage system and place disposable item as at point (a) above. If the articles are non-disposable, dispose of contents and then clean and disinfect ready for re-use.

Sanitary products. These are usually held within a specific sanitary bin and must only be disposed via port agents.

Special procedures. Items such as life expired or unwanted pharmaceutical products and full or part used aerosols, are generally returned to the ships home port for disposal. These items generally require specific accounting procedures and therefore should be kept onboard until completion of voyage.

### **13.5 Hazardous Waste**

These wastes include substances/chemicals that are known to be toxic to man or the environment and are also known as 'special wastes' because they are often bound by specific provisions. Special waste includes waste that is potentially hazardous due to it being flammable, toxic, corrosive, an irritant or possessing carcinogenic properties. Special wastes are considered so dangerous or difficult to keep, treat or dispose of that specific provisions are to be made for their storage, transfer and disposal.

The following types of waste fall generically within the category 'special' waste, however the list is not exhaustive and all waste should be fully assessed before disposal:

- Sludge tank contents (sullage is no longer a recognised NATO term).
- Machinery space bilge contents.
- Waste oils.

- Paints, varnishes and chemicals.
- Batteries and acids.

Each country has its own environmental legislation and public expectations; however, NATO aims to comply with the highest expectations providing it does not conflict with operational necessity. As such there should be records of hazardous substances from receipt onboard the ship to its ultimate disposal ashore.

It is the responsibility of ships to implement measures to guard against spillage or leaks, accidental damage, loss at sea or deliberate damage to containers, until disposal ashore. Each ship should have procedures and resources for dealing with any leaks or spillage and should treat any used resources such as absorbent mats, granules or protective clothing as hazardous waste.

When disposed of ashore, the wastes must be contained in such a manner to contain the hazards. Ideally this would be the substance's original container but any container should be clearly labelled to indicate the contents of the container, any hazards present, and any relevant hazard warning labels, the ship's name and point of contact. The ship should liaise with the port agent regarding disposal requirements and any relevant disposal paperwork such as a *Landed Ships Waste Note*.

#### **13.5.1                  Medical Issues**

Medical personnel should be prepared to treat individuals affected by the use or accidental contact with hazardous substances. Generally these materials are supplied with a Safety Data Sheet, which provides details on health risks and first aid measures. Additionally, hazardous material labels will provide useful information.

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**14.1 Introduction**

Local anaesthesia combined with sedation is the technique of choice in the naval setting. MOs who already have anaesthetic experience will have a wider choice of technique but wherever possible will also select local anaesthesia.

Various techniques of anaesthesia are described. Reliable skills and the experience of the physician are required in using these techniques. Attention should be given to possible side effects and emergency situations resulting from anaesthesia. It must be kept in mind that some of the techniques described (especially the use of muscle relaxants) require a thorough training in order for their safe use. The potentially disastrous situation of inducing anaesthesia with muscular relaxation, and then not being able to maintain the patient's airway properly must be underlined.

For guidelines on the subject of general anaesthesia refer to → **Subchapter 14.4.**

It is emphasised that whether local anaesthesia or general anaesthesia is undertaken, written consent of the patient for the surgical procedure and anaesthesia should be obtained wherever possible.

Facilities for resuscitation and airway management have to be available whichever technique is carried out. The basic equipment should always be ready to use. Prior to any anaesthetic measure, including local anaesthesia, at least one secure intravenous line **MUST** be established.

By using local anaesthetic techniques, better results will be obtained when they are combined with sedation.

**14.2 Sedation in the Preoperative Phase**

The objectives are to reduce patient anxiety, to minimise the effects of partial failure of the local anaesthesia and to counteract possible toxic effects of the local analgesic drug.

Benzodiazepines of short duration (e.g. midazolam) should be preferred for surgical measures, others like Diazepam or flunitrazepam are also commonly used. There is a wide variation of response to benzodiazepines, even among patients of similar weight and age. The effects of long acting substances (e.g. Diazepam) could last for more than 24 hours. The physician should be aware of the dose related effects, side effects and respiratory effects of benzodiazepines.

The effects of sedative drugs can keep on for some hours and the patient should be kept under observation until fully recovered. Alcohol has an addictive action with sedative drugs that should be reduced or omitted in the patient who has been drinking.

Some opioid analgesics such as Morphine have a sedative effect and may be given by intramuscular injection (0.2 mg/kg body weight) or if the patient is shocked, by slow intravenous injection up to the same dosage. All opioid analgesics can cause respiratory depression. If this occurs it could be reversed by the intravenous administration of a narcotic antagonist like Naloxone (Narcan) in a dose of 0.0015 to 0.003 mg/kg body weight.

Diazepam, midazolam or flunitrazepam are powerful benzodiazepines with useful sedative, amnesic and anticonvulsant properties but provide no analgesia. They may be administered by mouth about half an hour or hour before surgical measures or by slow intravenous injection immediately before a surgical procedure. The oral dose for diazepam and midazolam is 5-10 mg, the intravenous dose is 0.1 mg/kg body weight. The intravenous injection of diazepam should be given undiluted into a large vein because it has a local thrombogenic effect and is painful. Effect controlled increments of about 2.5 mg could be given slowly with a pause of 1 minute between each dose until the patient has moderate ptosis. With the proper dosage the patient will remain cooperative but will lapse into sleep if left alone and will usually have no memory of the procedures afterwards. The oral dose 1-2 mg oral for flunitrazepam is given 1 hour before. The intravenous dose is 1 - 2 mg.

Other preoperative sedation with morphine, papaveratum, triflupromazine or barbiturates is not used on a routine basis anymore and should be avoided.

### **14.3 Local Anaesthetics**

Local anaesthetics are drugs that block the generation and propagation of impulses in excitable tissues, most notably the spinal cord, spinal nerve roots, and peripheral nerves, as well as skeletal muscle, cardiac muscle, and the brain. This section will

briefly cover the pharmacology of commonly available local anaesthetics, review the maximum recommended doses, and discuss the potentially catastrophic allergic and toxic responses.

#### **14.3.1 Distribution and Elimination**

Although there are many local anaesthetics available, the clinician should remember that lidocaine (lignocaine) is frequently the safest overall choice and the standard by which all other local anaesthetics are compared. When in doubt, use lidocaine.

- Aminoamides are cleared from the plasma by hepatic metabolism. Active metabolites of lidocaine can contribute to toxicity even when plasma levels of lidocaine are in a therapeutic range.
- Aminoesters are rapidly cleared from the plasma by plasma and liver cholinesterases. Plasma levels of these local anaesthetics may be elevated in patients with deficient or atypical cholinesterase enzyme.

#### **14.3.2 Chemistry, Use and Duration**

For chemistry, use and duration of local anaesthetics refer to → Annex 14-1.

#### **14.3.3 Toxicity and Side Effects**

A common problem faced by the clinician is the report by patients that they are allergic to local anaesthetics. Unfortunately, most of these patients are then subjected to a lifetime of inconvenience because this diagnosis is often incorrectly established. It is estimated that less than 1 percent of all adverse reactions to local anaesthetics are actually caused by a true allergic reaction. The remaining balance of reactions occurs because of the rapid rise in circulating local anaesthetics or the absorption of Epinephrine / Adrenalin.

Aminoesters are more allergenic than aminoamides because of their relationship to p-aminobenzoic acid (PABA), a metabolic by-product. Parabens are present in multidose local anaesthetic solutions, other drugs, cosmetics, and foods. Prior exposure to parabens may sensitise patients to subsequent administration of local anaesthetic solutions containing these materials, resulting in an allergic reaction unrelated to the local anaesthetic. Using preservative free local aminoamides will eliminate the risk of paraben sensitivity.

Prevention is the best solution for avoiding systemic toxicity with local anaesthetics, not more than the maximum allowable dose should be

administered. Meticulous attention to technique and to recognition of intravascular injections with appropriate monitoring is indicated.

**Signs and symptoms of local anaesthetic toxicity include:**

- Tinnitus.
- Perioral numbness.
- Metallic taste in mouth.
- Slurring of speech.
- Vertigo.
- Visual disturbances.
- Nystagmus.
- Muscle twitching.
- Mental status changes.
- Vasodilation.
- Decreasing blood pressure.
- Bradycardia.
- Arrhythmias.

**Delayed:**

- Convulsions.
- Coma.
- Depression or paralysis of breathing.

Oxygen should be administered at the first sign of toxicity. Depending on the circulatory situation the administration of IV-colloid solutions, vasopressors or catecholamines is necessary. The reduction of blood pH might be indicated to reduce with the resulting alkalosis the diffusion of local anaesthetics into the brain. This could also be accomplished by moderate hyperventilation of the patient.

Should symptoms progress, the patient's airways must be maintained and advanced cardiac life support (ACLS) guidelines followed. There is a risk of seizures. Seizures are preferably treated using Benzodiazepines, which reflect a less tendency for depression of breathing.

( Note → ) Premedication with Benzodiazepines could be used to decrease the likelihood for seizures.

**14.3.4            Epinephrine / Adrenaline Effects**

The addition of Epinephrine / Adrenalin to local anaesthetics has some beneficial effects:

Prolongs duration of	Increases the intensity of
----------------------	----------------------------

anaesthesia	blockade
Reduces systemic absorption	Reduces surgical bleeding

**Manifestations of Systemic Epinephrine / Adrenalin Absorption:**

- Increased heart rate.
- Increased cardiac output.
- Decreased systemic vascular resistance.

**Contraindications to the addition of epinephrine / adrenalin to local anaesthetics are**

- Unstable angina.
- Cardiac dysrhythmias.
- Uncontrolled hypertension.
- Treatment with monoamine oxidase (MAO) inhibitors or tricyclic antidepressants.
- Uteroplacental insufficiency.
- Peripheral nerve blocks in areas that may lack collateral blood flow (penis, digits).
- Intravenous (IV) regional anaesthesia.

Solutions of epinephrine / adrenalin containing 5 mcg/ml (1:200,000) appear to be optimal for the reduction of surgical bleeding and systemic absorption of local anaesthetics. Pre-mixed solutions are available.

**( Note → )** In order to avoid the risk of miscalculation resulting in dangerous incorrect dosages self-preparation of epinephrine / adrenalin solutions should not be used.

**14.3.5        Intravenous Regional Analgesia**

This is suitable for limb surgery distal to a pneumatic tourniquet sited proximally on the limb. If the patient is very hypertensive or obese, the technique may be difficult.

**Material required:**

1. Suitable cannula (butterfly needle (18 - 20 gauge, Venflon 18 – 20 gauge).
2. 2 or 3 syringes 20 ml and filling needle.
3. Local analgesic solution, without added vasoconstrictors.
4. Pneumatic tourniquet or sphygmomanometer with inflatable, air-tight cuff, capable to hold elevated pressures for about 60 – 90 minutes.
5. Esmarch bandage or inflatable limb splint.
6. Skin cleansing solution.
7. Adhesive tape for fixation of needle or cannula.
8. Resuscitation equipment for treatment of any toxic effects of the local analgesic.

#### **14.3.5.1        Upper Limb Regional Analgesia**

A pneumatic cuff is placed around the upper limb as high as is practicable but not inflated. In general a double cuff is preferred; however, this procedure requires special knowledge and precautions.

An intravenous needle or cannula is inserted into a vein, usually on the back of the hand, and secured with adhesive tape. The limb is partially exsanguinated either by using an Esmarch bandage, an inflatable splint or elevation for five minutes.

The pneumatic cuff is inflated well above the patient's systolic pressure (of the order of 250 mm Hg in a normotensive adult).

Local analgesic solution is injected rapidly through the indwelling needle or cannula. Lidocaine without vasoconstrictor 0.5% in a dose of 2.5 mg/Kg body weight is recommended. Analgesia below the cuff will be complete in between 5 and 20 minutes and will persist for about 60 – 90 minutes with Prilocaine.

In order to prevent the intravascular injection of a bolus of local anaesthetic into the general circulation, the cuff should not be deflated for at least 30 minutes after the local analgesic has been injected. The cuff should be deflated in stages thereafter.

#### **14.3.5.2        Lower Limb Regional Analgesia**

The procedure is similar to that for the upper limb. For procedures on the foot and ankle, the cuff may be placed around the mid calf.

For more proximal procedures on the lower limb, the cuff must be placed around the thigh. The cuff pressure must be higher since it is over a greater muscle mass and 350 mm Hg is suitable in the normotensive adult. A greater quantity of local analgesic solution is required and therefore 0.25% lidocaine without vaso-constrictor in a dose of 2.5 mg/kg body weight or 0.5% Prilocaine without vasoconstrictor in a dose of 5 mg/kg body weight or 0.125% Bupivacaine without vasoconstrictor in a dose of 0.5 mg/kg body weight are recommended.

The pain and spasm associated with fracture of the shaft of the femur can be relieved by blocking the femoral nerve in the groin which will allow the application of a split or traction. 10 ml of 1 or 1.5% lidocaine with 1 in 200,000 Epinephrine / Adrenalin and a 23 gauge needle are required. Standing on the opposite side of the patient from the fractured limb, the femoral artery is identified below the inguinal ligament by its pulsation. The needle is inserted at a point 1.2 cm lateral to the pulsation and the local analgesic solution is injected fan-wise lateral and deep to the artery. An electro stimulation needle could be used for a more proper and injection into the femoral nerve.

#### **14.3.6        Infiltration of Fracture Haematomas**

This does not produce as good analgesia as the intravenous regional technique and rapid absorption of the local analgesic may occur. The only use of this method is for the reduction of fractures.

Strict asepsis is essential. 10 ml of lidocaine 2%, Prilocaine 2% or Bupivacaine 0.5% is drawn up into a syringe, without vasoconstrictor. The needle with the syringe attached is inserted aseptically into the fracture haematoma and its position is checked by aspiration of blood. The local analgesic solution is injected slowly into the haematoma and after about 5 minutes relative analgesia of the fracture is obtained and manipulation may be carried out.

#### **14.3.7        Analgesia for Abdominal Surgery**

Local infiltration is the method of choice. The skin and each succeeding layer as it is reached are infiltrated with a dilute solution of local analgesic before they are incised. The parietal peritoneum is particularly sensitive and should be bathed in solution for 30 seconds.

The local analgesic drug should be combined with a vasoconstrictor in this situation as large volumes are required and a larger total dose is possible with slower absorption. Lidocaine 0.25% with epinephrine 1 in 400.000 up to a total volume of 200 mls in an adult is recommended. The alternative doses are Prilocaine 0.25% with epinephrine 1 in 400,000 up to a total volume of 300 ml or

Bupivacaine 0.25% with epinephrine 1 in 400,000 up to a total volume of 200 ml.

#### **14.3.8        Analgesia for Phimosis and Paraphimosis**

In phimosis the line of the proposed incision should be infiltrated with lidocaine 1% without vasoconstrictor using a fine needle.

A field block of the penis may be required for the reduction of a paraphimosis. Using lidocaine 1% without vasoconstrictor, an intradermal and subcutaneous weal is raised around the base of the penis. The dorsal penile nerves are blocked by the injection of a further 5 ml into the dorsum of the base of the penis superficial to the corpora cavernosa. The para-urethral nerves are blocked by pulling the penis upwards and injecting a further 2 ml at the base of the organ in the groove between the corpora cavernosa and the corpus spongiosum.

#### **14.3.9        Digital Nerve, Scalp and Abscess Analgesia**

The digital nerves of fingers or toes run forwards along the anterolateral aspects of each digit and are blocked by injecting on either side of the proximal phalanx using a small gauge needle. 2.5 ml of 1% lidocaine without vasoconstrictor is satisfactory and the injection should be made from the dorsal aspect where the skin is thinner and less sensitive.

Scalp lacerations can be infiltrated with 0.5% lidocaine with 1 in 200,000 epinephrine to produce satisfactory analgesia.

The skin over the area in which an abscess is pointing can be infiltrated with 0.5% lidocaine with or without 1 in 200,000 epinephrine to make incision almost painless. A fine gauge needle should be used and the infiltration made intradermally and immediately subcutaneously.

### **14.4        General Anaesthesia**

#### **14.4.1        General Principles**

General anaesthesia (GA) in the maritime situation by the single-handed MO is very rarely indicated but might be required for the reduction of some dislocations where other methods have failed.

Fasting is essential before a planned general anaesthesia. The aim is to reduce the volume and acidity of stomach contents during surgery, thus reducing the

risk of regurgitation/aspiration. Be aware of the great danger of vomiting and aspiration in emergency surgery. The technique of Rapid Sequence Intubation (RSI) is necessary under these circumstances.

The physician must have a thorough experience in intubation techniques, procedures (RSI!) and the control of anaesthesia. If not, a general anaesthesia should not be induced with Barbiturates, opioids and/or muscle relaxants drugs. General anaesthesia must be the last resort. Most things can be done under regional anaesthesia.

After consent has been obtained the patient should be prepared in the following manner:

- The stomach should be empty; normally 4 hours after the last oral fluid and 6 hours after a meal intake. The stomach has a delayed emptying time after trauma or abdominal sickness like appendicitis, ileus or incarceration of hernia.
- Premedication should be given before general anaesthesia to minimalise psychological trauma. Attention has to be given to hypovolaemic hypotension. A hypovolaemic shock can be induced or aggravated.
- The bladder should be empty. In an emergency case do a catheterisation after the induction of the general anaesthesia.
- All tight clothing should be loosened or removed.
- Any dentures are removed to avoid asphyxia.

#### **14.4.2      Definition of General Anaesthesia**

##### Sedation:

Sedation is the reversible reduction of the conscious level. It includes the concept of conscious sedation, but as the sedation becomes deeper, there is a continuous spectrum of effect until it becomes general anaesthesia.

##### Deep sedation:

Deep sedation is very difficult to differentiate from general anaesthesia. The state of Anaesthesia can be defined as the reversible elimination of all sensation.

##### Anaesthetic:

Anaesthesia may be defined as a technique or procedure to produce anaesthesia. It can also be a type of drug – usually used as the adjective, e.g. anaesthetic agent.

**General Anaesthesia (GA):**

GA has been defined as the reversible loss of consciousness and all sensation, deliberately produced for therapeutic purposes, in which the reflex responses to stimuli are diminished or eliminated. It includes induction, maintenance and reversal.

**14.4.3        The Three Principles of General Anaesthesia**

1. **Hypnosis:**

Induced suppression of consciousness with anaesthetics.

2. **Analgesia:**

Suppression of physiological responses to stimuli (pain).

3. **Relaxation:**

Suppression of muscle tone and relaxation for intubations and abdominal surgery.

**14.4.4        Hypnosis with Intravenous Induction of Anaesthesia**

The patient should breathe 100% oxygen in advance for 3 minutes before induction to provide a reserve of oxygen in the lungs and tissues in case problems arise with intubation. After the airway is secured the anaesthesia could be prolonged with the inhalation of volatile gases or intravenous anaesthesia.

**14.4.4.1      Thiopentone Sodium**

Thiopentone is a short acting intravenous Barbiturate. It is a yellowish white powder and is administered as a 2.5% solution (500 mg in 20 ml of water for injection). The solution deteriorates rapidly and should be used within 12 hours of being made up. Thiopentone causes hypnosis and anaesthesia but not analgesia.

The solution is alkaline (pH about 10) and care should be taken to avoid arterial or extra-venous injection which could lead to tissue necrosis. If the patient complains of severe pain, the injection should be stopped and a new vein chosen. Thiopentone is a lipophile substance and has fast interactions with the brain. Loss of conscious occurs in about 30 seconds. A reduction of blood pressure could be observed caused by a decrease in cardiac output.

Thiopentone has well documented cerebral protective effects at burst suppression doses. In susceptible patients it can cause an acute episode of porphyria. Other side effects are liberation of histamine with cutaneous flush

and status asthmaticus, also hiccups, nausea and vomiting in the phase of recovery.

Sodium Thiopentone is only recommended for single shot administration. The solution should be injected slowly intravenously until the eyelash reflex stops. The dose range is 4 – 7 (5) mg/kg body weight.

If respiration ceases the lungs have to be ventilated with oxygen.

Thiopentone is steadily losing ground to Propofol, mostly because of Propofol's recovery characteristics, less nausea, vomiting and pulmonary complications and its use for TIVA and long term sedation.

#### **14.4.4.2 Etomidate**

Etomidate is a short acting induction agent in a propylene glycol solution with less cardiovascular depression than Thiopentone. The concentration is 20 mg in 10 ml of solution. The initial dose is about 0.2 mg/kg body weight with a good safety range.

Etomidate could cause pain on injection, occasional involuntary movements occur. These effects could be reduced by the injection of a small dose of Midazolam and an opioid prior to the administration of Etomidate which suppresses the cortisol production.

Etomidate or ketamine are the preferred hypnotic agents in a critical circulatory or shock situation.

#### **14.4.5 Anaesthesia Using Inhaled Volatile Gases**

Total Intravenous Anaesthesia is replacing narcotic gases more and more. Nevertheless volatile anaesthetics are still used. The physician needs special experience in their use, kinetics and side effects of the different volatile anaesthetic gases.

#### **14.4.5.1 Possible Adverse Effects**

Volatile anaesthetic gases have more or less of the listed effects. They should be considered by their application.

##### Cardiovascular:

- Decreased myocardial contractility.
- Reduced cardiac output.
- Hypotension.
- Arrhythmias.
- Increased myocardial sensitivity to catecholamines.

Respiratory:

- Depressed ventilation.
- Laryngospasm and airway obstruction.
- Decreased ventilatory response to hypoxia and hypercapnia.
- Bronchodilatation.

Central nervous system:

- Increased cerebral blood flow.
- Reduced cerebral metabolic rate.
- Increased risk of epilepsy.
- Increased intracranial pressure.

Others:

- Decreased renal blood flow.
- Stimulate nausea and vomiting.
- Precipitate hepatitis.
- Can cause malignant hyperthermia.

#### **14.4.5.2 Common Volatile Anaesthetic Agents**

Halothane:

- Traditional volatile gas, not much used anymore (see side effects).
- Potent anaesthetic but poor analgesic agent.
- Can be used for gaseous induction in children.
- 20% is metabolised in the liver and can cause hepatic dysfunction.
- Occasionally causes severe hepatitis that can progress to liver necrosis.
- Depressed myocardial contractility and can induce arrhythmias.

Isoflurane:

- Most common used volatile gas.
- Potent anaesthetic but poor analgesic agent.
- Less cardiotoxic but causes greater respiratory depression.
- Reduces peripheral resistance and cause a 'coronary steal' phenomenon.
- Few adverse effects have been reported.

Other modern volatile anaesthetic gases:

- Sevoflurane (gaseous induction possible).
- Enflurane.
- Desflurane.

#### **14.4.6 Total Intravenous Anaesthesia (TIVA)**

TIVA means 'Total Intravenous Anaesthesia'. In its pure definition this means that no volatile gas is used and that it eliminates occupational exposure to volatile gases for the assisting personnel. Intravenous anaesthesia and TIVA are firmly established to an increasing degree in modern anaesthetic techniques.

Among other hypnotics, like barbiturates and Etomidate, Propofol is the best suited intravenous agent for maintenance of anaesthesia.

#### **14.4.6.1 Propofol**

Propofol is a widely used anaesthetic induction agent with slightly slower onset than Thiopentone and a greater tendency to drop blood pressure, especially on fast injections. It is a short-acting intravenous anaesthetic agent.

Propofol is a white aqueous isotonic oil in water emulsion for i.v. injection with Propofol (1 or 2 mg/ml ) as its active ingredient.

The rapid and usually pleasant offset makes it suitable for monitored sedation, maintenance of anaesthesia and patient sedation in ICU.

Compared to volatile anaesthetic gases and other intravenous hypnotics the rate of postoperative nausea and vomiting (PONV) is much less and it can be safely used in patients with a susceptibility to malignant hyperthermia.

Pain on injection is probably pH related and can be ameliorated by the addition of plain lidocaine (2-5ml of 1% to 20ml Propofol works fine).

Common practice in intubations without muscle relaxant is to inject the opioid drug prior to the hypnotic drug Propofol

#### **14.4.6.2 Ketamine**

This drug produces a dissociative anaesthesia and can be administered by the intravenous or intramuscular route. Ketamine has profound analgesia but muscle relaxation is poor. When ketamine is used, normally the pharyngeal reflexes and spontaneous breathing remain intact or only slightly depressed. For these reasons ketamine is the classical general anaesthesia technique for practitioners with less experience in general anaesthesia.

The drug is a clear colourless solution presented in three strengths of 10 mg/ml, 50 mg/ml and 100 mg/ml. Loss of consciousness occurs in about 30 seconds after intravenous and 3 minutes after intramuscular administration.

The single use of ketamine may be associated with bizarre hallucinations. If the patient is disturbed during the recovery phase he may react violently.

Hypersalivation is another side effect. This can be avoided by the intravenous administration of 0,5 mg Atropine 10 minutes before ketamine is given.

Before starting an anaesthesia with ketamine 5 – 7,5 mg of Midazolam (or another benzodiazepine) should be given orally or with careful titration

intravenously. This is indicated to avoid hallucination and to reduce the repetitive dose of ketamine.

( **Note →** ) Ketamine can cause a marked rise in blood and intracranial pressure and therefore is contraindicated in patients with untreated arterial hypertension and closed head injury.

In a dose of 0.5 mg/kg body weight intravenous ketamine has a very good analgesic effect.

The recommended dose for ketamine intravenous is 1 - 2 mg/Kg body weight of 1% solution given slowly over one minute. Transient apnoea may occur and passes in seconds with the beginning of surgical irritation.

Surgical anaesthesia lasts about 10 minutes and it can be prolonged every 10 minutes with repeating doses of 0.5 mg/Kg body weight and is indicated for short surgical intervention cases.

If the patient becomes violent or irrational during recovery, this can be helped by diazepam (5-10 mg) or midazolam (2.5 –5 mg) intravenously. A secure intravenous line is therefore indicated when using this drug.

#### **14.4.6.3 Guide to Ketamine Anaesthesia**

##### Intramuscular Administration (Emergency):

- Premedication: Atropine: 0,5 mg intramuscular 30 minutes pre-op
- Sedation: For adults 10 mg Diazepam orally 1hourr pre-op or 5 – 7.5 mg Midazolam.
- Induction: 5-10 mg/kg body weight ketamine
- Maintenance: 3-5 mg/kg IM or 0.5mg/kg IV as bolus dose

##### Intravenous Administration:

- This technique should be preferred to avoid the risk of an intramuscular septic abscess.
- Premedication: same as for intramuscular administration
- Or no premedication: administer Atropine 0.5 mg IV 10 minutes and 5 – 7.5 mg midazolam 5 minutes prior to ketamine.
- Induction: 1 - 2 mg/kg ketamine
- Maintenance: repeating IV boluses of 0.5mg/kg body weight every 10 – 20 minutes.

##### Note:

- The addition of IV Diazepam or midazolam (0.1mg/kg) on induction allows a reduction in the initial dose of ketamine (to 1mg/kg body weight).

- These combinations should only be used if no oral premedication has been given.

## 14.5 Analgesia

### 14.5.1 Opioids

The action of opioids consists in binding to opiate receptors in CNS tissues concerned with pain perception, integration and the response to pain. The opioids can be classified in their effects on the different receptors and their duration.

The classification is by duration of action:

Short (10-15 minutes):

Remifentanil, Alfentanil, Sufentanil, Fentanyl to use for intraoperative analgesia.

Medium (1-4 hours):

morphine, Piritramid, Pethidine (Meperidine) to use for pre-anaesthetic pain relief and for post-operative analgesia. Repeated doses are needed for continued analgesia. Slow release preparations available.

Long (4 -12 hours):

Buprenorphine to use for pre-anaesthetic medication, and for post-operative analgesia. Less frequent dosing needed.

( → Note ) Short acting analgesics (Remifentanil, etc) should be used with special care because they may produce significant respiration depression even in effective analgesic dosages. Profound airway management skills and management of ventilation is required.

### 14.5.1 Opioid-Antagonist Naloxone

Naloxone antagonist at all opioid receptors, highest affinity for  $\mu$ -receptors. Duration is 30-45 minutes. Doses could range from 0.2 – 2 mg. If no effect could be seen after 10 mg of Naloxone it is unlikely that an opioid is the origin of the problem (e.g. depression of breathing)

Naloxone reverses the respiratory depression, sedation, analgesia, urinary retention and bradycardia associated with opioid administration.

Naloxone as such has no clinical effect. Very large doses may cause mild drowsiness.

An overshoot of reversal could cause a sudden awareness of pain which can lead to hypertension, tachycardia, hyperventilation, dysrhythmias and pulmonary oedema, following the central catecholamine release. Formulation: 1 ml Naloxone 0.4mg/ml diluted to 10 ml = 40 µg/ml. From this mixture 1 – 2 ml every 2 – 3 minutes until it is effective.

## 14.6 Muscle Relaxants

### 14.6.1 General Considerations

Muscle relaxants are principally used to provide good muscular relaxation for surgery. Muscle relaxants could be divided in two main effects on the muscle: Depolarising or Non-depolarising relaxation. Respiration must be controlled via an endotracheal tube when muscle relaxants are used. A few general guidelines for the use of relaxants are listed below.

Before Muscle relaxants are administered always be certain that the ventilation of the patient via face mask is safely possible.

If a rapid onset of action is required (e.g. Rapid Sequence Intubation – RSI) Suxamethonium could be used as it acts more quickly than any of the non-depolarising drugs.

If a short duration of paralysis is required suxamethonium is most suitable and may be given in repeated doses provided 0.5 mg of Atropine is administered prior to the second dose of Suxamethonium to avoid bradycardia. With the availability of other fast acting muscle relaxants the indication for the use of Suxamethonium should be limited to RSI, because Suxamethonium could be associated with severe side-effects as malignant hyperthermia and bronchoconstriction.

Non-depolarising muscle relaxants take about one to two minutes to act and enough time should be given for the development of relaxation before attempting intubation. The supplemental doses should be about 25 % of the initial dose.

Never attempt to reverse the relaxation until at least 15-20 minutes after the last dose of relaxant was given.

Never extubate a patient until you are certain that the paralysis has been reversed and the patient has adequate muscle strength to protect the airway and breathe. One way of testing this is to assess whether they are able to lift their head off the pillow for 5 seconds.

Before extubation ensure that breathing is of adequate depth and frequency. It takes some time before the larynx is able to protect the airway and so the patient is best placed in the lateral position for recovery. If a nerve stimulator is available it can be used to monitor the degree of relaxation. However it is

not essential and relaxants can be safely be used without a nerve stimulator by careful observation of clinical signs.

When muscle relaxants are administered awareness is always a danger since a paralysed patient is unable move in response to pain. It is therefore essential to ensure that the depth of anaesthesia is adequate.

For an overview about pharmacokinetics and effects of different muscle relaxants refer to → **Annex 14-2**.

#### **14.6.2 Indications**

##### Endotracheal intubation:

- Elective sequence induction without residual gastric contents and controllable airways.

##### Surgical relaxation:

- Mivacurium for procedures < 15 minutes
- Vecuronium, Atracurium and Rocuronium for procedures < 30 minutes
- Pancuronium, Doxacurium and Pipecurium for procedures > 90 minutes

#### **14.6.3 Diseases and Circumstances that Could Prolong Muscle Relaxation**

- Neuromuscular disease.
- Hypothermia.
- Acidosis.
- Electrolyte abnormalities with K<sup>+</sup>, Ca<sup>2+</sup> and Mg<sup>2+</sup>.
- Drug interactions.
- Antibiotics.
- Anti-arrhythmic.
- Local anaesthetics.
- Anti-psychotics especially lithium.

#### **14.6.4 Depolarising Agents**

For example Suxamethonium acts rapidly within seconds and lasts for approximately 5 minutes. Used during induction of anaesthesia.

##### Side effects:

- Histamine release causing a scoline rush and / or bronchospasms.
- Bradycardia.
- Somatic pain resulting from fasciculation.
- Hyperkalaemia.
- Increased intra-ocular pressure and gastric pressure.
- Persistent neuromuscular blockade = 'scoline apnoea':
  - Affects 1:7000 of population.
  - Due to pseudocholinesterase deficiency.
- Agent of Malignant Hyperpyrexia:
  - Suxamethonium has highest risk among muscle relaxants.
  - Affects 1:100,000 of population.
  - Due to increased calcium influx and uncontrolled metabolism. Rapid increase in body temperature and increased PaCO<sub>2</sub>.

#### **14.6.5 Non Depolarising Muscle Relaxants**

##### **14.6.5.1 Atracurium**

Atracurium is a short acting relaxant that is rapidly broken down by the body. This makes Atracurium very predictable as it wears off rapidly compared to the longer acting relaxants.

Cardiovascular effects: Although Atracurium produces few direct circulatory effects the absence of vagus blocking activity makes the patient vulnerable to bradycardia during anaesthesia. These episodes are commonest during ophthalmic (traction on the ocular muscles), ENT or abdominal surgery, particularly laparoscopy. The patient should be monitored closely and any bradycardia treated with Atropine. Some anaesthesiologists administer Atropine or Glycopyrrolate routinely at induction to prevent this problem.

Histamine release may occur with doses of atracurium greater than 0.6mg/kg. Histamine may also be released if Atracurium precipitates in the

syringe or vein. This may occur if Atracurium is injected immediately after Thiopentone.

Respiratory effects: In standard doses Atracurium rarely causes problems like bronchospasms.

Placental transfer is insignificant and the drug is widely used in obstetrics.

Distribution, metabolism and excretion: Atracurium is broken down to inactive metabolites by ester hydrolysis and spontaneous Hoffman degradation. There is little change in its effects in patients with renal or liver failure. When used for long operations it is very predictable.

Dose, administration and use: A dose of 0.3-0.6mg/kg will provide relaxation for 20-40 minutes. Supplemental doses should be 5-10mg.

Contraindications: Atracurium precipitates (comes out of solution) in an alkaline pH and it should never be mixed with Thiopentone. Always flush the vein with saline if using the two drugs at induction.

Storage should be in a refrigerator at 4 degrees centigrade as the drug deteriorates at room temperature.

#### **14.6.5.2 Rocuronium**

It is a non-depolarising agent and has a fast onset within 45 – 90 seconds and acts for about 30 – 40 minutes.

No liberation of histamine and minimal cardiovascular effects with slight increase in blood pressure and heart rate (vagolytic effect).

Distribution, metabolism and excretion: no metabolism, about 70 % excreted over the liver and 10 – 30 % renal elimination.

Dose administration and use: An iv dose of 0.5 – 06 mg/kg body weight will produce relaxation for about 30 - 40 minutes, supplemental doses should be 10 to 25 mg.

Storage: refrigerated between 2 – 8° C.

#### **12.6.5.3 Pancuronium**

It is a synthetic non-depolarising long-lasting neuromuscular blocking agent. It is mainly used for long term relaxation.

Cardiovascular effects: There is a mild vagal blocking effect on the heart and an inhibition of the re -uptake of noradrenalin by the cardiac sympathetic nerves. These result in a rise in pulse rate of about 20% and an increase in the blood pressure of 10-20%.

Respiratory effects: Pancuronium can be safely used in patients with asthma. Histamine release is not a problem.

Placental transfer is not a problem and Pancuronium may be used in obstetric anaesthesia.

Distribution, metabolism and excretion: 60 to 80 % of Pancuronium is excreted through the kidneys and the remainder is metabolised in the liver and excreted in the bile. It should be avoided if possible, in patients with renal impairment.

Effect of metabolic abnormalities: Acidosis boosts Pancuronium.

Dose administration and use: An initial dose of 0.1mg/kg body weight will last 60 - 120 minutes. Increments of 1 - 2mg should be given as required. Always allow at least 20 minutes following the last dose before attempting to reverse the patient. Infants, children, elderly and obese patients may be more sensitive to Pancuronium.

( → Note ) Pancuronium should be kept in a refrigerator.

## **14.7 Monitoring During Anaesthesia**

Monitoring of fundamental physiological variables during anaesthesia is essential. Clinical judgement will determine how long this monitoring should be continued following completion of anaesthesia. The Sickbay in which the procedure is being performed is responsible for provision of equipment for anaesthesia, monitoring and for effective maintenance of this equipment. The following recommendations refer to patients undergoing general anaesthesia or major regional anaesthesia for therapeutic procedures.

Clinical monitoring is the basis of safe patient care during anaesthesia. A medical practitioner must be appropriately trained in basics of anaesthesia. In exceptional circumstances brief absences of the person primarily responsible for the anaesthetic may be unavoidable. In such circumstances that person may temporarily delegate observation of the patient to an appropriately qualified person (paramedic) who is judged to be competent for the task. The individual surgeon is responsible for monitoring the patient and should ensure that appropriate monitoring equipment is available.

### **14.7.1 Patient Monitoring**

Circulation: The circulation must be monitored at frequent and clinically appropriate intervals (e.g. in non-complicated patients every 5 minutes) by detection of the arterial pulse and measurement of arterial blood pressure by indirect or direct means. ECG-monitoring is a standard procedure.

Ventilation: Ventilation must be monitored continuously by both direct and indirect means. This includes the measurement of inspired and expired volumes, O<sub>2</sub>- and CO<sub>2</sub>-levels, breathing pressures and maybe volatile gases.

Oxygenation: Oximetric values (pulse oximetry or blood gas analysis) must be interpreted in conjunction with clinical observation of the patient. Adequate lighting must be available to aid with assessment of patient colour.

#### **14.7.2 Material**

Oxygen Supply Failure Alarm: An automatically activated device to monitor oxygen supply pressure and to warn of low pressure must be fitted to the anaesthesia delivery system.

Oxygen Analyzer: A device incorporating an audible signal to warn of low oxygen concentrations, correctly fitted in the breathing system, must be in continuous operation for every patient when an anaesthesia delivery system is in use.

Pulse Oximeter: Pulse oximetry provides evidence of the level of oxygen saturation of the haemoglobin of arterial blood and identifies arterial pulsation at the site of application. A pulse oximeter must be in use for every anaesthetised patient.

Breathing System Disconnection or Ventilator Failure Alarm: When an automatic ventilator is in use, a monitor capable of warning promptly of a breathing system disconnection or ventilator failure must be in continuous operation. This must be automatically activated.

Electrocardiograph: Equipment to monitor and continually display the electrocardiograph must be available for every anaesthetised patient.

Temperature Monitor: Equipment to monitor temperature continuously must be available for every patient undergoing prolonged anaesthesia.

Carbon Dioxide Monitor: A monitor of carbon dioxide level in inhaled and exhaled gases must be in use for every patient under general anaesthesia.

Neuromuscular Function Monitor: Equipment to monitor neuromuscular function should be available for every patient in whom neuromuscular blockade has been induced.

Volatile Anaesthetic Agent Monitor: Equipment to monitor the concentration of inhaled anaesthetics must be in use for every patient undergoing general anaesthesia from an anaesthesia delivery system where volatile anaesthetic agents are available. Automatic agent identification should be available on new monitors.

## 14.8 Postoperative Monitoring

### 14.8.1 Postoperative Analgesia

#### Postoperative pain control:

It is very important. A patient who is in severe pain does not recover well. Good postoperative pain control regimens include analgesics. Be aware to overdose. In order to avoid phases of pain and stress in the post-operative phase it might be useful to start the administration before / during the operation (preventive analgesia).

#### Non-narcotic mild analgesics:

Such as Paracetamol 1000 mg rectal as needed.

Non-steroidal anti-inflammatory drugs (NSAID): They are also considered "mild" analgesics. Newer compounds provide more effective analgesia (Carprofen, Ketoprofen). Act by suppressing one or more components of the inflammatory process.

( Note → ) Strong analgesics are opioids (narcotics):

- Such as Pethidine 0.5 - 1 mg/kg body weight (but not more than 100 mg) IM or IV slowly.
- Piritramid is a very often used opioid for postoperative analgesia. It could be used in single shots from usually 3 – 7.5 mg as well as in Patient Controlled Anaesthesia (PCA) with on demand infusion pumps.
- Morphine 0.1 mg/kg bodyweight IM every 4 hours as needed; titrate to the individual with top up doses every 1 to 4 hours.
- Immediate postoperative pain is most notable when using Remifentanil.
- Tramadol: Appears in plasma in 15-45 minutes with a peak concentration at 2 - 4 hours elimination half life of 5 hours dose: moderate post-operative pain 50 - 100mg orally every 4 hours 50 - 100mg intravenously titrated to effect. Respiratory depression is clinically less. Minor reports of dizziness, nausea, sedation and dry mouth. Formulation: solution of 50 mg/ml for intravenous and intramuscular usage (racemic mixture) capsule or tablet of 50mg. Indication: Moderate postoperative pain control, especially in patients who have a problem taking opioids or non-steroidal anti-inflammatory drugs. Contra-indications: NOT for intra surgical pain management as there is increased intra-operative awareness. Avoid in patients taking mono-amine oxidase inhibitors Caution in epileptics. Not recommended for children.

Nausea and vomiting: If the patient receives analgesics this may be combined with antiemetics such as:

- Prochlorperazine (Compazine): 5-10 mg PO/IM/IV or rectal:  
25 mg /12h
- Metoclopramide (Reglan): Dose: 10 mg PO/IM/IV
- Prometazine (Phenergan): Dose: 25-50mg PO/IM/PR 4-6 hourly.

#### **14.8.2 Recovery and Discharge**

Monitoring, particularly pulse oximetry, should be continued and vital signs recorded regularly until the patient is fully alert and oriented.

If Naloxone or Flumazenil were given, monitoring must be continued for at least 2 hours.

In day-case surgery, the patient should be discharged into the care of a responsible adult with written instructions for their care. Patients must not drive or operate heavy machinery until the following day.

### **14.9 Resuscitation Equipment and Assessment**

Heart rhythms associated with cardiac arrest can be divided into two groups: ventricular fibrillation / pulse-less ventricular tachycardia (VF / VT) and other rhythms.

The latter includes both asystole and pulse-less electrical activity (PEA), also known as electromechanical dissociation (EMD). The principle difference in the management of these two groups of arrhythmias is the need for attempted defibrillation in those patients with VF / VT.

Cardiac arrest may occur as a result of special circumstances, for example: hypothermia, drug overdose and submersion. In these cases additional interventions may be required.

#### **14.9.1 Potentially Reversible Causes**

During any cardiac arrest, potential causes or aggravating factors for which specific treatment exists should be considered.

For ease of memory, these are divided into two groups, based upon their initial letter - either H or T:

The 4 'Hs':

- Hypoxia.

- Hypovolaemia.
- Hyperkalemia, hypocalcaemia, acidaemia.
- Hypothermia.

The 4 'Ts'

- Tension pneumothorax.
- Cardiac tamponade.
- Toxic substances or therapeutic substances in overdose.
- Thromboembolic or mechanical obstruction (e.g., pulmonary embolus).

**14.9.2        Ventricular Fibrillation (VF) / Pulseless Ventricular Tachycardia (VT)**

In adults, at the time of cardiac arrest the most common rhythm is VF, which may be preceded by a period of VT or even supraventricular tachycardia (SVT).

To maximise the success of resuscitation from either of these two rhythms, a shock must be delivered promptly. The chances of successful defibrillation decline by 7 - 10% for each minute that the arrhythmia persists, as myocardial energy reserves are depleted. This process can be slowed, but not halted, by effective basic life support (BLS).

Therefore, the patient's rhythm should be determined at the earliest opportunity (using the monitoring electrodes or paddles of a manual defibrillator, an automated defibrillator, or attaching a dedicated ECG machine) and, if indicated, a shock delivered as soon as possible.

**14.9.3        Attempted Defibrillation**

Up to three shocks are given initially with energies of 200 J, 200 J, 360 J (or their equivalent when using defibrillators with alternative waveforms).

When using manual defibrillators, if more than one shock is required, the paddles are best left in position on the patient's chest while the defibrillator is recharged, at the same time observing the ECG monitor for any changes in the rhythm.

After each shock or sequence of three shocks the carotid pulse should be palpated only if the waveform changes to one usually capable of providing a cardiac output (including ventricular tachycardia).

If ventricular fibrillation persists after the initial three shocks, the best chance of restoring a perfusing rhythm still lies with defibrillation, but myocardial and cerebral viability must be maintained with chest compressions and ventilation of the lungs (CPR).

One minute of CPR (with a compression to ventilation ratio of 15:2) is undertaken during which reversible causes should be considered and, if identified, corrected.

#### **14.9.4 Airways**

Tracheal intubation (Combitube for not experienced) provides the most reliable airway but only if the healthcare provider is properly trained and has adequate ongoing experience with the technique.

Acceptable alternatives include the insertion of a laryngeal mask airway (LMA). The aim is to ventilate the patient's lungs and deliver the highest possible concentration of oxygen, preferably 100%.

Once the patient's trachea has been intubated, chest compressions, at a rate of 100 min<sup>-1</sup>, should continue uninterrupted (except for defibrillation or pulse checks when indicated), and ventilation continued at approximately 12 breaths min<sup>-1</sup>. A pause in the chest compressions allows the coronary perfusion pressure to fall substantially.

On resuming compressions there is some delay before the original coronary perfusion pressure is restored. Thus, chest compressions uninterrupted for ventilation result in a substantially higher mean coronary perfusion pressure.

#### **14.9.5 Intravenous Access and Drugs**

Intravenous access should be established if this has not been achieved already. The technique of central venous catheterisation has a variety of complications, some of which are potentially life-threatening. Peripheral venous cannulation is quicker, easier to perform, and safer. Ultimately, the route chosen will depend upon the skills and equipment available.

Drugs administered by the peripheral route must be followed by a flush of at least 20 ml of 0.9% saline to assist their delivery to the central circulation. Epinephrine / Adrenalin is administered, 1 mg by the intravenous route or 2 - 3 mg via the tracheal tube.

Epinephrine /adrenalin given by the tracheal route should be diluted to at least 10 ml with sterile water.

Vasopressin or Terlipressin (Glycylpressin), in a single intravenous dose of 40 units (Vasopressin) or 1 mg (Terlipressin), has been proposed as an alternative to epinephrine / adrenalin in cases of VF / pulseless VT refractory to three initial shocks. Further evidence is required before a firm recommendation on the use of this powerful vasopressor can be made.

The evidence supporting the use of any antiarrhythmic drugs in VF / VT is weak. Amiodarone should be considered, following epinephrine, to treat

shock-refractory cardiac arrest due to VF or pulseless VT. It can be considered as early as before delivery of the fourth shock provided it does not delay delivery of this shock. Amiodarone 300 mg (made up to 20 ml with dextrose or from a prefilled syringe) may be administered into a peripheral vein. A further dose of 150 mg may be given for recurrent or refractory VT/VF, followed by an infusion of 1 mg/min for 6 hours and then 0.5 mg/min, to a maximum daily dose of 2 g.

The recommended dose of 1.2 g. magnesium (8 mmol) should be given for refractory VF if there is any suspicion of hypomagnesaemia (e.g., patients on potassium losing diuretics).

Lidocaine should not be given if the patient has received Amiodarone but may be used as an alternative if Amiodarone is not available.

Procainamide is another alternative to Amiodarone or lidocaine for refractory VF. It is given at 30 mg/min to a total dose of 17 mg/kg body weight. The necessity for this relatively slow rate of infusion makes Procainamide a less favourable option.

#### **14.9.6 Non-Dit / VT Rhythm**

If asystole or PEA is confirmed, appropriate drugs are given and a further two minutes of CPR is given to complete the loop. A temporarily poor cardiac output, due to myocardial stunning, may result in impalpable pulses and the incorrect diagnosis of PEA.

After a minute of CPR, the cardiac output might recover spontaneously and, at this stage, further epinephrine could be detrimental.

After the delivery of a shock, monitoring through gel pads may result in spurious asystole being displayed. This is more likely to occur in the presence of high chest impedance and with an increasing number of shocks delivered through the same gel pads.

If defibrillator paddles and gel pads have been used for "quick look" monitoring, and "asystole" is displayed after delivery of a shock, the rhythm must be confirmed immediately with monitoring leads.

Asystole: It is essential that the correct diagnosis is made and, most importantly, that VF is not missed. Asystole must be confirmed by:

- Checking that the leads are attached correctly.
- Checking the gain.
- Viewing the rhythm through leads I and II.

If there is any doubt, treatment for VF should be started, as the risks of not treating VF, with its greater potential for a successful outcome, are greater than for three unnecessary shocks administered to an asystolic heart.

Chest compressions and ventilation should be undertaken for three minutes with each loop (or one minute if directly after a shock), during which the airway can be secured, intravenous access obtained, and the first dose of Epinephrine / Adrenalin given. Atropine, 3 mg intravenously or 6 mg via the tracheal tube (in a volume of 10 - 20 ml) can be given to provide total blockade of the vagal nerve.

Whenever a diagnosis of asystole is made, the ECG should be checked carefully for the presence of P waves or slow ventricular activity because this may respond to cardiac pacing. Consideration should be given also to external cardiac percussion for patients in whom electrical pacing is to be performed, but where a delay will occur before it is achieved. Repeated pre-cordial blows can be used to stimulate the myocardium (percussion pacing). Each blow is delivered lateral to the lower left sternal edge, using less force than a pre-cordial thump, and at a rate of about 70 min

#### **14.9.7      Pulseless Electrical Activity (PEA)**

This condition comprises the clinical signs of a cardiac arrest with an ECG rhythm compatible with a cardiac output.

The patient's best chance of survival will be by prompt identification and treatment of any underlying cause. Potential causes can be categorised into two main groups, which are listed in the universal algorithm.

Resuscitation should be continued while these conditions are sought. CPR is started immediately; the airway and ventilation managed as appropriate and intravenous access obtained.

Epinephrine / adrenalin 1 mg intravenously is administered every three minutes. The administration of epinephrine in single doses greater than 1 mg is no longer recommended. If PEA is associated with a bradycardia: < 60 min<sup>-1</sup>, Atropine 3 mg intravenously or 6 mg via the tracheal tube, should be given.

**15. Infectious Diseases**

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**15.2 Personal Protective Measures**

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**15.6 Fever**

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**15.1 Introduction**

Infectious diseases can act as war-stoppers. Due to improved prevention and treatment, the number of infected soldiers on the battlefield has considerably declined in the past decades. However, infection remains a continuous and worldwide threat particularly under the viewpoint of increasing resistance to classical treatment, emerging and re-emerging diseases and the outlook of deliberate use of dangerous, possibly modified infectious agents. Permanent strong efforts are necessary to protect the individual soldier as well as the community from infectious diseases.

All recommendations should be based on the epidemiological picture in the region of interest.

## **15.2 Personal Protective Measures (PPM)**

In order to prevent soldiers from acquiring infectious diseases they need to be protected from the (causative) infectious agent. The sources of infectious agents often are other (infected) humans, animals (including vectors) or their respective excretions. Some infectious agents can occur in natural environments such as dust, soil or water bodies.

Personal Protective Measures (PPM) builds up a barrier between the infectious agent and its respective host. Properly applied PPM reduces the risk of infection considerably and therefore is essential in prevention of infection and thus disease.

Mechanisms of transmission are direct or indirect.

Direct transmission means the straight uptake of infectious agents via the → oral route (e.g. water- / food borne infection), the → inhalation route (airborne infection) or the → (muco) dermal (contact) route (dissemination of infectious agents on skin or mucous membranes e.g. by touching, sexual intercourse etc.).

Indirect transmission requires a contaminated or infected vehicle (e.g. hands or cooking utensils, surgical instruments, vectors) in order to pass infectious agents to susceptible individuals. Vector-transmission is performed by various arthropods and can occur both at day and night-time.

Knowing the transmission-mode of a disease facilitates strategies to prevent this disease. PPM may often be the only available option of protection. For that reason every soldier should know the importance of implemented PPM. Soldiers should be trained in the correct application and usage of implemented PPM. Permanent risk-awareness promotes the adherence to PPM. However, adequate compliance of PPM must be continuously monitored by the command.

### **15.2.1 Preventive Behaviour Direct Transmission**

In order to prevent water- / food-borne diseases, personnel must only consume water and food from approved sources. Other sources of water and food are to be considered as unsafe and must therefore be consequently avoided.

Airborne diseases can be prevented or significantly reduced by keeping sufficient distance from the infective source. Depending on the infectious agent the use of protective breathing-masks can be necessary.

Adequate camp selection reduces the risk of infections originating from the environment. Camp selection requires the assessment of several items (e.g. presence of arthropod breeding sights, prevailing winds, proximity of settlements with infected inhabitants or livestock, environmental sanitation etc.).

(Muco) dermal (contact) transmission can be prevented by avoiding the direct contact of infectious agents with unprotected skin or mucous membranes. Frequent washing and disinfecting of hands reduces transmission risk significantly. The use of gloves, protective dressings and facemasks may be necessary. In medical settings in particular all measures of barrier nursing must be applied (isolation, protective gear, and disinfecting, proper technique). Transmission of STD's is greatly reduced by adhering to practice of safe sex.

### **15.2.2 Preventive Behaviour Indirect Transmission**

- Maintaining thorough hygiene (e.g., kitchen hygiene, pest control, and sterilisation of medical instruments) prevents vehicle-borne transmission.
- Combining appropriate clothing with the usage of repellents and other protective measures can significantly reduce vector transmission.
- Sanitation of breeding sights effectively reduces vector density.
- Clothing should be long-legged, long-sleeved, using brightly coloured fabric. Insecticide (e.g. permethrin) -treated fabric enhances the protective effect.
- Apply repellents frequently on otherwise unprotected skin such as hands, neck and face.
- Other protective measures (e.g. treated bed nets, air-conditioning) provide further protection against vector transmission.

## **15.3 Chemoprophylaxis**

Consequent appliance of PPM can yield a far-reaching protection against various infectious diseases. Despite thoroughly applied PPM, invasion and thus infection of the human body by infectious agents remains possible. Poor adherence to PPM even promotes invasion and infection of the body.

**( → Note )** At the stage of infection it is the main concern to inhibit proliferation of the infectious agent and so avert overt disease.

### **15.3.1 Malaria**

PPM is one key-strategy to prevent malarial disease. However, in areas of moderate and high malaria transmission PPM by it self does not yield sufficient safety from malaria infection. Despite properly applied PPM the soldier will most probably receive infective mosquito bites. Proliferation of the parasite in the host then predictably leads to malarial disease.

Consequently additional means are needed to further reduce the risk of disease. As another key-strategy in malaria-prevention the intake of low-dosage anti-malarial drugs (malaria-chemoprophylaxis) inhibits proliferation of malaria parasites that have already entered the host. As a result an infected individual remains protected from developing overt disease.

( → Note ) Drugs used in chemoprophylaxis are Mefloquine, Doxycycline, Chloroquine, Chloroquine/ Proguanil, Atovaquone/proguanil.

Parasite drug resistance in specific locations influences the selection of the appropriate anti-malarial drug as well as allergic or other reactions to the drug or restrictions by job (Mefloquine is not authorised for prophylaxis in aviators and divers). In malaria-chemoprophylaxis the drug is required to be taken before, during and after the exposure to malaria. Depending on the selected anti-malarial drug these periods vary.

PPM and malaria-chemoprophylaxis yield a broad protection against infection and disease. However, development of malarial disease remains a rare, but possibly serious event. Therefore all symptoms compatible with malaria coming up during or after exposure to malaria may be due to acute malarial disease. In this situation immediate diagnosis and therapy are compulsory.

#### **15.3.2      Other Diseases**

Chemoprophylaxis is not only used in the prevention of malaria. In some other infectious diseases such as Leptospirosis, traveller's diarrhoea or meningococcal meningitis specific antimicrobials have proven to be effective in preventing overt disease although infection of the host has already occurred. As in malaria-chemoprophylaxis this chemoprophylaxis must be taken before, during and after exposure to the infectious agent.

If available at all chemoprophylaxis must be considered, if risk of infection is high (because PPM are not sufficiently safe in preventing infection) thus leading to severe, possibly life-threatening illness.

Under certain conditions a → post-exposure chemoprophylaxis must be considered.

This can be the case after exposure to (e.g.) *Neisseria meningitidis*, HIV or Lassa-virus.

#### **15.4      Vaccination**

Infectious diseases that can have great operational impact are numerous and among them only a tiny minority is preventable by vaccination. Building up a protective vaccine-derived immunity is possible only for Td, Poliomyelitis, MMR, Pertussis,

Varicella, HIB, Hepatitis A+B, Influenza, Pneumococcal disease, Tick-borne Encephalitis (European and Russian variant), Meningococcal Meningitis (serotype ACW135Y), Typhoid fever, Yellow Fever, Rabies, Japanese encephalitis, Cholera, Smallpox, (Anthrax), the majority of them requiring periodical boosters.

Immunisation against Td, Poliomyelitis, MMR, Pertussis, HIB, Hepatitis B, Meningococcal Meningitis (conjugated vaccine, serotype C), [BCG] are generally performed in infancy.

Military activities may require additional immunisations that can go far beyond immunisation schedule of childhood. The decision to immunise military personal depends on endemicity of the disease in a prospective deployment area, its contagiousness, supposed degree of exposure of military personal, severity of the disease (despite therapy) and its operational impact.

( → Note ) In certain situations (e.g. outbreak of poliomyelitis) a vaccination-campaign (e.g. ring-vaccination) may be necessary to contain the outbreak.

( → Note ) Contact to rabid animals crucially necessitates immediate simultaneous post-exposure vaccination.

#### **15.4.1            Administration**

Administration of vaccines is generally performed via the parenteral (intramuscular, subcutaneously, [intradermal]) or the oral route. Parenterally given vaccines should be administered in the deltoid muscle, never in the gluteal region. Separately administered live vaccines must be given simultaneously; otherwise an interval of at least 4 weeks between each vaccination should be kept. Different inactivated vaccines do not require any interval one to the other. Live vaccines do not require any interval to inactivated vaccines.

Although any drug-administration including administration of vaccines should be handled restrictively in pregnancy certain vaccines may be indicated (e.g. Tetanus-toxoid) or are not generally contraindicated. Most vaccines are contraindicated in pregnancy.

The immediate simultaneous active and passive rabies vaccination (post-exposure prophylaxis) after possible infection on a potentially rabid animal is vital and will therefore be performed also in pregnancy.

#### **15.4.2            Time Schedule**

Certain vaccines confer reliable, long lasting immunity after single administration while others need to be given repeatedly in defined intervals until the onset of immunity.

Immunisation may therefore require several weeks or even months. Hence, timely onset of vaccination is essential.

→ If possible, vaccination should be completed at least two weeks before deployment in order to yield maximum degree of immunity, avoiding possible adverse reactions during deployment.

( → Note ) Yellow fever vaccinations as well as meningococcal vaccination get validity 10 days after administration. Yellow fever vaccination is only administered in WHO-affiliated vaccination-centres.

#### **15.4.3 Adverse Reactions**

The vast majority of available vaccines are generally well tolerated without any serious side effects.

Frequently occurring adverse reactions are usually mild and short lasting, not requiring specific therapy. They may present as pain or tenderness at the injection site, oedema, erythema, lymphadenopathy, fever, irritability, malaise, drowsiness, rash, diarrhoea.

Severe adverse reactions requiring specific therapy are rare. They include allergic reactions, arthropathy, neuropathy, polyneuritis, Guillain-Barré syndrome, seizures, meningitis, encephalitis, thrombopenia and granulocytopenia.

( → Note ) All recommendations should be based on current National Immunisation Programs.

### **15.5 Diarrhoea**

Diarrhoeal diseases are primarily transmitted by ingestion of contaminated food or water due to non-compliance with approved hygiene-standards at the level of food- / water preparation or storage.

( → Note ) Risk of infection is year-round but increases during warm season.

In urban areas municipal water supply is often of unreliable quality. In rural areas where ground water or water from lakes and rivers is used, water supply is also unsafe since raw sewage is discharged into lakes and rivers without previous adequate treatment.

#### **15.5.1 Differential Diagnosis**

Diarrhoeal diseases may be associated with abdominal discomfort, pain, cramps and fever. Incubation periods may be as short as 6 hours. Stools usually are watery but may also contain mucus, pus and blood. Aetiology may

be bacterial, viral or protozoal. Common bacterial agents include *Campylobacter spp.*, *Escherichia coli spp.*, *Salmonella spp.*, *Shigella spp.*, rarely *Vibrio cholerae*. Viral agents comprise Rotavirus, enteric adenovirus, human calicivirus, and noroviruses. Frequently associated with more chronic infections are endemic protozoans such as *Entamoeba histolytica*, *Giardia lamblia* and *Cryptosporidium spp.* However these can also cause acute diarrhoea.

#### **15.5.2 Prevention**

Food and water being supplied during deployment must be reliably safe. Battle rations are to be used if safe food and water can not be provided otherwise. Particular hygiene of field-kitchens must be observed; only selected, trained personal should be admitted to the galley.

( → Note ) The provision of proper sanitation and pest-control (hygiene / veterinary counselling) at the logistic site and adjacent area is imperative.

#### **15.5.3 Treatment**

Due to significant loss of water diarrhoeal diseases primarily require rehydration which should in first line be performed via the oral route with oral rehydration solution (ORS).

( → Note ) Severe dehydration may require iv treatment.

( → Note ) Antibiotic treatment of bacterial mediated diarrhoea is in otherwise healthy individuals not required. In Shigellosis however antibiotics are routinely administered.

Individually, antibiotic treatment may be given to accelerate recovery in order to maintain or restore combat readiness.

( → Note ) Premature antibiotic treatment promotes carrier-status.

Viral pathogens are of short duration but may have significant impact on combat readiness due to the incapacitating disease they cause, and their rapid spread within the community. Beside rehydration further specific (antiviral) therapy is not available.

Due to its invasive property *Entamoeba histolytica* can cause haemorrhagic colitis. The pathogen tends to disseminate to the liver and other sites, thus causing lesions in hepatic or other tissues (amoebic liver abscess [ALA], amoebic lung abscess, amoebic brain abscess). → Treatment (e.g. metronidazole) is therefore obligatory. Cysts of *Entamoeba histolytica* in otherwise healthy carriers should be eliminated (e.g. paromomycin, diloxanid-furoate). *Giardia lamblia* as a known cause of chronic diarrhoea may also cause wasting illness, → treatment (e.g. Metronidazole) is necessary. *Cryptosporidium*

*spp.* causing self-limited diarrhoea in otherwise healthy subjects may also lead to chronic and wasting illness. Paromomycin or Azithromycin may be tried in treatment.

## 15.6 Fever

In underlying infectious diseases fever is a frequently observed symptom. However - it may also occur in non-infectious pathologies (e.g. neoplastic or auto-immune processes, heat-stroke in warm climates, hyperthermia due to impaired thermoregulation, etc.).

Causative infectious agents may be bacterial, viral, protozoal, helminthic or mycotic; many of them being effectively transmitted by vectors. Incubation time until fever appears is extremely variable, ranging from a few days up to weeks, months or even years.

Though infections are a threat in virtually all climates, the tropics and subtropics imply a significantly higher risk of infection and fever than cold climates.

( → Note ) Vector-mediated infectious diseases are of particular importance in warmer climates.

### 15.6.1 Differential Diagnosis

When investigating in fever an accurate history with special focus on the last months before fever-onset is essential.

Living conditions (accommodation, water- / food-supply, job and leisure-related exposures, habits) and previous medical history (e.g. blood transfusion?) must be assessed.

Many infectious diseases are confined to a limited geographical region (e.g. malaria, dengue, typhoid, yellow fever, Schistosomiasis). Consequently a negative travel history ("missing exposure") to a certain region can sufficiently rule out all diseases that exclusively occur in this region. Vice versa fever after a stay at a certain region strongly advocates for a disease known to be highly endemic there.

Distinct fever types can suggest certain diseases (e.g. continua in typhoid, undulating fever in brucellosis, fever peaks in tertian or quartan malaria). However - waiting for a fever type to appear must never prevent urgent diagnostic procedures.

( → Note ) Even slightest suspicion of malaria requires prompt testing.

Not only registration of fever as such, but also evaluation of the corresponding clinical picture is of supreme importance. An affected system (gastro-intestinal, respiratory, dermatological, hepato-splenic, urogenital, neurological,

dermatological, etc.) will lead to a series of probable pathogens, known to frequently cause the symptoms observed.

Depending on the affected system(s), laboratory testing of blood, stool, sputum/BAL, urine, liquor or taking of biopsies is mostly necessary. The aim is to directly visualise the causative agent (protozoal or helminthic stages, bacteria, fungus) further identifying it by culture (bacteria, protozoans, fungus, and virus), serology (bacteria, virus, protozoans, fungus, helminths) or PCR (bacteria, virus, protozoans, and fungus).

#### **15.6.2 Prevention**

Prevention of "fever" or rather febrile diseases in a prospective deployment area requires the knowledge of the epidemiological picture in this area.

On the base of this picture a prevention strategy is set up which comprises various items as already pointed out above: risk awareness, personal protective measures (PPM), vaccination, chemoprophylaxis, personal and community hygiene, pest-control (hygiene / veterinary counselling), safe food / water supply, sanitation, interruption of present transmission cycles, separation (quarantine) and treatment of infected individuals until contagious phase has ceased.

#### **15.6.3 Treatment**

Until establishment of the diagnosis a symptomatic, antipyretic treatment and prevention of dehydration is required.

Deteriorating clinical conditions may require empirical therapy, based on a presumed diagnosis. Specific therapy is administered as soon as diagnose is achieved.

### **15.7 Outbreak Investigation**

This sub-chapter is designed to give basic ideas of an outbreak investigation to the medical officer and to facilitate the communication with public health officials and epidemiologists in the actual outbreak situation.

( → Note ) Outbreak investigation is always teamwork. The MO cannot run a full-scale outbreak investigation by himself, but he can help to save important data, which may be lost otherwise.

An *outbreak* is the occurrence of cases of an illness clearly in excess of expectancy within a defined setting of time, place and person (adopted from Benenson 1995). It could be a clearly defined disease, a clinical entity or just symptoms. Therefore this could be an epidemic of an endemic disease like measles in Europe or just a single case of a non-endemic disease like a viral haemorrhagic fever. In most instances an

epidemiological investigation should be done. Very often large-scale outbreaks are initially recognised by few cases only.

The investigation should answer the questions of who is involved, and where and when it happened? What is the common cause, where is the source for the agent and what is the mode of transmission? All the points mentioned in this investigation algorithm can be dealt with one after the other or simultaneously.

Before heading out to the field the team should gather as much information as possible about the actual situation and background-information about the expected disease. Planning and preparations about personnel and material are essential as well as consultations of all parties involved.

#### **15.7.1 Confirmation of the Outbreak**

Is it really an outbreak? To judge whether there is something going on which is exceeding the expectancy the team needs to know the baseline rate of the disease. Seasonal, secular and local trends and occurrences of the disease should be considered.

The decision whether there is or is not an outbreak will be made within a higher level of the national or international surveillance system.

At the beginning of the investigation the diagnosis should be verified by reviewing all available data. Confirmation is done clinically together with technical help like lab-results, x-ray or ultrasound. The medical officer in the field can start confirmation by sending probes to the lab or just saving clinical specimen for further investigation, e.g. stool samples, serum or sputum.

#### **15.7.2 Identification of Cases and the Population at Risk (PAR)**

A case definition must be generated to identify cases. The definition should include information about the disease, time, place and person. It should be broad enough to include all real cases.

Case-definition can be made with different levels of certainty: suspected, probable and confirmed. A case may be classified as 'suspected' by only a few clinical signs (fever, sweating, and nausea) whereas a confirmed case needs 'hard' data like PCR or microbiological confirmation. In a large-scale outbreak not every case needs to be verified by technical investigation. After first results are acquired the following cases showing the same signs and symptoms can be defined as cases on clinical basis alone together with an epidemiological link.

Still, susceptible subjects should be identified as early as possible. For example, in military settings this is essential because too many cases may harm the performance of the unit. The PAR should be the first to receive countermeasures.

Susceptible persons are very likely to be harmed or affected by the agent causing the disease due to lack of natural or acquired resistance, e.g. non-vaccinated subjects in a vaccine-preventable disease outbreak.

### **15.7.3                  Formulate and Test Hypothesis**

After getting the first impression a working hypothesis should be developed.

The first hypothesis can be broad and unspecified. It should include the type of agent (poison, bacteria, virus etc.) with its source and the mode of transmission including exposure and vehicle or vector. The more details that are available, the more specific the hypothesis about the cause of the outbreak can be.

In large-scale outbreaks only a fraction of the cases and PAR may be examined. In clear defined settings like ships or military barracks the entire unit may be included.

Data collecting can be done by using many different sources such as medical records, lab reports, personal interviews and/or questionnaire. In clear defined settings basic demographic data of the study population like age, sex and job-description are easily available. Other data should include clinical appearance; personal identifiers (name, address etc. and risk factors (participation at lunch, exposure to the possible agent, etc.). Some of the patients should be interviewed personally to get more detailed and helpful first-hand-information.

The quality of data in the acute situation is never satisfying but the urgency of the outbreak often requires fast analysis to test the hypothesis that enables action against the outbreak. With the data it is possible to perform the descriptive analysis of time, place and person. This can be done by plotting a graph with date of onset of the cases (epi-curve), plotting a map of the location of cases (workplace, home, etc.), or calculating of attack rates (number of cases divided by number of exposed) and finally describing personal data. From these results the investigation team may get information about the type of agent, its mode of transmission (person-to-person, continuous source, etc.) and the distribution of the disease.

At this point the initial hypothesis must be reviewed and modified, confirmed or rejected. The next step is the statistical analysis performed by epidemiologists or public health officials using either case-control or cohort-studies. These results will show the measures of association for the relation of risk factors with the disease with Odds Ratio (OR) in case-control-studies or Relative Risk (RR) in cohort-studies.

### **15.7.4                  Management of the Epidemic**

Management of an epidemic includes different levels of action like optimised treatment for already existing cases, control of further spread of disease and

prevention of future outbreaks. This includes communicating the findings to all that need to know.

The individual patient is normally not the focus of an epidemiological investigation. But the communication of results and spread of even preliminary data to the medical community can help to improve treatment decisions for the individuals in the outbreak-area. After getting first or definite ideas about the agent, or mode of transmission of an unknown agent, control measures can be implemented like barrier nursing, destroying possibly contaminated food or quarantine of infectious subjects. Training the public about risk behaviour, vaccination campaigns for vaccine-preventable diseases or adequate prophylaxis for specific exposures like malaria may prevent future outbreaks.

**( → Note )** Outbreaks may catalyse further research by questions that surfaced during and after the initial investigation. The actual disease, mode of transmission or agent may show yet unknown characteristics like a new disease entity, a more effective transmission or an antibiotic resistance.

#### **15.7.5              Recommended Literature**

- (1) Last JM, Harris SS, Spasoff RA, Thuriaux M. A dictionary of epidemiology. 4th. ed. New York: Oxford University Press, Inc., 2000.
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## 16. Maritime Emergency Situations

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**16.1 Drowning**

**16.1.1 Nature and Presentation**

Drowning is asphyxia resulting from inhalation of a liquid, almost invariably water. If sufficient water (typically more than 1.5 litres for an average adult male) is inhaled to stop adequate gas exchange in the lungs, primary drowning occurs; a typical scenario where this might occur is a person falling overboard when not wearing adequate buoyancy to support their airways clear of the water surface. Secondary drowning is an uncommon but by no means rare condition in which initial inhalation of water is insufficient to result in primary drowning, but secondary pulmonary oedema develops in minutes to 3 days after that minor inhalation. It can occur in anyone who has been immersed and inhaled a lesser quantity of water, which may have passed unnoticed at the time.

**16.1.1.1 Primary Drowning**

Presentation is usually obvious, although distinction from hypothermia and other cause of imminent death during immersion (such as barotrauma in divers) can be difficult. In many cases, mild hypothermia reduces the immersion casualty's ability to maintain their airways clear of the water, and thus results in primary drowning. Most victims are apnoeic and pulseless, typically after a relatively short immersion without a lifejacket, and/or in water sufficiently rough to endanger the airways.

**16.1.1.2 Secondary Drowning**

Secondary drowning presents as an acute-onset adult respiratory distress syndrome within 3 days of an immersion incident. Progressively worsening shortness of breath, persistent cough productive of copious amounts of frothy sputum which may be pink, and frank haemoptysis are common features. Chest X-ray shows pulmonary oedema. If left untreated, most patients will suffer progressive pulmonary oedema, with consequent collapse, unconsciousness, respiratory arrest, and death.

**16.1.2 Management and Disposal**

Aggressive resuscitation using the standard approach is essential for those suffering from primary drowning. If they are also hypothermic, careful consideration needs to be given to the decision to start cardiac compression (refer to → **Subchapter 16.2.2**). Resuscitation should not be terminated until efforts have been made to re-warm those who are hypothermic (refer to → **Subchapter 16.2.2**), which in most cases will require the casualty to be transferred to hospital whilst maintaining life support. Those who are successfully resuscitated are liable to a wide range of complications, including pneumonia which can involve exotic pathogens from inhaled matter. Care must also be shown to minimize the risk of post-rescue collapse (refer to → **Subchapter 16.2.2**) and all immersion casualties should therefore be rescued in a near-horizontal position whenever possible.

Secondary drowning merits immediate administration of oxygen, and evacuation to a hospital with an intensive care facility, where positive end-expiratory pressure ventilation can be provided. Currently recommended approaches for pulmonary oedema may buy time for longer evacuations.

**16.1.3 Prevention**

Anyone at risk of immersion, particularly in cold or rough water, must wear an effective lifejacket capable of maintaining their airways clear of the water.

( → Note ) If the water temperature is below 15 degrees C, initial ‘cold shock’ responses make inhalation of water very likely in those suddenly immersed. In those circumstances, lifejackets should either have inherent buoyancy or an automatic inflation mechanism, and dry immersion suits are increasingly important with falling water temperatures.

Secondary drowning cannot readily be prevented, but efforts should be devoted to its early detection. Anyone who may have inhaled even a small amount of water during an immersion incident should be cautioned, similarly to those who have suffered head injury. They and those with them should be warned to look for the development of shortness of breath and cough up to 3 days after immersion; if they suspect that secondary drowning may be developing, the patient should be taken to a hospital with an intensive care facility without delay, and the receiving staff should be informed that they may be suffering from secondary drowning. Casualties and those watching them should be informed that left untreated, it may be fatal.

## 16.2 Hypothermia

### 16.2.1 Nature and Presentation

Hypothermia is defined as occurring when the core temperature falls below 35 degrees C. In maritime environments this most commonly involves water, which will not only remove body heat very rapidly during immersion, but also chills when evaporating from a wet surface exposed to the air.

( → Note ) Loss of core temperature in water may be up to 25 times quicker than under similar environmental circumstances in the dry.

At first, cooling the surface of the body stimulates the cold receptors in the skin, resulting in peripheral vasoconstriction, increased metabolic rate, and eventually fully established shivering. If cooling cannot be compensated for by these responses, the temperature of the core will start to fall, with increasing shivering, mood change, and progressive impairment of most body functions. Peripheral cooling and the retraction of the warmer core impair peripheral sensation and motor performance; memory, co-ordination, judgement and most other higher functions are also progressively impaired.

When hypothermia has become established, thermoregulation starts to fail, and at about the point that casualties are lapsing into sleep or unconsciousness, cooling becomes more rapid and ability to perform actions necessary to survive suffer badly. Thus anyone immersed without an effective lifejacket may at that point cease to maintain their airways clear of the water surface, and succumb to drowning. In rougher waters, this may also occur if they are not provided with a face screen to keep wave splash and spray clear of the airways.

( → Note ) Although immersion casualties can drown within seconds or minutes of entering the water, even in the coldest waters hypothermia does not normally occur for at least 20 minutes.

Prolonged unprotected immersion in warmer waters can still result in hypothermia, as water must be warmer than 34 degrees C before a naked adult can survive indefinitely in it.

Definitive diagnosis requires a reliable measurement of the core body temperature. This is best performed using a calibrated electronic rectal thermometer, although proper low-reading liquid-in-glass clinical thermometers are also acceptable. Infra-red tympanic membrane devices are unsuitable, as there may be several degrees difference from the true core temperature. Similarly, oral and axillary readings are of no value.

( → Note ) Careful timed records of rectal temperature should be maintained from the earliest moment possible, throughout treatment.

## **16.2.2 Management and Disposal**

Advanced first aid should minimise further heat loss by insulation and shelter, maintain the casualty at rest and horizontal (with the legs slightly elevated), and evacuate them with great care to a location in which they can be rewarmed. Rescue methods should endeavour to keep casualties in a near-horizontal position at all times, e.g. helicopter double strop, cradles, parbuckles, or suitable stretcher.

### **16.2.2.1 Resuscitation**

Conventional cardio-pulmonary resuscitation should be commenced as necessary, although care needs to be exercised in deciding whether or not to start cardiac massage. If the casualty is suffering from moderate or severe hypothermia, with a core temperature below about 33 degrees C, cardiac massage should only be started if it is certain that there is no effective circulation, and that it can be maintained until the casualty has been rewarmed. This is because the cold myocardium is prone to fibrillation, and efforts to defibrillate are not going to be successful until the myocardium has been rewarmed. Many hypothermic casualties in whom no pulse can be detected do in fact have a cardiac output that is adequate for their depressed body function; it is then hard to know whether cardiac massage is going to tip such a slowed and depressed heart into ventricular fibrillation, and thus make survival entirely dependent on maintaining an adequate cardiac output by cardiac massage, until rewarming can be accomplished and defibrillation attempted. If the casualty is only 30 minutes from a well equipped medical facility, cardiac massage should normally be started if required; if it will be many hours or even days before such care can be reached, cardiac massage is almost certainly contraindicated.

### 16.2.2.2            Rewarming

Unless good medical facilities (including immediate electrolyte and blood gas measurements) are available, great caution should be shown in trying to rewarm patients rapidly, and rewarming should only ever be attempted with casualties lying down at rest. Allowing casualties to stand, sit, or exert themselves makes them liable to sudden cardio-vascular 'post-rescue' (or 'circum-rescue') collapse. Excessive heating of the skin can also cause syncopal 'rewarming' collapse. If the casualty became, or has remained, hypothermic for some hours, major changes are likely to have occurred in the water and electrolyte content of different fluid compartments.

( → **Note** ) Attempts to rewarm them rapidly or to alter fluids or electrolytes without monitoring, can worsen the patient's condition and outcome.

( → **Note** ) Patients who are cold but otherwise well and conscious can be rewarmed rapidly by immersing the torso and limbs (to the neck) in a bath at 37-40°C degrees C. Continuous supervision is mandatory. Water temperature must be measured using an accurate thermometer, and maintained carefully during rewarming. Once their rectal temperature has reached about 36.5 degrees C, and before they start to feel hot or start to sweat, they should carefully get out of the bath, lest their core temperature overshoot.

When leaving the hot bath, erect posture may again cause circulatory collapse with syncope, due to peripheral vasodilation.

Most other hypothermic casualties should be slowly rewarmed whilst recumbent in a warm but not hot room, with frequent monitoring of vital signs, heart rate (ECG if possible), blood pressure, and rectal temperature from a thermistor inserted 15 cm beyond the anal sphincter. Full life support and symptomatic management should be continued until they can be carefully evacuated to a hospital facility. If there remain no signs of life in spite of sustained and prolonged efforts to rewarm, and the casualty cannot be taken to a hospital, death can reluctantly be assumed.

In completely conscious victims, drinking hot, sweet fluids may be helpful.

Many different methods are claimed to accelerate rewarming, from hot air blankets to heated breathing systems. The wisdom of such approaches is questionable, and their efficacy in doubt. They can never be a substitute for good medical and nursing care.

( → **Note** ) Forced air rewarming by appropriate air heating systems have proven to offer an extremely sufficient and safe rewarming method, especially in situations without good clinical possibilities.

### 16.2.3            Prevention

Hypothermia can be prevented only by ensuring that heat loss remains in balance with the body's capacity to produce heat. In all but the warmest of waters, this means the maintenance of a layer of insulating air next to the skin, within a dry immersion suit, or sealed within neoprene foam used in a wet suit. However the wear of such suits whilst working out of the water often imposes heat stress on the individual, and a compromise needs to be struck between the ill-effects of excess insulation before immersion, and the improved protection that results during immersion. In general water temperatures of 15 degrees C and below are considered to be cold, and to provide serious thermal challenges before the onset of hypothermia, such as result in initial cold shock and subsequent swimming failure. Accordingly the wear of immersion suits is usually considered to be mandatory when at risk of sudden immersion in water of 15 degrees C and below, and should be considered in risk assessments for water between 15 and 25 degrees C. Suits should cover as much of the body surface area as possible, as the initial responses to cold immersion (cold shock) may still be prominent if they do not cover portions of the arms and legs, for instance.

Protection out of the water generally has the same aim, of maintaining a dry layer of insulation that traps air next to the skin. This will involve an outmost waterproof layer, but ensuring facilities to allow water vapour to escape from within the clothing. If the latter is not encouraged, sweat will accumulate inside the waterproof layer and reduce both comfort and thermal insulation. This may be acceptable for short periods when work rates will be maintained, but as soon as physical work is reduced or stopped, rapid cooling can result. Waterproof layers often minimise the effect of wind, which increases the cooling power of the ambient air through 'windchill'. Although windchill tables reinforce this issue, there are many inaccuracies and assumptions that limit their validity.

Evaporation of water also removes heat from the body at a high rate, because of the high latent heat of vaporisation of water. In some circumstances heat loss may be less when immersed, against having soaking wet clothing in air. Whilst a waterproof outer layer should minimise heat loss from evaporation, protective clothing needs to be well designed to ensure that water ingress is minimised at cuffs and other closures. If clothing does get soaked, personnel should be put inside robust plastic bags (head outside), to eliminate evaporation. These are much more effective than flimsier bags, or those made of metallised plastic sheeting ('space blankets').

When personnel are required to work in the cold, adequate provision must be made for them to return to warm up periodically in a warm and sheltered environment. Attention must also be made to keeping the hands, feet, head and face warm: numb fingers make any type of manual work dangerous, and appropriate gloves or mittens must be worn when necessary. Personnel should also watch for local cold injury such as frostnip and frostbite.

#### **16.2.4      Prediction of Survival Times**

When personnel fall overboard or otherwise become immersed, medical staff are often expected to predict their likely survival, and give advice as to when it is reasonable to step down or call off a search operation. Predicting probable survival times (usually expressed as a '50% survival time') and search durations is empirical, fraught with difficulty, and often influenced by public expectation and other confounding factors.

Important information that should be gathered and recorded carefully includes the sea state, wind speed, wave details (amplitude and frequency, whether breaking or not), water temperature, air temperature, rain or snow, presence of spray or foam, full details of the survivor(s) including build (fat thickness), fitness, known medical problems, clothing, lifejacket, survival suit, level of training, expected time of immersion and mode of entry (fall from height, potential injury during fall), and any other details that might be relevant.

In rougher and colder waters, and those who have neither lifejacket nor immersion suit, a substantial proportion will be expected to die within minutes of entering the water, as a result of cold shock leading to drowning. Most published survival curves are then very optimistic in their predictions, and survival beyond the first 20 minutes, long enough for hypothermia to become relevant, may be unusual if not exceptional.

Warmer and calmer waters can result in remarkably long survival times, with many having survived for longer than 6 hours, and some for more than a day. Those with thicker subcutaneous fat can stabilise their core temperature in quite cool water, and provided that they can remain afloat with their airways and are not attacked by sharks etc. may survive almost indefinitely.

One potentially helpful approach to estimating likely survival times is to start with a base time for a given water temperature, assuming fair conditions, and then to adjust that up or down according to each of the survival factors specific to the case. Analysis of immersion incidents from around the UK coast suggests that reasonable base expectations might be 3 hours for water at 5 degrees C, 6 hours for 10 degrees C, and 12 hours for 15 degrees C.

( → Note ) Survival times of immersion incidents wearing a good floatation device may be much higher according to these data.

Beyond such a likely survival time, the chances of a survivor being alive after recovery are diminishingly low. Attempts to apply a simple multiplier to the expected survival time in order to arrive at a search time are manifestly ill-founded. Searches should be stepped down and eventually terminated altogether when the prospect of recovering someone alive is too small to justify the risk to those undertaking the search. This would be quite different for a small vessel operating alone in worsening weather, compared with settled fine conditions on a populated coast. Decisions made on search times are only ever provisional, and should be reviewed frequently during the operation.

## 16.3 Burn Injuries

### 16.3.1 General Principles

#### 16.3.1.1 Aetiology

Burn mechanisms can be classified into:

- Thermal
  - Contact
  - Flame
  - Flash
  - Scald
- Chemical injuries are treated as burn injuries
  - Acid
  - Alkali
  - Organic hydrocarbons
- Electrical
- Non-Ionizing Radiation

Thermal burns produce coagulative necrosis of skin and underlying tissues. Burn severity depends on the temperature of the insult and the duration of exposure. Above 45 degrees Celsius, progressive cell death occurs and above 60 degrees cell death is almost instantaneous.

Acids produce coagulative tissue necrosis similar to thermal burns, whilst alkalis produce liquefactive necrosis, allowing deeper penetration of injurious agent. Organic hydrocarbons cause liquefaction of lipids.

Electricity causes tissue destruction through heat produced by the resistance of tissues to its conduction.

Intense exposure to non-ionizing radiation produces burns through electrical and microwave energy.

#### 16.3.1.2 Burn Depth

Burns of skin are described as either partial or full-thickness, depending on whether all epidermal elements have been lost. On examination a full-thickness (3rd degree) burn may appear 'waxy-white' or 'lobster red' and is insensitive to the firm touch of a sterile needle. Partial-thickness (2nd degree) burns can be further divided into superficial and deep which refers to the depth at which the dermal layer is injured. Blanching on pressure is present and sensation is preserved. Healing of the skin is likely without surgical intervention. 1st degree burns cause erythema only (e.g. sunburn).

### **16.3.1.3              Outcome**

Burn mortality is related to 4 factors:

- The age of the casualty.
- The volume of burnt tissue (as measured by total body surface area (TBSA) burnt, and depth of burn), and
- The quality of first aid and emergency treatment.
- The presence of inhalation injury

Major burns can be defined as those requiring intravenous fluid resuscitation (>10% TBSA in a child (<30Kg) and >15% in an adult).

### **16.3.1.4              Thermal Burn Pathology**

#### **16.3.1.4.1            Local Effects**

Capillaries of the injured tissues become leaky. Plasma is lost, drawing water with it. This continues for between 3 and 36 hours and results in oedema of the tissues involved. Local airway swelling may lead to loss of the airway by both internal and external oedema. Chest wall oedema may make ventilation difficult and oedema of the limbs may cause ischemia leading to limb loss, especially if the burn is circumferential or in high voltage injuries.

#### **16.3.1.4.2            Systemic Effects**

Hypovolaemia and haemoconcentration lead to a rising blood viscosity, which results in poor systemic tissue perfusion. This is 'Burns Shock'. Red blood cells are lost both directly in the burn and as a result of increased cellular fragility. Damaged tissue will release inflammatory mediators (leukotrienes, prostaglandins, oxygen free radicals and histamine) into the circulation leading to a systemic increase of capillary permeability. Above 25-30%TBSA, this 'middle molecule' release may result in a Systemic Inflammatory Response Syndrome.

#### **16.3.1.4.3            Inhalation Injury**

Inhalation injury is not a single entity, but is considered a variable combination of:

- Airway burn. Supraglottic thermal injury caused by the inhalation of hot gases, flame or steam. Swelling and airway obstruction may be rapid or develop over a period of hours.
- Lung Injury. Lungs are rarely injured from a thermal insult, but products of combustion dissolve in alveolar fluid to produce a chemical pneumonitis.
- Systemic toxicity. Alveolar absorption of combustion products can lead to systemic toxicity. This is usually seen in fires in enclosed spaces and most commonly involves CO and cyanide.

For detailed management, see section (refer to → **Subchapter 11.1.2**)

### **16.3.2 Special Considerations Onboard Ship**

- Enclosed spaces lead to a greater likelihood of inhalation injury.
- Rapid overwhelming of onboard medical facilities and stores.
- Likely delay to evacuation.

### **16.3.3 First Aid**

- Ensure First Aider safety.
- Remove the casualty from the burning source.
- Stop the burning process.
- Ensure ABC.
- Immediate cooling of burned areas.
- Remove to a First Aid Post for emergency medical management.

### **16.3.4 Emergency Medical Management at Role 1 and 2**

#### **16.3.4.1 Manage ABC**

- Consider early airway management, especially if an airway burn is suspected (soot in the nostrils / stridor / hoarse voice). Intubation is unlikely to be tolerated without anaesthetic assistance. If necessary, perform a surgical airway under local anaesthetic.
- Give 100% oxygen by face mask and reservoir bag.

- Ensure IV access obtained, through burnt skin if necessary. Start fluid resuscitation with Ringer's lactate / Hartmann's solution (refer to → **Subchapter 16.3.5.2**).

#### **16.3.4.2            Continuous Cooling of the Burn**

- Continue cooling for at least 20 minutes.
- Use cool fresh or sea water, preferably flowing.
- Proprietary cooling gels should be avoided.
- Avoid very cold water and ice, which may worsen the injury through vasoconstriction.
- Beware inducing hypothermia.

#### **16.3.4.3            Analgesia**

This is best achieved by cooling the burn and by aliquots of IV opiate.

#### **16.3.4.4            Estimation of the Burn Size**

Use the process of serial halving:

- Over half the body surface area burnt.
- Between half and a quarter burnt.
- Between a quarter and an eighth burnt.
- Less than an eighth burnt.

#### **16.3.4.5            Triage (if necessary)**

- Any suspicion of inhalation injury =                      T1
- Burns over a quarter TBSA =                              T1
- Burns between a quarter and an eighth =              T2
- Burns less than an eighth =                              T3

#### **16.3.4.6            Consideration of Early Casevac**

Earliest transfer to a definitive treatment facility at Role 3 should be emphasized for casualties suffering partial and full-thickness burns to over 25% of the body. Survival is low if definitive care is not provided urgently. The advantages of transport must be weighted against the risk of acute complications during evacuation.

( **Note →** ) Fluid replacement should not be excessively delayed while awaiting evacuation.

#### **16.3.5 Treatment in The First 48 Hours**

If a casualty cannot be evacuated to a superior facility, consideration must be given to:

- Management of inhalation injury.
- Adequate fluid resuscitation.
- Prevention of infection.
- Nutrition.

##### **16.3.5.1 Management of Inhalation Injury.**

For details (refer to → **Subchapter 16.5** ).

( **Note →** ) Beware incipient airway obstruction. Give 100% oxygen by face mask with reservoir bag.

##### **16.3.5.2 Fluid Resuscitation**

If a casualty cannot be evacuated, consideration must be given to accurate fluid resuscitation. The TBSA burned must first be precisely mapped onto a Lund and Browder Chart (refer to → **Annex 16.1** ), ignoring areas of simple erythema. Other tools for burn area assessment, such as serial halving and the 'Rule of Nines' are insufficiently accurate for calculation of fluid resuscitation requirements. As aids to accurate assessment, the palmar surface of the casualty's hand, including the fingers, equates to 1% TBSA, and it may be easier in large burns to map unburned areas. The casualty should be weighed, or weights taken from medical records as estimates are unreliable.

If the TBSA burned is >15% (10% in children), intravenous fluid resuscitation must be instituted. A urinary catheter must be placed to monitor fluid resuscitation.

Use Hartmann's solution (Ringer's Lactate). Fluid resuscitation requirements are calculated according to the formula:

- Volume needed in first 24 hours =  $2 \times \text{Weight (kg)} \times \% \text{TBSA burnt}$
- In children =  $3 \times \text{Weight (kg)} \times \% \text{TBSA burnt}$

Half of this volume is given in the first 8 hours from injury, and the remaining half in the following 16 hours. Administer additional fluids for maintenance requirements and where indicated for other losses. Adjust resuscitation fluids to keep an adequate urine output of:

- 0.5 – 1mL/kg body weight/hour in adults.
- 1 – 2mL/kg body weight/hour in children.

After 24 hours, fluids can be given as colloid in aliquots of 500mL, as necessary to maintain an adequate urine output.

( **Note →** ) In burns of <15% (10% in children), oral fluids will suffice. Beware inducing hyponatraemia through inadequate salt intake.

#### **16.3.5.3              Dressings**

The aim of dressings is to reduce the incidence and severity of infection of the burn wound. A burn wound is initially sterile, and if the casualty is to be evacuated within 12 hours of injury, dressings should be kept simple – Clingfilm™ or paraffin gauze, gauze and crepe are most suitable. If evacuation is unlikely to be within 12 hours, a silver-based preparation such as Silver Sulphadiazine 0.01g/g (Flamazine™) or preferably Cerium in Silver Sulphadiazine (Flammacerium™) can be applied to burnt skin and kept in place with paraffin gauze, gauze, Gamgee and crepe (the Haifa dressing), or for hand burns by the use of hand bags or loose gloves secured proximally at the wrist.

( **Note →** ) Burn wounds produce a large amount of exudate. Dressings require changing when exudate has soaked through, or at least daily.

#### **16.3.5.4              Antibiotics**

The main cause of late death of burnt casualties is sepsis, and paradoxically this becomes increasingly difficult to treat if large quantities of early, prophylactic antibiotics have created bacterial resistance. In addition, the normal systemic response to burn injury includes a tachycardia, pyrexia up to 38.5 degrees Celsius and a leucocytosis. Early sepsis is unlikely, and is best avoided by the use of topical agents rather than antibiotics.

Casualties from land and littoral operations, however, are likely to be contaminated and the administration of antibiotic prophylaxis is recommended. In addition, if a casualty is likely to remain on board beyond 12 hours, administration of prophylactic antibiotics should be considered.

#### **16.3.5.5              Nutrition**

Start Nasogastric (NG) feeding if possible. This helps to maintain gut function, lowers the risk of ulceration and may be beneficial in reducing bacterial translocation from the gut. If NG feeding is not possible, administer an H<sub>2</sub> antagonist or PPI.

### **16.3.6              Chemical Burns**

#### **16.3.6.1              Acids and Alkalies**

Acids produce an eschar, similar to that produced by a thermal burn, and this prevents their penetration into deeper tissues.

In contrast, alkalis cause liquefaction and penetration into deeper tissues is more pronounced. Irrigation with water should continue for at least an hour, whilst avoiding hypothermia. Neutrality can be tested with Litmus paper.

( Note → ) Treatment thereafter is as for a thermal burn.

#### **16.3.6.2              Phosphorus Burns**

The majority of phosphorus burns are due to ignition of clothing and are treated as any other thermal burn. Where phosphorus particles are present, the area should be kept moist to avoid ignition of the phosphorus in air, and their removal may be aided by the use of UV illumination.

### **16.3.7              Electrical Burns**

These produce cutaneous contact burns at the site of entry and exit of the current. The cutaneous injury is an under-representation of the extent of tissue damage, and fluid resuscitation requirements should be adjusted accordingly.

( Note → ) Cardiac dysrhythmias may occur following passage of current across the thorax. Cardio-respiratory arrest is reversible and prolonged efforts at resuscitation are justified.

An ECG should be performed in all cases of electrocution.

#### **16.3.8              Non-Ionising Radiation**

Intense exposure to electromagnetic fields (non-ionising radiation) in radiation hazard environments can cause burns of skin and of deeper tissues.

Treatment is as for electrical burns.

#### **16.3.9        Multiple Burn Casualties**

The principles of triage as in disaster situations (refer to → **Subchapter 5.5.5, Annex 5.1**) should be followed.

When facilities for intravenous resuscitation are overwhelmed, Moyer's solution can be made up and given orally. Moyer's solution is an isotonic saline/bicarbonate solution made by adding 5g (one level teaspoon) of salt and 4g (one level teaspoon) of sodium bicarbonate to one litre of water. Toleration is better with chilling and a nasogastric tube may be necessary for administration. Up to 250 ml/hour may be absorbed and a good urine output is again the best clinical indicator of successful treatment. If the casualty has difficulty tolerating Moyer's solution, he may be given a fluid of choice supplemented with 5g sodium chloride per litre consumed.

#### **16.3.10      Surgery**

( → **Note** ) There is no place for tangential excision and grafting of full-thickness or deep partial-thickness burns at sea, other than onboard an Role 3 facility which has specialised burn surgeons and nursing staff on board.

The only requirement for emergency surgery is in performing an escharotomy of a circumferential burn of the thorax or, less urgently, of a limb.

Escharotomy requires incision into unburnt skin either side of the burn and is thus a painful procedure. It best carried out in under general anaesthetic in the operating theatre of an Role 2 or 3 facility. Bleeding can be profuse and facilities for haemostasis must be available.

In the unlikely scenario of an escharotomy being necessary far from these facilities, it must be done slowly and carefully, using local anaesthetic where necessary, and ligating any bleeding vessels as they appear. Application of adrenaline-soaked swabs may help to reduce bleeding from smaller vessels.

( → **Note** ) Take care to avoid the ulnar nerve at the medial elbow, and the peroneal nerve around the fibular head.

The lines of election for escharotomy are shown in ( refer to → **Annex 16-2** ).

( → **Note** ) In electrical and non-ionizing radiation burns, or where escharotomy has been excessively delayed, compartment syndrome may be present and fasciotomy will then be necessary.

## 16.4 Inhalation Trauma

### 16.4.1 Introduction

Exposure to heat, flame, smoke, fumes or noxious gases are particular hazards to personnel on vessels, who often work in closed compartments. There is potential damage to both the upper and lower respiratory tract, and systemic toxins such as carbon monoxide and cyanides, as well as pulmonary irritants including aldehydes, nitrogen dioxide and sulphuric oxides may complicate the picture.

Both upper and lower respiratory tracts must be considered and assessed, and the potential for mechanical restriction of breathing due to circumferential chest burns must be remembered.

( → Note ) Explosions may have occurred and be complicated by lung contusion or by penetrating injuries, themselves leading to possible tension pneumothorax. These will need to be managed along usual lines.

The upper respiratory tract is very vulnerable to life-threatening damage after inhalational injury and must be managed carefully. The lower tract less often suffers severe thermal injury, other than in the case of the inhalation of superheated steam, as the upper tract cools gases efficiently. It responds in a stereotype manner to many causes of inhalational injury and there may be an interval of several hours between exposure and the onset of lower respiratory symptoms and signs.

Recovery occurs after even severe pulmonary inhalation injury if the casualty survives the early damage. Treatment must therefore be instituted before the life-threatening stage is reached.

The initial management of any burns patient commences with a modified “advanced trauma life support” primary survey with emphasis on assessment of airway and breathing, including careful direct inspection of the oropharynx, associated signs of burns and appreciation of the mechanism, timing and details of the injury.

The Level of consciousness must be carefully assessed and observed given the likelihood of hypoxia, carbon monoxide intoxication and possible concomitant head.

( → Note ) All burns patients with inhalation injury should receive oxygen on presentation, ideally at 100% through a humidified non-rebreathing mask but otherwise as high a concentration as possible.

### 16.4.2 Upper Respiratory Tract

Direct thermal injury to pharynx and larynx is rare, but usually predominates in inhalational injury. It is usually associated with burns of the head and neck, or steam or flame inhalation, especially in an enclosed space. It can be sufficient to compromise the airway.

Its presence should be suspected: in flame burns, particularly in an enclosed space; if there is full-thickness or deep dermal burns to the face, neck or upper torso; if there is carbon deposit in the oropharynx; or if there is carbonaceous sputum or singeing of nasal hairs or eyebrows.

( → Note ) More serious features suggest the need for intubation: erythema or swelling of the oropharyngeal mucosa, hoarse voice, harsh cough, stridor, tachypnoea or dyspnoea.

( → Note ) Its onset may be delayed for several hours until fluid resuscitation for burnt areas is underway and this complication should be suspected if during close observation the above features develop. Tachypnoea, cyanosis and wheezing may also indicate involvement of the lower respiratory tract.

( → Note ) If an upper airway burn is suspected on the basis of the exposure history or survey findings, airway protection with a definitive airway is needed. Endotracheal (either orotracheal or nasotracheal) intubation is optimal but can be difficult in this situation, especially for the less experienced. In that case it is acceptable to carefully observe the casualty for signs of worsening respiratory distress while preparing to perform emergency cricothyroidotomy or cricothyroid puncture with large bore cannula should it prove necessary ( à Paragraph 18.3 ). Indications for this would include worsening stridor, cyanosis, worsening SaO<sub>2</sub> if oximeter available or fall in the level of consciousness.

( → Note ) Even if initially the airway appears uncompromised, careful monitoring of the casualty is essential, as deterioration may occur.

#### **16.4.3            Lower Respiratory Tract**

In lower respiratory tract injury combustion products directly irritate the lungs causing bronchospasm, bronchial secretion and inflammation even though they have cooled by the time they reach the lower tract. Normal mucus clearance is impaired, leading to atelectasis. Exudation of cells and fibrin may lead to mucosal sloughing. Where inhaled smoke or noxious gases reach the alveoli, there is an increase in capillary permeability with escape of fluid into the airspaces.

There may be no early signs, but an unexplained tachypnoea is suggestive. Established signs are those of an acute tracheobronchitis with hoarseness and wheeze with expectoration of viscid carbon-stained sputum or bronchial casts. Frank bronchospasm may occur, especially in those with pre-existing airways disease. If alveolar damage has occurred, crackles will be heard over the lungs

with a normal jugular venous pressure, excluding cardiac failure or fluid overload as their cause.

Chest X-ray, if available, shows lung infiltration of fluffy alveolar pattern, identical to that seen in other causes of ARDS.

( → Note ) If exposure to smoke or fumes has been heavy, if tachypnoea occurs or if stridor, wheeze or crackles are present over the lung fields, treatment should commence at once. Oxygen should be administered. Wheeze should be managed with Salbutamol nebulisers or inhalers as available or other bronchodilators, as in asthma. Dehydration should be anticipated and prevented by administration of oral or intravenous fluids. Expectoration should be encouraged and aided by positioning, and physiotherapy if available.

( → Note ) There is no role for prophylactic antibiotics, and steroids should not be used except to treat wheeze and bronchospasm.

For systemic poisoning, such as with carbon monoxide or cyanide, treatment is oxygen and respiratory support while natural clearance occurs.

( → Note ) Hyperbaric oxygen and specific antidotes do have their place in selected cases, but these are unlikely to be available at first or even second Role/level of care.

#### **16.4.4            Other Aspects of Care**

( → Note ) Other injuries must be sought during the rest of the primary survey and the secondary survey, and managed appropriately.

Fluids are needed, both for resuscitation for surface burns following established guidelines, and to aid expectoration by minimising the viscosity of airway secretions.

Analgesia with opiates, titrated against respiratory depression in the self-ventilating patient, should be given as needed for the burns and other injuries (refer to → Chapter 16.3).

( → Note ) Evacuation to specialist care will be needed for all cases, as soon as possible after stabilisation. Patients with inhalation injuries should be accompanied by a qualified escort and maintained on 100% oxygen throughout, after endotracheal intubation or provision of a surgical airway if necessary. Discussion with more experienced personnel regarding preparation for the transfer and optimum destination is essential when possible during the planning for evacuation. Adequate documentation of the incident, clinical state of the patient and management given must accompany him (refer to → Chapter 19).

( → Note ) It is important to remember that inflammatory changes in the airway persist long term, accompanied by systemic inflammatory reaction, and appropriate follow-up should be arranged.

## 16.5 Gynaecological Emergencies

### 16.5.1 Introduction

With increasing number of Navy women serving at sea a growing variety of gynaecologic complaints must be expected. Women assigned to sea duties are generally young and have the corresponding set of "gynaecological problems".

Fortunately, most clinical issues requiring gynaecological consultation are not emergencies and can safely await the ship's return to port or ideally administered using telemedicine second opinion advice. However, some situations will require immediate MEDEVAC. Abdominal or pelvic pain represents the leading symptom of a possible gynaecological emergency. This is often connected with an uncertainty of diagnosis. Sometimes these patients get well before you can figure out the diagnosis. Sometimes they may get worse rapidly with the need of transfer to immediate surgical intervention.

( → Note ) In gynaecologic cases the patient must often be treated before the physician can confirm the diagnosis. More important than knowing the correct diagnosis is doing the right thing for the patient.

The following sub-chapter is intended as guidance led by signs and symptoms of selected gynaecological emergencies, differential diagnosis and appropriate management in the ship's hospital. In some navies pregnant women will be unfit for duty at sea, others allow for a normal pregnancy to stay on board until the 20th week (under well determined general restrictions). Gynaecological emergencies during pregnancy will be covered in brief for the first half of the pregnancy period only.

( → Note ) Patients are to be interviewed and examined in surroundings designed to ensure reasonable visual and auditory privacy. This includes the right to have a person of one's own sex present as a standby during certain parts of an examination, treatment, or procedure performed by a health professional of the opposite sex.

### 16.5.2 Pelvic or Abdominal Pain

#### 16.5.2.1 General Treatment

If the patient has pelvic/abdominal pain or tenderness, placing her on bed rest for a few days will usually help and is never the wrong thing to do. For many of the patients, the pain will simply resolve, although the physician won't know why.

If the patient has a fever in addition to her pain, recommendation is to give her antibiotics to cover Pelvic Inflammatory Disease (PID). With mild pain

and fever, oral antibiotics should work well, so long as they are effective against Chlamydia (Doxycycline, Tetracycline, Erythromycin, Azithromycin, etc.).

If the fever is high or the pain is moderate to severe, IV antibiotics such as Clindamycin/Gentamicin, Cefoxitin, Cefotetan or Flagyl/Gentamicin to cover the possibility of pelvic abscess are indicated.

In cases of chronic pelvic pain complains but no fever, a course of oral Doxycycline is recommended. Some of these women will be suffering from Chlamydia and may become cured through the use of an antibiotic effective against Chlamydia. Others will not improve and will need further evaluation (ashore) by experienced providers in well-equipped settings.

( → Note ) Any female patient complaining of pelvic pain should have a pregnancy test.

#### **16.5.2.2            Oral Contraceptives**

Most patients complaining of intermittent, chronic pelvic pain will benefit from oral contraceptive pills. They reduce or eliminate most dysmenorrhoea and have a favourable influence on other gynaecologic problems such as endometriosis, ovarian cysts, and adenomyosis, causing pain and heavy periods.

Because the birth control pills are so very effective in treating dysmenorrhoea, the emergence of cyclic pelvic pain while taking them is a worrisome symptom. Endometriosis can cause these symptoms. Happily, birth control pills, particularly if taken continuously, are a very effective treatment for endometriosis. Upon return to port, women with pain while taking should be evaluated by an experienced Gynacology specialist.

#### **16.5.3            Early Pregnancy**

( → Note ) Only the first half of the pregnancy period (less than 20 weeks) will be covered by this overview.

##### **16.5.3.1            Pregnancy and Bleeding**

Any pregnant patient who experiences bleeding should lie still (bed rest) until the bleeding stops for a few days. Then she may be moved to a definitive care setting (level 3). If she is destined to miscarry, having her lie still will not prevent the miscarriage, but it will probably postpone the miscarriage until MEDEVAC can be performed to gynaecological capabilities.

##### **16.5.3.2            Threatened Abortion**

Patients who are less than 20 weeks pregnant and have cramping uterine pain are usually threatening to miscarry. Bed rest is recommended for all these patients, not because it will prevent the miscarriage, but because it may postpone the miscarriage until the patient is in a location that can deal effectively with any complications. If MEDEVAC is not an option, then bed rest will still help the woman tolerate the discomfort of the miscarriage. Of all women with a threatened abortion, about half will ultimately miscarry and about half will not. In the group who do not miscarry, the remainder of the pregnancy is usually uneventful.

#### **16.5.3.3            Ectopic Pregnancy**

This is a pregnancy occurring outside the uterus. While these pregnancies will grow briefly, they are not viable and lead to pregnancy loss. The pregnancy loss can be nearly unnoticed, a tubal abortion, but are more often very dramatic, with severe pain and bleeding.

( → **Note** ) If the tube ruptures, extensive and sometimes fatal hemorrhage into the abdominal cavity occurs.

( → **Note** ) Women with an ectopic pregnancy will almost always have a positive pregnancy test, often have vaginal bleeding, and may or may not have abdominal pain or tenderness. Right shoulder pain is an ominous sign, usually indicating extensive hemorrhage into the abdomen, with irritation of the phrenic nerve which courses along the undersurface of the right hemidiaphragm.

In an isolated naval setting, bed rest until a prompt MEDEVAC to a surgical facility is most appropriate. Should MEDEVAC to a surgical facility not be an available option, treatment is supportive, with IV fluids, bed rest, and blood transfusions as needed.

#### **16.5.4            Ovarian Cysts**

An ovarian cyst is a fluid-filled sac arising from the ovary. These cysts are common and generally cause no trouble. Each time a woman ovulates, she forms a small ovarian cyst (3.0 cm in diameter or less). Depending on where she is in her menstrual cycle, you may find such a small ovarian follicular cyst. Large cysts (>7.0 cm) are less common and should be followed clinically or with ultrasound. Occasionally, ovarian cysts may cause a problem by:

- Delaying menstruation.
- Rupturing.
- Twisting.
- Causing pain.

95% of ovarian cysts disappear spontaneously, usually after the next menstrual flow. Those that remain and those causing problems require often to be removed surgically.

#### **16.5.4.1                  Ruptured Ovarian Cyst**

This is an ovarian cyst that has ruptured and spilled its contents into the abdominal cavity. If the cyst is small, its rupture usually occurs unnoticed. If large or if there is associated bleeding from the torn edges of the cyst, then cyst rupture can be accompanied by pain. The pain is initially one-sided and then spreads to the entire pelvis. If there is a large enough spill of fluid or blood, the patient will complain of right shoulder pain. Symptoms should resolve with rest alone. Rarely, surgery is necessary to stop continuing bleeding.

#### **16.5.4.2                  Unruptured Ovarian Cyst**

While most of these have no symptoms, they can cause pain, particularly with strenuous exercise or intercourse. Treatment is symptomatic with rest for those with significant pain. The cyst usually ruptures within a month. Once ruptured, symptoms will gradually subside and no further treatment is necessary. If it doesn't rupture spontaneously, planned surgery is sometimes required to remove it. This will relieve the symptoms and prevent torsion.

#### **16.5.4.3                  Torsioned Ovarian Cyst**

A torsioned ovarian cyst occurs when the cyst twists on its' vascular stalk, disrupting its blood supply. The cyst and ovary (and often a portion of the fallopian tube) die and necrose. Patients with this problem complain of severe unilateral pain with signs of peritonitis (rebound tenderness, rigidity). This problem is often indistinguishable clinically from a pelvic abscess or appendicitis, although an ultrasound scan can be helpful.

Treatment is surgery to remove the necrotic adnexa. If surgery is unavailable, then bed rest, IV fluids and pain medication may result in a satisfactory, though prolonged, recovery. In this suboptimal, non-surgical setting, metabolic acidosis resulting from the tissue necrosis may be the most serious threat.

( → **Note** ) Mortality rates from this condition (without surgery) are in the range of 20%. Early MEDEVAC for surgical intervention will be required in almost all suspected torsioned ovarian cysts.

( → **Note** ) Other surgical conditions which may resemble a twisted ovarian cyst (such as appendicitis or ectopic pregnancy) may not have a good outcome if surgery is delayed. For this reason, patients thought to have a

torsioned ovarian cyst should be moved to a definitive care setting where surgery is available.

#### **16.5.5 Pelvic Inflammatory Disease**

Pelvic Inflammatory Disease (PID) is a bacterial inflammation of the fallopian tubes, ovaries, uterus and cervix. Initial infections are caused by single-agent sexually transmitted diseases (STD), such as Gonorrhea or Chlamydia. Subsequent infections are often caused by multiple non-STD organisms (E. Coli, Bacteroides etc.).

From a clinical management point of view, there are two forms of PID: Mild, and Moderate to Severe

##### **16.5.5.1 Mild Pelvic Inflammatory Disease**

Gradual onset of mild bilateral pelvic pain with purulent vaginal discharge is the typical complaint. Fever <38° Celsius and deep dyspareunia are common.

Moderate pain on motion of the cervix and uterus with purulent or mucopurulent cervical discharge is found on examination. Gram-negative Diplococci or positive Chlamydia culture may or may not be present. WBC may be minimally elevated or normal.

Treatment consists of Doxycycline 100 mg PO BID x 10-14 days, plus one of these:

- Cefoxitin 2.0 gm IM with Probenecid 1.0 gm PO, OR
- Ceftriaxone 250 mg IM, OR
- Ceftizoxime 1 gm IM, OR
- Cefotaxime 0.5 gm IM .

Alternative treatment includes:

- Ofloxacin 400 mg orally twice a day for 14 days, PLUS
- Metronidazole 500 mg orally twice a day for 14 days.

##### **16.5.5.2 Moderate to Severe Pelvic Inflammatory Disease**

With moderate to severe PID, there is a gradual onset of moderate to severe bilateral pelvic pain with purulent vaginal discharge, fever >38.0° Celsius, lassitude, and headache. Symptoms more often occur shortly after the onset or completion of menses. Excruciating pain on movement of the cervix and

uterus is characteristic of this condition. Hypoactive bowel sounds, purulent cervical discharge, and abdominal dissension are often present. Pelvic and abdominal tenderness is always bilateral except in the presence of an IUD (Intra Uterine Device).

Gram-negative Diplococci in cervical discharge or positive Chlamydia culture may or may not be present. WBC and ESR are elevated.

Treatment consists of bed rest, IV fluids, IV antibiotics, and NG suction if ileus is present. Since surgery may be required, MEDEVAC to a definitive surgical facility should be considered.

#### **16.5.5.2.1 Antibiotic Regimen**

Doxycycline 100 mg PO or IV every 12 hours, PLUS either:

- Cefoxitin, 2.0 gm IV every 6 hours, OR
- Cefotetan, 2.0 gm IV every 12 hours.

This is continued for at least 48 hours after clinical improvement. The Doxycycline is continued orally for 10-14 days.

#### **16.5.5.2.2 Alternative Antibiotic Regimen (A)**

- Clindamycin 900 mg IV every 8 hours, PLUS
- Gentamicin, 2.0 mg/kg IV or IM, followed by 1.5 mg/kg IV or IM, every 8 hours.

This is continued for at least 48 hours after clinical improvement. After IV therapy is completed, Doxycycline 100 mg PO BID is given orally for 10-14 days. Clindamycin 450 mg PO daily may also be used for this purpose.

#### **16.5.5.2.3 Alternative Antibiotic Regimen (B)**

- Ofloxacin 400 mg IV every 12 hours, PLUS
- Metronidazole 500 mg IV every 8 hours.

#### **16.5.5.2.4 Alternative Antibiotic Regimen (C)**

- Ampicillin/Subactam 3 g IV every 6 hours, PLUS
- Doxycycline 100 mg IV or orally every 12 hours.

#### **16.5.5.2.5 Alternative Antibiotic Regimen (D)**

- Ciprofloxacin 200 mg IV every 12 hours, PLUS
- Doxycycline 100 mg IV or orally every 12 hours, PLUS
- Metronidazole 500 mg IV every 8 hours.

#### **16.5.6 (Non) Gynaecological Differential Diagnosis**

##### **16.5.6.1 Appendicitis**

Acute appendicitis is the most important differential diagnosis in abdominal and pelvic pain. It is characterized by progressive right lower quadrant pain. Nausea and anorexia occur early. Vague pain begins in the perumbilical area and migrates over several hours to McBurney's Point in the right lower quadrant. The patient lies supine with the right hip flexed. On examination, marked tenderness at McBurney's Point, voluntary guarding, rigidity and rebound tenderness are found. Fever is not common unless appendix is ruptured. Bowel sounds are quiet and no bowel movement will have occurred since the onset of the pain. Motion of the uterus or right adnexa causes marked pain.

X-ray of the abdomen may show an oval, calcified fecalith up to 1-2 cm in diameter in the right lower quadrant of the abdomen. A sentinel loop of gas-filled small bowel next to the appendix may be seen.

( → Note ) The treatment is essentially surgical.

Antibiotics may be helpful but are not a substitute for surgery in other than extreme circumstances. Antibiotics can be used IV while arranging for MEDEVAC to a surgical facility for appendectomy:

- Unasyn 3.0 grams IV every 6 hours PLUS
- Flagyl 500mg IV every 6 hours, OR
- Mefoxin 2 gm IV every 6 hours, PLUS
- Gentamicin 80 mg IV every 8 hours, OR
- Gentamicin 80 mg IV every 8 hours, PLUS
- Flagyl (Metronidazole).
  - Loading dose: 15 mg /kg infused IV over 1 hour (1 gm or 1,000 mg for a 70 kg adult).
  - Maintenance dose: 7.5 mg/kg infused IV over 1 hour, every 6 hours (500 mg for a 70 kg adult).

#### **16.5.6.2      More Differential Diagnostic Considerations**

Consider

- Dysmenorrhoea.
- IUD Problems.
- Functional Bowel Syndrome.
- Gastroenteritis.
- Cystitis.
- Pyelonephritis.
- Bowel Obstruction.

For differential diagnosis.

### **16.6 Sexual Assault**

Reported sexual assault of active duty personnel is a rare event.

( → Note ) Patient care responsibilities take priority over forensic responsibilities, but both are extremely important. Always treat the patient's immediate medical problems first.

Provide a (trained victim) assistant (out of your medical team) who can stay with the patient and remain free of other responsibilities. If at all possible, the assistant should be of the same gender as the victim. As many as 25% of sexual assault victims are male, so you may well need both male and female victim assistants.

Sexual assault victims require expert psychological and social intervention. These patients have to be provided with this expertise as soon as possible, even if they say they want to stay with the command, even if it means MEDEVAC. Without acute psychological intervention, assault victims can lose their career, their long-term psychological stability, or even their lives by suicide. Request timely help from psychological crisis intervention teams or sexual assault response teams of the different navies.

( → Note ) Ensure evidence collection by meticulous documentation. Take photographs if possible with the patient's written permission. Keep the XO and the CO completely informed.

The role of the ship's MO in cases of sexual assault is huge, protecting the patient physically, psychologically, and legally.

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**17. Marine Life Injuries**

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**17.4. Vertebrates – Poisonous Bite or Stings**

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**17.5. Vertebrates – Non-Envenomation**

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**17.6. Treatment Summary**

**17.6.1 Puncture Wounds**

**17.6.2 Rashes**

## 17.1 Introduction

**(NOTE →)** This chapter is intended to provide the method of general wound care, including closure, tetanus prophylaxis, and antibiotic coverage most appropriate for marine bites and stings as well as to identify the invertebrate and vertebrate marine venomous bite/sting treatments. The chapter will provide the animals description (→ **D**), its clinical manifestation (→ **C**) and the medical management (→ **M**) required.

The growing underwater military diving and research presence in the seas makes marine medicine increasingly relevant. The range of medical emergencies precipitated by marine animals is wide. It includes simple, self-limited problems to life-threatening emergencies. Naval Medical Officers and their teams must be prepared for patients presenting after marine injuries. The following will concentrate upon marine bites and stings. The ability to recognize and group a variety of marine injuries into a clinically relevant management plan is the main agenda.

## 17.2 General Principles of Medical Care

### 17.2.1 Initial Considerations

Regardless of the aetiology of the marine injury, the first and most important goal is to rapidly assess the patient for any problem with airway, breathing, or circulation. Always follow the established guidelines in the initial management of patients requiring resuscitation. Anaphylaxis is not uncommon after venomous bite/sting. Pain control is important, provided alterations in mental status are absent.

As in most medical problems, the history is crucial. Attempt to determine when the event occurred, mechanism of injury, marine animal responsible if known, loss of consciousness, symptoms of near drowning, symptoms since injury occurred, concurrent diving injuries, and treatment given prior to arrival.

### 17.2.2 Wound Care

After any specific detoxification, all wounds should be thoroughly irrigated. Crushed or devitalized tissue and any foreign bodies should be removed. Radiographic evaluation for foreign bodies must be considered. Although haemostasis and cosmetics must be considered, closure of marine wounds is **not recommended** and they should be allowed to heal openly. There is a high propensity for marine wounds to become infected. Tetanus prophylaxis is always indicated, if there is no safe tetanus coverage. Wound checks have to be frequent during the first week due to the high infection rate of marine wounds.

**17.2.3           Antibiotics**

Most minor abrasions or lacerations do not require prophylactic antibiotics in healthy crew members. Any patient with suspicion of being immunologically impaired should have prophylactic antibiotic coverage. Oral coverage would be achieved with Ciprofloxacin or Trimethoprim-Sulfamethoxazole. The uses of Penicillin, Ampicillin, Erythromycin, or first generation Cephalosporins are not adequate. Once a marine animal wound becomes infected, the need for wound culturing (if feasible), debridement, and antibiotic therapy is present. *Vibrio* species are important to cover. It is recommended initial parenteral antibiotic coverage includes third or forth generation Cephalosporins such as Cefotaxime and Ceftazidime, Chloramphenicol, Gentamicin, or Tobramycin.

**17.3 Invertebrates****17.3.1           Sponges**

→ **D:** "Fire Sponge", *Tedania ignis*, with its brilliant yellow orange color, is a common offender found in large numbers off the coast of Hawaii and the Florida Keys. Other common sponges include: West Indian and Hawaiian Fire Sponge, *Tedania ignis*; Poison bun sponge, *Fibula nolitangere*; and Northeastern U. S. red sponge, *Microciona prolifera*. Serious reactions are most commonly seen with *Fibula* contact. Crinotoxin is contained in the slimy surface liquid.

→ **C:** Contact dermatitis initially presents as itching, burning, prickling sensation and erythema at the contact site usually the hands. Over the next few hours, local pain, edema, and joint stiffness usually develop. Severe reactions resemble erythema multiforme and may have an anaphylactoid component. Sponge contact can result in an irritant dermatitis secondary to the penetration of calcium carbonate or silicon dioxide spicules into the skin. This usually is manifested as pruritus and is inflammatory. "Sponge fisherman's disease" is stinging syndrome caused by the tentacles of the coelenterate anemones *Sagarlia rosea* or *Actinia* species, which are found attached to the base of the sponge.

→ **M:** Treatment is aimed at both possible reactions. Immediate therapy for sponge contact dermatitis is topical application of a dilute (5%) acetic acid soak for 10-30 minutes. Isopropyl alcohol 40-70% is a reasonable second choice; however, its use is controversial. Steroid lotions may help to alleviate the secondary inflammation but are of no value as an initial decontaminant and may exacerbate the reaction. Surface epithelium may undergo desquamation in areas of contact in a delayed fashion from 10 days to 2 months. Irritant dermatitis may be lessened by removing spine particles from the skin with adhesive tape.

**17.3.2           Coelenterates**

→ **D:** Included here in the “jellyfish” group are the Portuguese Man-of-War, Box-jellyfish, Fire Coral, Anemones, and Sea Nettle. Nematocyst envenomation is the unifying feature of this class of dangerous marine life. The nematocyst apparatus is the stinging organelle found near the mouth or outer surface of the tentacles. A single man-of-war envenomation may involve several hundred thousand nematocysts.

**(NOTE →)** Even broken pieces of tentacles and dead jellyfish can cause envenomation.

The principal biochemical components of the venom are histamine, histamine liberators, serotonin and catecholamines. It is important to consider coelenterate envenomation in all unexplained cases of unconsciousness in the surf, diving accidents, or near drowning cases.

**17.3.2.1                    Portuguese man-of-war**  
(*Physalia physalis* Atlantic, *Physalia utriculus* Pacific)

Found in all tropical and sub-tropical (high) sea areas. They are recognized by their iridescent purple float (pneumatophore), only 2-4 inches in diameter, from which are suspended nematocyst bearing feeding tentacles containing several million stinging cells. The tentacles may be 30 meters long. It is important to note that broken off tentacles fragments retain their potency for months, because these fragments are commonly found blown up on beaches. Fatal reactions are frequently reported from affected coastal areas.

**17.3.2.2                    Box-Jellyfish or Sea Wasp**  
(*Chironex fleckeri*)

They are one of the most lethal marine animals known and are found predominately off the coast of northern Queensland, Australia, as well in the Gulf of Oman. Small, 2-10 cm across the gelatinous bell, in size; however, they are capable of inducing death within one minute after a significant poisonous sting hit. They surface during the calm of the early evening because they are fragile and photosensitive. Mortality after contact is 15-20%, overall. The toxins lethal effects may be from a vasopermeability toxin, possibly serotonin.

**17.3.2.3                    Fire Coral**  
(*Hydrozoans Millepora*)

Fire coral is not a true coral. It is a sessile tropical bottom creature which is often mistaken for seaweed due to attachments to rocks, shells, and coral. Can attain a height of 1-2 meters and are white to yellow green with razor sharp ends in a variety of shapes. Untreated, the pain will resolve in 60-90

minutes; however, the urticarial dermatitis may last up to one week and the hyperpigmentation may persist for several weeks.

#### **17.3.2.4                    Sea Anemones**

Sea anemones are multicolored, flower-like, sessile creatures that can attain an overall diameter of one-half-meter or only be a few millimeters in size. One of the more common is the "Hell's Fire Sea Anemone" (*Actinodendron plumosum*).

#### **17.3.2.5                    Sea Nettle** (*Chrysaora* spp)

Found along the mid-Atlantic seaboard of the U.S.A. This jellyfish creates seasonal problems. The poisonous sting is like that of the Portuguese Man-of-War but usually less severe.

→ **C:** Coelenterate poisonous sting results in a spectrum of severity. It may be limited to a mild skin irritation. It may progress to stinging, paresthesia, pruritis, and central radiation. If severe, multiple organ system findings may appear involving central nervous system, cardiovascular, respiratory, gastrointestinal, and musculoskeletal.

Acute local dermatitis is characterized by linear, erythematous, painful "tentacle prints". Bronchospasm has been reported from inhaling dried jellyfish tentacles. Subacute and chronic reactions are reported in the literature. Fatal reactions are usually from the Box-jellyfish.

The "Irukandji syndrome" is named from a native tribe of NE Queensland, Australia, where a very small box jellyfish, *Carukia barnesi* is endemic. An initially, minor appearing sting is followed by an intense "burning ache" and over the next 24-48 hours intense myalgias and arthralgias develop. Most resolve, but multi-system involvement including pulmonary oedema and respiratory failure has occurred.

→ **M:** Avoiding further nematocyst discharge is important. Immobilization of the affected extremity by whatever available means should be completed. Neutralization of the toxin is accomplished by rinsing the affected area with sea water, NEVER fresh water. Fresh water will trigger un-discharged nematocysts. Diluted 5% acetic acid soaks should be used following sea water rinse for at least 30-90 minutes or until symptoms resolve. If acetic acid is unavailable, isopropyl alcohol (40-70%) irrigation can be used as a last resort. The use of alcohol is controversial, as some report it as ineffective and may discharge nematocysts.

Remove large tentacle fragments with forceps. Apply a drying agent, such as shaving cream, flour, baking soda, or "powder" to the local area then scrape with a knife, razor, or similar device. The drying agent helps to coalesce the tentacles for easier removal. Application of topical steroids and antihistamines can provide symptomatic relief. Tetanus status is indicated. No prophylactic antibiotics are required.

**(NOTE →)** Almost all jellyfish stings can be avoided by wearing total body suits.

Specific antivenin for box jellyfish is available from Commonwealth Serum Laboratories (CSL), Parkville, Australia and is from sheep serum. The dose is 20,000 units (one vial) IV diluted 1:10 in isotonic NaCl solution over 5-10 minutes or 3 ampoules IM. Repeated antivenin administration is possible, if life threatening cardiac or respiratory disturbances remain unchanged (Royal Darwin Hospital recommendations).

Antivenin reference → **Annex 17.1**

Studies have suggested that IV Verapramil may be useful in Box Jelly fish, Sea Nettle, or Portuguese Man-of-War stings.

### **17.3.3 Molluscs**

#### **17.3.3.1 Cone Shells**

→ **D:** Cone shaped gastropods found in shallow tropical water most commonly in the Indo-Pacific region. Cones are nocturnal predatory carnivores that capture their prey by the injection of a neurotoxin via venomous radular teeth. The venom interferes with neuromuscular transmission and has a curariform effect. Most human injuries of this nature result from careless handling of live specimens. Cones inflict a puncture wound, into which the venom is deposited.

→ **C:** Stinging or burning sensation at the local site is noted first, which may quickly progress to local ischemia, cyanosis, numbness and local paralysis of voluntary muscles. A variety of systemic findings can occur and cardiopulmonary arrest has been reported within two hours post-injury . Typically, symptoms resolve within 6-8 hours after initial injury.

→ **M:** For severe bites, therapy is supportive. Otherwise treatment is centered on alleviation of pain. Immersing the wound in hot water to tolerance (45-50 °C) is helpful. No antivenin is available.

#### **17.3.3.2 Octopuses**

→ **D:** Included here are Octopuses, Squid and Cuttlefish. Octopuses are shy cephalopods that usually inhabit the warm water of the inter-tidal zone. All known bites have resulted from handling or accidental contact. The smallest octopi are likely the most dangerous.

Of real interest is only one, the blue-ringed octopus, *Hapalochlaena maculosa*. It is found off the coast of Australia, the Philippines and Salomones. When threatened its inconspicuous yellowish brown body develops iridescent blue rings. These are small and rarely exceed 20 cm in

length. Severe bites result in the rapid onset, less than 30 minutes, of severe respiratory failure secondary to neuromuscular blockade. This is the only animal known to sting with Tetrodotoxin. The duration of action of the toxin is short and no long term effects of the toxin are known provided access to BLS/ACLS is promptly available.

→ **C:** Many victims are unaware of being bitten. Initially, two small puncture wounds may be noted. Mild burning, with subsequent oedema, erythema and pain radiating from the local site is typical. Severe poisonous bites are characterized by perioral paraesthesia, visual blurring, dysphonia, dysphagia, ataxia, paralysis, nausea, vomiting, coagulopathies and respiratory failure. Death is usually secondary to respiratory failure. If no signs of paralysis or respiratory symptoms are present within 15-30 minutes after removal of the octopus, it is unlikely that a severe poisonous sting has occurred.

→ **M:** No antivenin is available. Hot water immersion is not beneficial. Treatment consists of symptomatic and supportive care. Medical supervision of at least 24 hrs is requested, even if the bite is not with major general symptoms.

#### 17.3.4            **Annelid Worms**

##### 17.3.4.1            **Bristleworms**

→ **D:** These segmented marine worms are carnivorous, up to one foot in length and are common in Caribbean waters. Their appendages are bristle-like projections that detach into the victim upon contact.

→ **C:** An intense local reaction occurs and consists of intense pain, redness, pruritus and edema.

→ **M:** Treatment consists of careful bristle removal with forceps if visible or adhesive tape if unable to see bristles. Application of Acetic Acid or Alcohol may relieve pain. Hot water immersion may be effective and should be continued for 30 minutes.

#### 17.3.5            **Echinoderms**

Of the 6,000 species of echinoderms, approximately 80 are known to be venomous. In general they are non-aggressive, slow moving animals whose hallmark is their radial symmetry. The venom of echinoderms contains many toxic components including steroid glycosides, serotonin, acetylcholine-like substances and some neurotoxins.

##### 17.3.5.1            **Sea Urchins**

→ **D:** These are globular creatures with their vital organs encased in hard shell, covered by regularly arranged spines and delicate triple-jawed seizing

organs named pedicellariae. The spines may be venom-bearing or non-venom-bearing.

→ **C:** Immediate local intense burning is typical. A frequent observation is a purple spine dye discoloration under the skin from fragments of irretrievable spines. Soft tissue radiographic films are helpful in localizing spines. Secondary infections are frequent. Systemic reactions may occur, usually following multiple stings, and can include numbness, paralysis and bronchospasm. Delayed reactions to Sea Urchin spines have been reported.

→ **M:** No uniformly accepted treatment of Sea Urchin spine injuries is known. Immersion of the affected part in hot water (45-50 °C), until the pain and other local symptoms subside is helpful. Embedded spines should only be removed if easily accessible and/or radiographic localization has been achieved. Puncture wounds from sea urchins can be prevented by wearing neoprene, booties or shoes, even in shallow water.

#### **17.3.5.2                  Sea Cucumbers**

→ **D:** These are free living, warm like echinoderms located on the ocean floor. When the animal initiates a defense, it anally excretes a visceral liquid toxin, holothurin.

→ **C:** The toxin may induce a contact dermatitis and intense corneal inflammation. Blindness has been reported. It is important to note that Sea Cucumbers eat Nematocysts; therefore, coelenterate venom may accompany the holothurin.

→ **M:** In addition to the treatment of contact dermatitis, it may be useful to rinse with Acetic Acid or Isopropyl Alcohol as described in the treatment of coelenterate.

#### **17.3.5.3                  Starfish**

→ **D:** Although a number of species excrete a slimy venomous substance that produces a contact dermatitis, only one type is most notable for poisonous sting. The crown-of-thorns starfish, *Acanthaster planci* is widely dispersed in tropical waters. Poisnous sting is by contact with the 4-6 cm long needle-like spines on the dorsal surface.

→ **C:** Local symptoms are sharp pain with paresthesia about the wound.

→ **M:** Treatment is symptomatic, with no therapy being required in most cases. Hot water immersion, although suggested, does not yield consistent results as seen with other poisonous stings listed above.

### **17.4 Vertebrates – Poisonous Bite or Sting**

#### **17.4.1                  Stingrays**

→ **D:** Stingrays are common in tropical and subtropical waters. They are the most frequently incriminated group of fishes with respect to human bite with at least 1,500 -2000 injuries reported annually in the U.S.A. Frequently these creatures keep submerged in the sand with only their eyes, spiracles and part of the tail exposed. This accounts for most attacks occurring when the animal strikes an unwary victim who surprises the Stingray while wading in shallow water. Shuttling the feet when walking in the water may warn the Stingray you are near and avoid a painful encounter.

The venom organ is composed of 1-4 stings arranged on the dorsum of the whip-like tail. During an attack, the tail lashes up, thrashing the caudal spine into the victim. The lower extremities are most frequently involved. The venom contains multiple toxic fractions including serotonin, phosphodiesterase, and 5'-nucleotidase which produce varying degrees of cardiovascular and neurological disturbance. The venom is highly unstable and very heat labile.

→ **C:** A stingray wound is traumatic and poisonous. Severe lacerations and secondary bacterial infection frequently occurs. The immediate local effects of the bite include immense pain, oedema, cyanosis and bleeding. The initial cyanosis will become erythematous. The degree of pain is usually out of proportion to what would be seen for non-venomous injuries of similar severity. Systemic findings include abdominal pain, nausea, vomiting, diarrhea, diaphoresis, lymphadenitis, dyspnoea, chills, weakness, bradycardia, hypotension and death.

→ **M:** The wound should be irrigated immediately with whatever is available, including sea water. As soon as possible, the wound should be immersed in hot water (45-50 °C) for 30-90 minutes. The wound should be superficially explored to remove any obvious retained integumentary sheath, which may continue to poison if left undisturbed. Antibiotic prophylaxis is recommended at least with a third generation cephalosporin or Trimethoprim-Sulfamethoxazole. Steroids and Antihistamines have not been effective. **Cryotherapy is absolutely contraindicated.** Supportive treatment of systemic manifestations as required is indicated. No antidotes are available.

#### 17.4.2            Catfish

→ **D:** Catfish inhabit both fresh and salt waters. Marine catfish travel in large schools, are bottom feeders and are generally poorly evasive. The venom apparatus consists of sharp dorsal and pectoral fin spines, associated with venom glands. When the fish becomes excited, the spines can be locked into an extended position. The venom is a milder version of Stingray venom.

→ **C:** The sting usually involves the upper extremity and occurs when the fish is handled. The local reaction consists of intense pain with central radiation, local ischemia, cyanosis, erythema and oedema. Severe stings may remain painful for 48 hours, but usually resolves in 30-60 minutes. Secondary infections are common and *Aeromonas* species are frequently implicated. Systemic symptoms reported include nearly all those listed above for Stingray stings.

→ **M:** Treatment is similar to that outlined above for Stingray stings. Immediate immersion in hot water will often produce immediate pain relief. The spines are frequently a retained foreign body.

#### 17.4.3      **Weeverfish**

→ **D:** Also known as the "Sea Cat" or "Sea Dragon", the Weeverfish is one of the most venomous fish. It is found in the eastern Atlantic Ocean, Mediterranean sea and in European coastal waters. Usually found buried in the soft bottom, when stepped upon they become aggressive and may actually attack. Weeverfish stings occur more frequently in the summer months as the fish move to the shallow waters near shore. Poisonous sting occurs via dorsal dentinal spines which are associated with venom producing glandular tissue. The Weeverfish can generate sufficient thrust to allow the spines to penetrate even leather boots. The venom contains 5-hydroxytryptamine, two albumins, a mucoploysaccharide and other non specified compounds.

→ **C:** The onset of pain is instantaneous and enormous, with a peak in the first hour and resolution occurring over the first 24 hours. A wide spectrum of systemic reactions has been reported.

→ **M:** Treatment is similar to the Stingray's poinsonous sting. Pain is more intense and may be difficult to control, frequently necessitating the liberal use of narcotics. No antidote is available. The fish can survive for hours out of water and should never be handled.

#### 17.4.4      **"Scorpion Fish"**

→ **D:** Scorpion fish rank second only to stingrays in the number of poisonous bites reported per year. This group consists of Scorpion fish, Lionfish, Zebrafish, and Stonefish. They are most commonly found off the Florida Keys, Gulf of Mexico and the coastlines of California and Hawaii; however, they are typical coastal water inhabitants.

Zebra fish are ornate coral reef fish with small venom glands. Scorpion fish are intricately camouflaged, found on the ocean floor and along rocky coastlines. They have moderate sized venom glands. Stonefish are unattractive bottom dwellers found under rocks, coral crevices or buried in the mud. They have short, thick spines with large, well developed venom glands covered with a thick integumentary sheath. Stonefish are the most dangerous, accounting for most known fatal poisonous bites and are indigenous only to the Indo-Pacific region. Stonefish venom is similar in potency to cobra venom. The principal toxic compound is a heat-labile protein. It is thought that the venom is similar in all groups, differing only in potency. The venom retains full potency for at least 24-48 hours after the animal's death.

→ **C:** The clinical manifestations range from relatively mild for Lionfish, moderate to severe for Scorpion fish and potentially lethal for Stonefish. Overall, the first symptom is pain at the site of the poisonous bite, if untreated reaches a maximum of intensity in 60-90 minutes and lasts for 8-12 hours. Radiation of the pain throughout the involved extremity is common. Local findings of erythema,

pallor, ecchymosis, induration, oedema, hyperesthesia or paresthesia are not uncommon. In older wounds, necrosis and sloughing at the wound site has been reported.

( **Note →** ) Stonefish bites can result in cardiovascular collapse in one hour and death in 6-8 hours.

→ **M:** Therapy is similar to the Stingray's poisonous sting. Because the venom is very heat labile, the primary treatment is immediate immersion of the affected area in hot water (45-50 °C) for 30-90 minutes or until symptoms subside. Stone fish antivenin is manufactured by Commonwealth Serum Laboratories (CSL), Parkville, Australia.

Antivenin reference → Annex 17.1.

#### 17.4.5            Sea Snakes

→ **D:** No sea snakes inhabit the Atlantic Ocean or Caribbean; however, they are quite common along the coast in tropical waters of the Indian and Pacific Oceans. Persons most commonly bitten are marine fisherman. Although they may attain lengths of 9 feet, most are 3-4 feet long. Their fangs are short and easily dislodged, therefore most bites are not accompanied by a poison injury. Recognized by their flat tails, all sea snakes are poisonous and are close relatives of the Cobra and Krait. They can travel forward or backward with ease and can remain submerged for hours.

→ **C:** Because Sea Snakes' fangs are so small, the wound site is easily overlooked. Many victims report no known bite until symptoms arise. Unlike the bite of terrestrial Pit Vipers, Sea Snake bites usually lack local manifestations. Major Sea Snake bites are due to the effect of neurotoxins which result in paralysis, dysphagia, dysarthria, muscle spasm and respiratory arrest. Phospholipase A results in myonecrosis and myoglobinuria. Because the typical finding is muscle pain, if no myalgias are present within several hours, poisonous bite likely did not occur. However, all patients should be observed for at least 8 hours prior to discharge. Urine output should be closely followed as myoglobinuria can be detected several hours after the bite. SGOT increases can be used to follow the degree of poisoning.

→ **M:** The pressure-immobilization technique should be used to localize the venom and prevent systemic circulation. Keep the patient warm and quiet. **Cryotherapy is contraindicated.** Always consider that respiratory failure may develop in these patients.

The definitive treatment is to administer antivenin. Antivenin injection remains useful 24-36 hours after the bite. Indications for antivenin include systemic neuromuscular findings, shock, and tender lymphadenopathy. First choice is Australian Sea Snake Antivenin from Commonwealth Serum Laboratories (CSL). Second choice is CSL Tiger snake antivenin. If neither antivenin is available, use polyvalent antivenin. In the absence of antivenin, hemodialysis can be considered. The mortality is 25% in patients not receiving antivenin and 3% overall.

Antivenin reference → Annex 17.1

## **17.5 Vertebrates – Non-Envenomation (Marine Trauma)**

This grouping of marine animals is responsible for the vast majority of marine trauma. Besides the animals listed below in more detail, others like Sea Lions, Killer Whales, Crocodiles, and Alligators have the ability to inflict significant trauma and caution must be taken when in the animal's possible vicinity.

### **17.5.1 Sharks**

The odds of being attacked by a shark are very small, one in four or five million. Sharks do not appear to have a culinary appreciation for people. Most shark attacks occur in temperate waters (between latitudes 40° north and south). Risk factors for attack include recreational areas, sewer outlets, late afternoon, early evening, murky warm water, deep channels, drop-offs, movement (fin-swimming) and bright shiny objects.

It is unusual for the victim to see the shark prior to the attack, except for sometimes being "bumped". Shark bites obviously cause varying degrees of tissue disruption and blood loss. Resuscitation by ATLS management of this trauma is commonly required. The most common offenders are the Grey Reef, Great White, Blue and Mako sharks.

### **17.5.2 Barracudas**

Human attacks have only been documented with the Great Barracuda. These animals are found only in tropical and semitropical waters. Barracudas attack out of confusion in turbid waters or when attracted to shiny objects. The two parallel rows of teeth result in straight or V-shaped wounds. Again, as with shark injuries, trauma is the rule and management is as per shark bites.

### **17.5.3 Moray Eels**

Although most are smaller, moray eels can reach lengths of 3-4 metres. They are bottom dwellers that reside in tropical, semitropical or temperate waters. Encounters occur when divers probe holes and crevices. Most will flee upon confrontation; however, when aggressive, severe lacerations and punctures, most commonly of the hand, are the rule. The eel will not release its grip and frequently requires killing the animal or disarticulating its jaw to free the diver. Treatment is the same as shark bites. The puncture wounds should be irrigated, explored for retained teeth, left open and prophylactic antibiotics used.

### **17.5.4 Needlefish**

Needlefish are surface swimmers that can attain lengths of two metres and are found in tropical waters. "Needle" refers to an elongate sharp snout with which

these animals can impale victims as the fish leaps from the water. Documented injuries have reported in nearly every organ system including fatal brain injuries.

#### **17.5.5        Giant Grouper**

The Sea Bass or Grouper are found in tropical and temperate seas. The Giant Grouper can be 3 metres in length and weigh over 450 kilograms. Although, not aggressive by nature, it should be respected for its fearlessness, size, and cavernous jaws. Shipwrecks and caves are common dwellings. Aggression has been displayed while protecting its domain. Management is the same as shark bites.

### **17.6 Treatment Summary**

The frequency of encounters between swimmers or divers and marine life is ever-increasing due to recreational and occupational interests. The incidence of marine bites and stings is common. Often the inexperienced human will be unable to identify or not be aware that a bite or sting occurred until symptoms develop. The following treatment summary will simplify the approach to the unknown culprit.

This summary is only a framework to begin treatment. It is important to always identify the specific cause when a marine bite or sting is suspected.

**( Note → )** Meticulous wound care is vital to reducing the already high probability of infection.

The wounds may be first divided into two broad clinical presentations: puncture wounds and rashes (vesicles, urticaria, and linear dermatitis).

#### **17.6.1        Puncture Wounds**

Puncture wounds can be considered into two groups.

The first consists of sea snake, octopus, and cone shell.

The appearance of one to several fang marks imply seasnake.

Painless puncture with developing paralysis implies octopus (Blue-ringed).

Painful ischaemic puncture wounds imply cone shells.

For this group local pressure immobilization with close observation for respiratory or cardiovascular collapse is required.

It may develop to a life threatening emergency situation.

Consideration of antivenin if members of this group are suspected (no antivenin is available for cone shells).

The second group of puncture wounds consists of the Stingray, Sea Urchin, Stonefish, Scorpion fish, Starfish, Catfish, and Weeverfish.

The appearance of a lacerated leg wound with ischaemic borders suggests a Stingray.

Purple discoloration, multiple spines or puncture marks suggests a Sea Urchin.

A single puncture wound with an erythematous halo suggests a Scorpion fish.

For this group, immerse the wound in hot (45-50 °C) water for 30-90 minutes or until pain improves. Retained foreign bodies are common.

Consideration of antivenin if Stonefish poisonous bite is suspected.

#### **17.6.2 Rashes**

The rashes can also be considered in two groups.

The first consist of the Fire Coral, Jellyfish, and Anemone.

Linear, sometimes cross-hatching, "tentacle prints" suggests jellyfish.

The rapid onset of skin necrosis at the wound site suggests an anemone.

When this group is suspected, avoid freshwater rinsing and do not rub the surface. Soak the area in 5% acetic acid for 30-90 minutes and then remove remaining stinging cells by forceps and shaving with cream.

If the Box-jellyfish is suspected or endemic, consider antivenin.

The second group of rashes results from the Sponge and Bristleworm.

Irritation from these animals is from multiple microscopic puncture wounds that present as erythematous or urticarial eruptions.

The wound should have adhesive tape applied to remove the tiny spicules. Following spicule removal, an 5% acetic acid soaking should be completed for 30 minutes.

Topical corticosteroid ointment may help local inflammation.

## **18. Management of Specific Maritime Situations**

### **18.1 Seasickness**

#### **18.1.1 Nature and Presentation**

- 18.1.1.1 Aetiology and Susceptibility**
- 18.1.1.2 Signs and Symptoms**

#### **18.1.2 Operational Significance**

#### **18.1.3 Diagnosis and Prevention**

- 18.1.3.1 Diagnosis**
- 18.1.3.2 Prevention**

#### **18.1.4 Treatment**

- 18.1.4.1 Antimuscarines**
- 18.1.4.2 Antihistamines**
- 18.1.4.3 Antimuscarinic / Antihistamines**
- 18.1.4.4 Second Generation Antihistamines**
- 18.1.4.5 Unconventional Treatments**

#### **18.1.5 Practical Recommendations**

### **18.2 Claustrophobia**

#### **18.2.1 Nature and Presentation**

- 18.2.1.1 Symptoms of an Anxiety Attack**

#### **18.2.2 Management and Disposal**

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### **18.3 Humanitarian Missions and Support**

#### **18.3.1 Introduction**

#### **18.3.2 Features Common to Humanitarian Missions**

#### **18.3.3 Effects of Humanitarian Disasters**

- 18.3.3.1 Management of Dehydration and Nutrition in Children**

#### **18.3.4 Naval Humanitarian Assistance Missions (HA)**

#### **18.3.5 Noncombatant Evacuation Operations (NEO)**

### **18.4 Distress and Abandoning Ship**

#### **18.4.1 Introduction**

#### **18.4.2 Actions Prior to Abandoning Ship**

**18.4.3 Distress under Immersion****18.4.3.1 Specific Hazards****18.1 Seasickness****18.1.1 Nature and Presentation**

Seasickness is associated with other forms of motion sickness such as airsickness, car sickness, simulator sickness or space sickness. Motion sickness is a maladaptive response to real and apparent motion. The term "motion sickness" is a misnomer; the much better term is motion adaptation syndrome (MAS).

The spectrum of severity of symptoms ranges from mild discomfort to severe compromise of function to prostration from continual emesis leading to dehydration. With prolonged exposure, the patient may adapt and gradually return to well-being. However, symptoms may recur if motion increases or recurs after a short respite. Prolonged motion sickness with vomiting may lead to arterial hypotension, dehydration, inanition, and depression.

( **Note →** ) Motion sickness can be a serious complication in patients with other illnesses. Incapacitation of key personnel can be devastating.

**18.1.1.1 Aetiology and Susceptibility**

Several theories of the aetiology of motion sickness are described. Most of these theories are variations of a theme that asserts that the symptoms of motion sickness arise when the brain is unable to resolve a conflict between the various sensory modalities that provide information regarding position and movement of the body. These modalities include tilt/linear acceleration and angular acceleration from the otolith organs and the semicircular canals, respectively, visual information, and proprioception.

A crew member below deck in rolling seas without visual reference to the horizon experiences the motion of the ship perceived by the vestibular and proprioceptive systems while the bulkheads do not appear to move relative to the observer. This mismatch of sensory information somehow gives rise to the release of neurotransmitter that acts in the general region of the Area Postrema, stimulating the nearby vomiting centre.

One theory postulates that the sensory conflict stimulates a response in the brain stem similar to that caused by some neurotoxins. Proponents of this theory describe the signs and symptoms of motion sickness as the result of the stimulation, by motion, of a "poison-response mechanism." This mechanism evolved to rid the body of toxic ingested substances by emptying the stomach, and countering or minimizing the effects of absorbed toxin via a stress response of the sympathetic nervous system.

Of particular interest is the fact that a functional vestibular system is required for an individual to suffer from motion sickness. In individuals and animals in whom the vestibular apparatus has been ablated or the vestibular pathway interrupted, motion sickness has not been induced, despite extensive effort.

( **Note →** ) Conflict theory: the pattern of sensory inputs concerning orientation and motion is in conflict with the pattern of inputs anticipated on the basis of past experience.

Individual susceptibility to seasickness varies greatly.

Visual stimuli, poor ventilation (with fumes, smoke, or carbon monoxide), and emotional factors (e.g., fear, anxiety) commonly act with motion to precipitate an attack.

It is a compounded problem in the maritime environment since sleeping conditions aboard often is not conducive to restful sleep. Sleep deprivation interferes with the vestibular habituation process.

( **Note →** ) Sleep deprivation magnifies motion sickness occurrence.

According to recent studies there is no difference in seasickness susceptibility on gender and age.

#### **18.1.1.2                    Signs and Symptoms**

Cardinal signs are facial and circumoral pallor and / or flushing, cold sweating, retching, vomiting. Leading symptom is cyclic nausea. Associated with seasickness are other signs and symptoms such as:

- Epigastric awareness.
- Epigastric discomfort.
- Drowsiness.
- Yawning.
- Feeling of bodily warmth.
- Increased salivation.
- Headache.
- Dizziness.

Once nausea and vomiting develop, the patient is weak and unable to concentrate; however, several after-effects are likely to affect the individuals' performance, such as:

- Persistent (frontal) headaches.
- Lethargy and apathy.
- Anorexia.
- General malaise.
- Persistent dizziness.
- Disorientation and light-headedness.
- Belching and flatulence.
- Reactive depression.
- Irresistible drowsiness.

( **Note →** ) Typical for seasickness is disinclination for physical and mental work, introversion avoiding participation in group activities.

#### **18.1.2              Operational Significance**

The fighting and functional abilities of warships are degraded in severe weather conditions, primarily due to the adverse effects of ship motion on crew performance, primarily for the first few days of a bad weather period.

An impact on behaviour and performance varies independently from reported symptoms. They may include:

- Distraction from task.
- Decreased spontaneity, inactivity, and subdued affect.
- Decreased muscular and eye-hand coordination.
- Decreased ability to estimate time.
- Decreased performance of arithmetic computation.

Crew members may become unable to perform assigned duties and pose a liability to others. Morale may become affected. Embarked personnel may become affected in the ability to carry out their duties immediately after disembarkation or landing.

In sea survival settings (refer to → **Chapter 24**) seasickness may have adverse effects on survival by:

- Erosion of the will to survive.
- Fading of ability and willing to take positive action on aiding survival.
- Speeded dehydration and electrolyte balance disturbances by recurrent vomiting.

**( Note → )** Motion induced fatigue caused by added muscular effort to maintain balance interferes with task performance due to the loss of balance and has significant impact on cognition or perception especially in tasks of long duration.

#### **18.1.3 Diagnosis and Prevention**

Prevention and management of seasickness offers a broad field of scientifically proved methods and self-medications based upon individual experiences. Technical solutions like ship design considerations are beyond the scope of this chapter. In principle the following may be considered by the ships' MO for crew members being seasick:

- Habituation and adaptation effects.
- Biofeedback training.
- Relaxation therapy.
- Drug treatment.
- Unconventional measures.

##### **18.1.3.1 Diagnosis**

Diagnosis of motion sickness is straightforward. However, a differential diagnosis should be considered in cases of persistent illness or illness refractory to management.

##### **18.1.3.2 Prevention**

Prevention is easier than treatment using (prophylactic) drugs.

Most individuals habituate or adapt to a motion environment over a period of time that varies in length. Habituation is the effects of repeated exposure to the stimulus whereas adaptation occurs in a prolonged single exposure. Continuous exposure to rough sea brings about reduced sensitivity through a change in the relevant sensory organs. The acquisition of habituation shows individual

variation. The factors determining habituation and the question about long term effects remain still unclear.

Biofeedback and relaxation therapy may be beneficial for some, however, training effects vary greatly among individuals.

When motion is unavoidable, susceptible persons should minimize exposure by positioning themselves where motion is the least (residing amidships close to water level) and limit their own head movements to prevent confusing vestibular input. A supine or semirecumbent position with the head supported is best.

Reading should be avoided. Keeping the axis of vision at a 45° angle above the horizon reduces susceptibility. Avoiding visual fixation on waves or other moving objects is helpful to some. A well-ventilated cabin is important, and going out on deck for a breath of fresh air helps.

( **Note →** ) Alcoholic or dietary excesses before or during the cruise increase the likelihood of motion sickness.

#### **18.1.4 Treatment**

Certain drugs can reduce the incidence and severity of seasickness. None can completely prevent seasickness under all conditions of provocative stimulation. None are entirely specific and all have side effects.

It remains unclear whether the effectiveness of anti-motion sickness in antihistamines is due to its sedative action or its antihistaminic property.

( **Note →** ) The mechanism of action of commonly used agents is poorly understood. Unconventional treatments have even poorer scientific background.

##### **18.1.4.1 Antimuscarinics**

Scopolamine (hyoscine) (“bella donna”) shows considerable side effects, drowsiness, dry mouth and short-term memory loss.

Preferred application form by TTS patch applied 18 - 10 hours before, lasts for 48-72 hours. Loading dose of 200 µg and controlled release at 10 µg /hour.

##### **18.1.4.2 Antihistamines (H<sub>1</sub> Receptor Antagonists)**

They are less efficacious than antimuscarinics, however more commonly used due to higher safety and fewer side effects except for drowsiness.

Cyclizine has been displaced in most nations by the longer acting Meclizine. Cinnarazine has low incidence of sedation (but is not available everywhere) and its derivate Flunarizine are as well antihistamines although they are sometimes listed as calcium blockers.

Commonly used antihistamines are:

- Dimenhydrinate  
50 mg, oral dose, acts within 1-2 h, lasts about 6 h.
- Cyclizine HCL  
50 mg, oral dose, acts within 1-2 h, lasts about 6 h.
- Meclizine  
30 - 50 mg, oral dose, acts within 2 h, lasts about 8 h
- Cinnarazine / Flunarizine  
75 / 10 mg, single oral dose, acts within 2 h, lasts about 8 h

#### **18.1.4.3 Antimuscarinic / Antihistamines**

These drugs are frequently described as antihistamines that also have anticholinergic effects. At therapeutic doses they are highly anticholongeric. They are acting as antagonists on the parasympathetic system and relax voluntary muscles.

Promethazine (25 mg, oral dose, acts within 1-2 hours, lasts about 8 - 12 hours) is more anticholinergic than Diphenhydramine. Side effects are drowsiness and sleepiness.

#### **18.1.4.4 Second Generation Antihistamines**

Drugs like Fexofenadine (Allegra), Astemizole (Hismanal), or Cetirizine (Reactine) have shown some promising laboratory effects, however, they are ineffective in alleviating seasickness.

#### **18.1.4.5 Unconventional Treatments**

- Herbal (ginger roots): some reported prophylactic effects, other failed to substantiate the effectiveness.
- Homeopathic (Cocculus, Nux Vomica, Petroleum, Tabacum, Kreosotum, Borax, Rhus Tox).
- Ascorbic Acid (Vitamin C).
- Acupuncture and acupressure therapy (wristbands, sea bands, relief band) to prevent nausea and vomiting.

Controlled scientific studies failed to indicate effectiveness. Positive effects could be attributed to placebo effect and habituation to the environment.

However, they may help and they don't harm.

#### **18.1.5 Practical Recommendations**

The following recommendations will keep the active role in prevention and treatment of seasickness patients at the ships MO:

- Inform the crew by thorough understanding of the phenomenon of seasickness.
- Encourage affected individuals to discuss their susceptibility early and frankly with medical staff.
- Prevent self-medication.
- Do not stop "successful" unconventional treatments.
- Ensure optimal environmental conditions, suitable temperature and ample ventilation.
- Check for co-existing claustrophobia or as differential diagnosis.

Affected crew members should be encouraged to:

- Become familiar with their own development of symptoms.
- Maintain normal light consumption of food and drink, however, nil alcohol.
- Achieve optimal physical fitness condition.
- Minimize anxiety by gradual introduction to provocative motion and task performance.
- Avoid multiple provocative stimuli.
- Minimize unnecessary head motion.
- Use an external visual frame of reference whenever possible.

#### **18.2 Claustrophobia**

##### **18.2.1 Nature and Presentation**

A phobia is a form of anxiety disorder in which someone has an intense and irrational fear of certain objects or situations. Anyone suffering from high levels of anxiety is at risk of developing a phobia.

One of the most common phobias is claustrophobia, or the fear of enclosed spaces. A crew member who has claustrophobia may panic when inside a crowded room, other confined area or wearing a respirator.

Because claustrophobic behaviour is connected with the level of anxiety first manifestation may be present under specific conditions aboard.

#### **18.2.1.1              Symptoms of an Anxiety Attack**

If a crew member suffering from (masked) claustrophobia suddenly finds themselves in a triggering situation, they may have an anxiety attack.

Symptoms can include:

- Sweating,
- Tachycardia.
- Hyperventilation.
- Shaking.
- Light-headedness.
- Nausea.
- Fainting.
- Fear of actual harm or illness.

( **Note →** ) Symptoms of claustrophobia can mimic seasickness or vice versa.

Specific symptoms of claustrophobia in the enclosed environment of a military vessel may include: checking for the exits, standing near the exits or feeling alarmed when all doors are closed. In extreme cases a closed hatch will trigger feelings of panic. In the fire fighting role wearing of the respirator may detect masked claustrophobia if the soldier refuses the respirator. Problems may also develop when wearing rescue equipment or in life rafts.

( **Note →** ) During the respirator clearance physical exams questioning should include possible symptoms of claustrophobia.

**18.2.1 Management and Disposal**

With appropriate treatment, it is possible to overcome most claustrophobia or any other phobia. However, this is time consuming and will disqualify for duty on board ships at least for a period of several months..

( **Note →** ) Handling of claustrophobic patients requires psychological or psychiatric consultation, especially in questionable cases.

During interim management, a person with questionable claustrophobia may be tested by the ships physician by wearing a breathing apparatus under controlled careful conditions for short periods trying to get used to wearing it for longer periods.

Once a person has experienced a number of anxiety attacks, they become increasingly afraid of experiencing another. They start to avoid the objects or situations that bring on the attack. However, any coping technique that relies on avoidance can only make the phobia worse. It seems that anticipating the possibility of confinement within a small space intensifies the feelings of anxiety and fear.

**18.2.1.1 Treatment**

For an individual with a disabling claustrophobia, the realisation that this fear is irrational and that treatment is needed can cause further anxiety. Since most treatment options depend on confronting the feared situation or object, the affected person may feel reluctant. Support and encouragement from the social environment is crucial. Trying to overcome a phobia may be particularly challenging, and will need the understanding and support of people around them.

Treatment options for claustrophobia may include:

- Flooding - this is a form of exposure treatment, where the person is exposed to their phobic trigger until the anxiety attack passes. The realisation that they have encountered their most dreaded object or situation, and come to no actual harm, can be a powerful form of therapy.
- Counter-conditioning - if the person is far too fearful to attempt flooding, then counter-conditioning can be an option. The person is taught to use specific relaxation and visualisation techniques when experiencing phobia-related anxiety. The phobic trigger is slowly introduced, step-by-step, while the person concentrates on attaining physical and mental relaxation. Eventually, they can confront the source of their fear without feeling anxious. This is known as systematic desensitisation.

- Modelling - the person watches other people confront the phobic trigger without fear, and is encouraged to imitate that confidence.
- Cognitive behaviour therapy - the person is encouraged to confront and change the specific thoughts and attitudes that lead to feelings of fear.
- Medications - Beta blockers may be used to treat the physical symptoms of anxiety, such as a pounding heart.

Treatment options on board are generally limited to light cases. Severe cases must be transferred to outpatient or in very severe cases inpatient treatment.

### **18.3 Humanitarian Missions and Support**

#### **18.3.1 Introduction**

The traditional roles of a nation's military are to defend the nation's borders against enemies, and to prepare to wage war when necessary. The military has seen a dramatic increase in the number of missions that Service members have participated in, and in the number of nations to which they have been deployed. While the use of the nation's military is increasing, the traditional roles of fighting wars and protecting the nation's borders have been augmented by what are broadly known as humanitarian missions. Such missions are also known as Operations Other Than War (OOTW) or Strategic and Sustainment Operations (SASO). Each mission is likely to have unique features, based on factors such as geography, climate, the population being served, and the local infrastructure.

It is most likely that naval forces may be engaged in humanitarian missions or found confronted with demanding local humanitarian scenarios at sea.

#### **18.3.2 Features Common to Humanitarian Missions**

Most humanitarian missions are undertaken in response to a humanitarian emergency.

A humanitarian emergency is defined as a crisis involving a large population for whom the local government is unable to meet basic needs, either due to disruption or displacement. Humanitarian emergencies are generally brought on by one or more specific events, such as war, famine or natural disaster.

- Natural disasters: These are more or less unpredictable, sudden climatic or geologic events. Some populations have greater vulnerability to such events due to overpopulation and weak infrastructure. Examples include flooding, "tsunami waves", earthquakes, hurricanes, or famine and

draught.

- Technological disasters: These include release of nuclear, chemical, or biological hazards. This may be accidental (nuclear reactor, chemical plant), or intentional, as a terrorist act.
- Complex Emergencies: These are the result of war or civil strife, typically involving displacement of many people from their homes, heavy damage to infrastructure, and continuing risks to personal safety. In recent years, more civilians have been killed and injured in war than have soldiers. Some are refugees, who leave their own country as a result of war, violence, or fear of persecution. Others are classified as displaced persons, since they stay within their own nation's borders, but leave their homes. Very often they are using boats or other floating platforms.

### **18.3.3 Effects of Humanitarian Disasters**

Effects can be expected to vary according to the type of disaster as well as unique local factors such as infrastructural features. Among the effects that should be anticipated and assessed in preparing a response for displaced people at sea are:

- Inadequate water supply: most likely to be too small and contaminated. This is also a problem with large numbers of displaced persons in complex emergencies.
- Inadequate shelter: likely to be particularly effected by using emergency platforms following floods, hurricanes and earthquakes.
- Inadequate sanitation: a leading contributor to the spread of disease. This is common to complex disasters with displaced persons, crowded situation aboard the swimming platform, as well as many natural disasters such as hurricanes and floods.
- Inadequate health care: this is often a problem even before a disaster in the developing world, making efforts to respond to a disaster that much more difficult.
- Trauma: a superimposed problem in sudden, catastrophic natural events such as earthquakes, tornadoes, and hazards at sea. It may complicate complex emergencies if military or paramilitary forces terrorize a population.
- Mortality: the unfortunate end result of many of the above factors. Most often measured through calculation of crude mortality rates (CMRs), which can be compared with baseline CMRs for the region to give an estimate of the severity of the disaster as well as the success of one's response efforts.

- The most common causes of mortality in displaced people at sea are the same as in the developing world, especially in children, even in the absence of humanitarian emergencies: Diarrhoea and dehydration, measles, malaria, acute respiratory infections and malnutrition.

( **Note →** ) Treatment of choice is oral rehydration therapy (ORT).

ORT is safe, effective, and cheap. Most important of all, it can be given by mothers or other relatives, enabling personnel to evaluate and institute therapy for far greater numbers. Diarrhoea can cause more than half the deaths early in a humanitarian emergency, but dramatic reductions in mortality have been made possible by ORT. Several alternative formulations have been found to be effective, using (local)components such as corn or rice in place of sugar.

#### **18.3.3.1 Management of Dehydration and Nutrition in Children**

Staff assigned to this activity need to be well-trained in the assessment and treatment of the dehydrated patient. Individual patients should be monitored to determine whether the recommended doses are adequate for their needs or whether rehydration proceeds faster than is expected.

( **Note →** ) For babies who are unable to drink but are not in shock, a nasogastric tube can be used to administer oral rehydration solution at the rate of 15 ml/kg body weight/hour. For infants in shock, a nasogastric tube should be used only if IV equipment and fluids are not available. If the child is less than 12 months of age, the mother should be advised to continue breast-feeding. If the child is not being breast-fed, 100-200 ml of clean, plain water should be given before continuing the oral rehydration solution. Older children and adults should consume plain water as often as they wish throughout the course of rehydration with oral rehydration solution.

The patient's hydration status should be reassessed after 3-4 hours, and treatment continued according to the degree of dehydration at that time.

Nutritional maintenance: For children greater than 4-6 months old and adults, feeding should begin as soon as the appetite returns. Energy-rich, easily digestible foods will help maintain their nutritional status. There is no reason to delay feeding until the diarrhoea stops and there is no justification for "resting" the bowel through fasting. The overall volume of fluid should be calculated according to the child's weight and degree of dehydration.

( **Note →** ) Anti-microbial drugs are contraindicated for the routine treatment of uncomplicated, watery diarrhoea. Specific indications for their use include Cholera, Shigella and Amoebic dysentery, acute Giardiasis ( refer to → **Chapter 15** ).

Anti-diarrhoeal agents are contraindicated for the treatment of diarrhoeal disease. Stimulants, steroids, and purgatives are not indicated for treatment of diarrhoeal disease and may produce adverse effects.

#### **18.3.4 Naval Humanitarian Assistance Missions (HA)**

( refer to → NATO document EXTAC 1011 )

Humanitarian assistance (HA) is a program to relieve or reduce the results of natural or manmade disasters or other endemic conditions such as human pain, disease, hunger or hardship that might present a serious threat to life or result in a great loss of property.

HA provided by extra-national forces is limited in scope and duration. The assistance provided is designed to supplement or complement the efforts of the host nation civil authorities or agencies that have the primary responsibility for providing HA.

#### **18.3.5 Non-combatant Evacuation Operations (NEO)**

( Refer to → NATO document EXTAC 1010 )

Non-combatant Evacuation Operations (NEO) NEO are conducted:

- To evacuate non-combatants and non-essential military personnel from locations in a foreign nation to an appropriate safe haven in the home nation or elsewhere
- To evacuate citizens whose lives are in danger
- To evacuate of selected citizens of the host nation or third country nationals.

NEO have humanitarian, military and political implications. The ship's Sickbay is alerted in almost every NEO involving the ship. The environment of the NEO may be permissive, uncertain or hostile with impacts on the alertness depending on the kind of (combat) landing forces used for the NEO. EvacOps are essentially defensive in nature.

If the ship is acting as an evacuation unit, provision of health and comfort items as well as medical assistance for the evacuees, is requested.

General considerations for the Sickbay:

- Coordination of the movement of casualties from the evacuation site to a medical facility capable of providing the required treatment.
- Immediate medical and surgical treatment may be required.
- Potential for large numbers of both military and civilian casualties.

- Search and Rescue (SAR) is absolutely necessary in uncertain or hostile NEO.
- Evacuee processing to medical unit(s).
- Preparation of the Sickbay to screen all evacuees for treatment.
- Desire to provide: surgery, special treatment, special psychiatric rapid intervention team, preventive medicine, disaster support.

Specific considerations for the Medical element of the evacuation unit:

- Provide necessary health and comfort items for evacuees.
- Provide emergency bunks, including blankets and bedding. If the number of bunks is less than the number of evacuees, establish a rotational system for maximum use of available berthing.
- Preparation of medical triage for administering first aid and inoculations as required.
- Preparation of Sickbay to receive medical emergencies as they arise.
- Preparation of isolation ward for evacuees with contagious diseases.
- Establishment of infant feeding centre (plastic baby bottles, disposable plastic liners, disposable diapers, one blender for food preparation).

Should the evacuation unit act as temporary safe haven organization the Sickbay provides support to temporary safe haven force; also conduction of evacuee medical screening if not yet performed at evacuation control centre (ECC):

- Determination if an evacuee requires emergency medical treatment.
- Perform emergency treatment or coordinate with local hospital to treat the patient.
- Advise temporary safe haven officer in charge on hygiene and preventive medicine.
- Inspect food and water obtained from local sources.
- Evaluate the general health of evacuees, particularly in regard to pregnancies and the possibility of communicable diseases

The Medical Regulation Organization known as the SMO of the naval force sent to NEO is responsible for comprehensive and detailed casualty and medical support planning to cover immediate medical and surgical treatment points.

Medical personnel must remember the potential for large numbers of both military and civilian casualties.

## **18.4 Distress and Abandoning Ship**

### **18.4.1 Introduction**

( Note → ) For Sea Survival including life rafts refer to →**Chapter 24**.

Analysis of naval disasters has revealed that, in spite of major technological developments in survival aids the changes of survival are limited in extreme conditions and only marginal in relatively good conditions, in the absence of adequate preparedness. Knowledge and pre-planning are as important to the MO as to any other individual onboard.

Protection from the hazards of the environment should have highest priority, and, as one can survive some days without water and weeks without food, protection and water supply have a higher priority than nutrition.

### **18.4.2 Actions Prior to Abandoning Ship**

Particular regard should be made to the requirement to don as much clothing as possible (including gloves and head (tent) protection) preferably with a waterproof outer layer. Experience has shown that, whether one is immersed or lucky enough to gain the safety of a life-raft, cold is the most life threatening hazard to the shipwreck survivor. If time permits, and abandonment is orderly, extra clothing and blankets will prove more important than extra water and rations in all but tropical waters.

Prior to abandoning ship there may be insufficient time for the MO to collect drugs and other items of equipment to supplement the usually meagre first-aid supplies in a life-raft. It is advisable to keep a small emergency pack in a waterproof container in the MOs cabin together with his lifejacket, and another container near the exit of the Sickbay. The contents of such a supplementary pack should be decided after checking the contents of the first aid pack of the life-rafts, and will be influenced by personal therapeutic practices. It is suggested that in addition to any drugs such a pack should contain:

- 1 pair blunt-ended scissors
- 2 curved artery forceps
- 12 safety pins (at least two sizes)
- 1 waterproof torch and spare batteries

- Bandages and dressings (including tins of Vaseline impregnated gauze dressings)
- Antibiotics; analgesics; anaesthetic and antibiotic eye drops and ointments; silicone ointment.

Ideally, this pack should be placed in a waterproof container with inherent buoyancy. It should be easy to carry and capable of securing to the lifejacket or person, because for personal safety both hands are required to assist a casualty or to scramble down a rope or ladder. Care should be taken to position it where it will not cause injury if the carrier is forced to jump into the sea.

#### **18.4.3            Distress under Immersion**

Every effort should be made to board the life-raft dry if at all possible. Immersion after shipwreck is associated with many hazards, the most important of which are the effects of cold and drowning (refer to → **Chapter 16**). For survival in life-rafts (refer to → **Chapter 24**). Other more acute dangers to the individuals in the water include entanglement or traumatic contact with structures from the sinking ship, suction, inhalation and contamination with fuel oil, trauma from surfacing buoyant objects from the sinking ship and underwater explosions.

##### **18.4.3.1        Specific Hazards**

Contact with oil on the sea's surface should be avoided as far as possible: hold one's nose when jumping, keep one's head and eyes clear of the surface when swimming and keep the mouth closed. Direct contact with fuel oil is more unpleasant than dangerous. It has a negligible systemic toxicity but if swallowed it may cause vomiting, if inhaled it may produce pneumonia and if brought into the eyes it will produce conjunctivitis. However, it does not produce any delay in wound or burn healing.

Burning oil at the sea's surface is a different matter: if one has to jump from the ship into burning oil one may be able to avoid being burned if the following procedure is adopted. First remove the lifejacket and other cumbersome clothing, then jump feet first through the flames, swim underwater for as long as possible then spring above the flames and breathe, using the breast stroke to push away the flames, then submerge and repeat until clear of the flames.

Suction from a sinking ship is a dramatic rumour. It depends on the survivor's proximity to the ship, its size and rate of sinking. The risk is reduced if one is wearing a lifejacket, and negligible if one is in a life-raft or lifeboat.

A far greater threat, whether in the water or in a boat or raft, is the possibility of being struck or ensnared by some part of the superstructure as the ship capsizes, or being hit from below by the release of some buoyant object from

the sunken vessel. This risk is reduced in distance from the sinking ship as quickly as possible and, if one is in the water near the sinking ship, it is better to adopt a vertical attitude.

An explosion may be responsible for the initial damage to the ship or may occur later as a consequence of the initial damage. Explosions may also occur from pre-set depth charges or some other cause when the ship is sinking. Injuries may be produced as direct or indirect result of the blast, or from the thermal effects of the flash. Underwater explosions constitute a serious threat to the life of the survivor in water. Tissues surrounding air-containing cavities are typically affected. Lesions include: contusion and haemorrhage of the lung bases, rupture of the large intestine and sub-capsular haemorrhage of the upper surface of the liver consistent with a violent upwards movement of the intra-abdominal viscera, bruising of the inter-costal muscles and tearing of ligaments and attachments, such as that of the gall bladder. These injuries are determined by the distance of the victim from the explosion and a variety of interacting factors such as depth of water, the nature of the seabed, the flotation attitude of the victim in the water and the amount and type of clothing worn.

## 19. Transfer of Patients

### 19.1 Introduction

### 19.2 General Principles

#### 19.2.1 Specific Problems

### 19.3 Means of Transfer

#### 19.3.1 Transfer by Sea-boat

#### 19.3.2 Transfer by Life-raft

#### 19.3.3 Transfer by Jackstay

#### 19.3.4 Transfer by Helicopter

#### 19.3.5 Transfer by Fixed Wing Aircraft Flight

#### 19.3.6 Transfer by Hovercraft

### 19.4 MEDEVAC

### 19.1 Introduction

A need for treatment which cannot be given satisfactorily onboard will determine the requirement for transfer to another ship or to shore. There will be both medical and operational risk associated with transfer at sea and the medical consequences of any delay while the ship makes for a suitable port must be considered and clearly stated when the matter is discussed with the officer in command. This discussion should take place early in the assessment if transfer is envisaged. The sea state as well as flying conditions may be variable and depending on the situation it may be more practicable to transfer the medical officer instead of the patient.

A patient capable of walking who has the use of his arms (e.g. a man with an eye wound) may be able to negotiate a ladder without risk but where an arm is splinted a considerable hazard is present in the same situation. In general there will be two groups to consider: those capable of fending for themselves with minimal restriction in situations of environmental danger, and those who require complete support and are usually best moved firmly secured in a stretcher.

A patient's priority status must be included in the message request for MEDEVAC (refer to → **Subchapter 2.4 and 19.4**).

→ URGENT indicates a life-or-limb threatening injury or illness. This should result in a pick-up within 24 hours.

→ PRIORITY means not immediately life threatening, but serious. These patients get picked up (theoretically) within 72 hours.

→ ROUTINE means the patient can be picked up when the next available flight can be arranged.

Full medical documentation should accompany a patient transferred at sea and in addition his personal documents (passport, vaccination certificates, identity card etc) and a minimal amount of personal effects should be considered where time allows.

Transfer of patients injured in diving accidents requires special precautions (refer to → **Subchapter 22.2**).

## **19.2 General Principles**

Whatever method of transfer is chosen, if the patient is in a conscious state and able to assimilate information, it is vital to brief him on what is going to happen in order to allay anxiety and to obtain his cooperation. This is often forgotten and where he is able to assist in preservation of his own safety and comfort, he should be allowed to do so. On the other hand there are occasions, particularly where helicopters are involved, where patients' self-protective actions may endanger the whole operation including the safety of personnel involved.

Medical escort may be desirable, even essential, not required or impracticable (e.g. in jack-stay transfer). This should be considered in the planning process of medical transfers as well as weight considerations in air movements.

Although timing of the transfer may be crucial, close liaison with cooperating authorities is required once the transfer is initiated, the patient will to a large extent be controlled by non-medical personnel and half way between two ships in a rough sea is no place for replacement of an intravenous line.

### **19.2.1 Specific Problems**

Patients with unstable circulation, particularly where there is or has recently been evidence of hypovolaemia should not be transferred until stabilized. However, in life-threatening situations transfer to a facility capable of providing the appropriate care has to be conducted.

Movement of any patient unable to protect his own airway implies close supervision by skilled medical personnel throughout the transfer and in some situations this means the risk of movement being greater than the risk of remaining in a less adequate medical environment.

Neuro-psychiatric patients are particularly susceptible to excitement and novelty associated with transfers at sea or in the air and therefore close medical supervision is required at all times.

Unstable fractures will need secure splints and the weight of these splints combined with the weight of the patient may exceed the limitations of flotation

devices. An injured immobile patient is more susceptible to the effects of environmental cold and wind-chill as he is producing less heat from muscular activity. Adequate insulation is therefore necessary.

If bulky or heavy medical equipment is required for a patient's transfer, weight, handling and securing of such material has to be considered.

Any patient whose teeth have been secured by wiring should carry on a pair of wire cutters in case of motion sickness and subsequent vomiting. Anti-emetic drugs prior to transfer and an empty stomach will reduce the hazard.

### **19.3 Methods of Transfer**

#### **19.3.1 Transfer by Seaboat**

Transfer by seaboat is available on all ships and is probably the most common means of transfer. State of sea will mainly determine the feasibility of this method. Placing the patient in the boat still hanging in the davits prior to lowering and, if compatible davits are present on the receiving vessel, hoisting the boat up with the patient still aboard, is the recommended procedure.

Lifting tackle is required where the above mentioned is not possible. In case of stretcher employment, the possibility of safe winching has to be considered.

In case of stretcher-employment use of a lifejacket is mandatory. The life-jacket should be attached at the head end and inflated for the transfer.

Regardless of transfer-method, protection from wind and spray must be taken.

#### **19.3.2 Transfer by Life-raft**

Transfer by life-raft is a useful way of shuttling patients or medical personnel in very rough sea conditions, even when other methods are considered to be impracticable, dangerous or are just not available. This method is used in the Northern Atlantic when rendering medical assistance to trawlers.

The person to be transferred is placed in an inflated life-raft with the vessel in a windward position. After the life-raft is set to sea, it will drift leeward towards the receiving vessel. There it either can be hoisted or just will be washed onboard. This might be not the most comfortable way of transfer but could mean the only chance if everything else fails.

Anti-emetic drugs are indicated if appropriate.

#### **19.3.3 Transfer by Jackstay**

Transfer by jackstay is feasible even in very bad weather conditions and is usually quicker and safer than transfer by seaboat.

The jackstay should be rigged and tested before the patient is exposed to the weather. He should be adequately insulated and equipped with flotation devices.

Ambulant patients who can use both hands can be transferred by stirrup or helicopter rescue strop. Wearing a life jacket if using these methods is mandatory.

Stretcher patients should be placed in a lightweight metal stretcher also wearing a lifejacket. Here it is important not to over-inflate the lifejacket in order to provide safe escape for the patient from the lifting harness in case of an emergency during transfer.

#### **19.3.4 Transfer by Helicopter**

The way of executing of helicopter transfers is mainly dependant on the type of ship (with or without a flight deck) and helicopter to be used. Ambulant patients may be transferred in a sitting position. A safety briefing prior the transfer must be given by the aircrew.

If the size of the helicopter allows, stretchers with patients strapped on can be stored internally. Smaller helicopters may only be able to take stretchers on outboard pylons. In this case the patient's exposure to windblast and weather must be taken into account.

In the absence of a flight deck, winching will be necessary. This procedure will be commanded by the aircrew and associated deck-personnel. Ambulant patients can be winched by means of a strop, while stretcher patients will be lifted under the supervision of the aircrew and the ships deck-personnel.

Some helicopters can be converted to an ambulance role but this can take several hours. Space then exists for the carriage of several stretchers, normally Army Pattern.

Medical supervision in-flight will be the responsibility of the medical attendant. However, command authority remains with the aircrew. Helicopter flight always is noisy and often accompanied by considerable vibrations. Therefore ear protection must be provided for the casualty and attendant. In case of high altitude flights changing barometric pressure can lead to problems with intravenous transfusion (drip rate slowing affecting the roller control on the giving set) and inflatable splints (increased pressure on the limb) and circumferential plasters.

Helicopter endurance is a function of total gross-weight. Therefore - time permitting - the weight of the medical attendant and any supporting medical equipment, especially heavy oxygen cylinders, must be discussed with the aircrew before flight.

(→ Note ) Transfer of diving casualties in an aircraft without pressure cabin, including submarine rescuees with a decompression obligation or after submarine escape, should be conducted at low altitude, if possible not over 300 metres. This is to prevent deterioration of symptoms due to bubble growth (Boyle's law). During transfer the patient must breathe 100 per cent oxygen.

#### **19.3.5        Fixed Wing Aircraft Flight**

Direct transfer from ships by fixed wing aircraft obviously is only possible on aircraft carriers. However, shuttling to an airstrip (e.g. by helicopter) where fixed wing aircraft for transportation are available, may be the fastest and most efficient way of getting a patient to the location of the medical facility required.

Airlift by military aircraft will be the responsibility of the national aero-medical evacuation personnel directed as medical attendants. In case civilian airlines are chosen, close liaison with the airline MO is required before flight details are arranged. Suitable escorts should be provided for the transfer and it is the responsibility of the military unit initiating the medical fixed wing transfer to provide such escorts.

Considerations of changes in barometric pressure and oxygen tension are required. Modern transport aircraft cabin pressurised systems provide cabin altitudes between 1525 and 1830 metres which corresponds to a barometric pressure of approximately 600 mmHg. Reduction in barometric pressure to these levels is accompanied by a corresponding reduction in oxygen tension to levels which may become significant to patients who by reason of cardiovascular or pulmonary pathology cannot tolerate a mild degree of hypoxia. A minimum haemoglobin of 7 gm % is advised in the chronically anaemic patient and higher values in more acute situations. A crisis may be promoted in sickle-cell anaemia. If it is essential for these sort of patients to wear oxygen masks when available.

Certain Casevac aircraft are capable of maintaining ground pressure level during flight.

Changes in barometric pressure will produce changes in volume of closed air cavities in the body. Personnel with blocked eustachian tubes should normally not fly. Pneumothorax is a hazard and a recent history a contra-indication unless a functioning chest drain is present. Intestinal surgery cases with anastomoses should not normally fly for three weeks.

Myocardial response to hypoxia is increased rate and a minimum two weeks should elapse before flight after myocardial infarction. No attack of angina should have occurred within three months of flight and oxygen should be available. Patients with myocardial failure should not be exposed to flight. Uncomplicated hypertension is acceptable provided the blood pressure is below 200/120 and there is no evidence of cardiac failure, gross albuminuria or retinal change. A good test of cardiovascular fitness to fly is the ability to walk 300 metres or climb a one storey flight of stairs without symptoms. Neuropsychiatric

patients must always have a medical escort and the full case be discussed with the airline MO. No alcohol should be available to them.

Patients with recent acute gastrointestinal disease need careful assessment. Gastric distension may promote fresh bleeding or even perforation in peptic ulcer. Anti-emetic drugs should be administered. A patient should not fly within ten days of an uncomplicated appendicectomy.

A long leg plaster will prevent a patient from sitting in a normal aircraft seat unless his leg is in the aisle where it will constitute a hazard to other passengers and crew. Prior arrangement with the airline will normally be rewarded by local adjustment of seating arrangements, even if at greater cost. Some swelling of tissues may occur within a circumferential plaster and the military organisation usually insist on that all such plasters are bi-valved partly for this reason and partly because a fixed plaster will be a hazard should the aircraft ditch at sea.

Any diabetic who shows evidence of instability of control should only fly in company of a sufficiently experienced escort who can deal with any fluctuation in his diabetic state and who carries insulin and dextrose with the means to administer them.

Transportation of patients with severe burns should, if possible, be delayed until correction of the vascular deficiencies can be made. If complete stabilization is not possible, then all attempts must be made to transport the unstable patient with as little additional trauma as possible.

( **Note →** ) Modern aeromedical practice allows early transfer by air of most patients under specialized attendance.

Concerning the transfer of diving accidents, refer to → **Subchapter 16.3.4.** Those patients must always breathe 100 per cent oxygen during transfer, even in an aircraft with pressure cabin.

### 19.3.6 Hovercraft

Cushion craft were initially expected to have attractive possibilities as casualty carrying and rescue vehicles. Although not as fast as helicopters, they can under certain conditions be considerably faster than conventional vessels and have the advantage of amphibious capabilities. Unfortunately this early promise has not been borne out as they are noisy and suffer from vibration. They are also very bumpy during rough sea states. Larger craft have a high freeboard making the rescue of shipwrecked personnel floating at sea difficult. This also applies for the transfer of casualties from sea boat to cushion craft.

## 19.4 MEDEVAC

There will be circumstances while underway that mandate the evacuation of a patient to the nearest medical facility. Patients who are beyond the level that can be provided on board or who may have a potentially life-threatening medical condition need to be sent to a higher level care facility.

( → Note ) Ships' MOs should never be too proud to admit that a higher level of medical care is mandatory. The CO will always do everything possible to accommodate the evacuation request.

Evacuation is usually by helicopter. Occasionally ship-to-ship transfer via sea-boat will be necessary. The CO will weigh the responsibilities of the ship's mission against the well-being of the patient. The situation will be dependent on the MO bringing the professional opinion forward to enable coherent arguments for ultimately what command decision is chosen.

( →Note ) The MO should weigh all options carefully. Evacuating a patient is not easy and entails significant risk both to the patient and to the transport crew. Helicopters are rough. Transferring a patient from ship to ship in rough seas is sometimes dangerous and at least stressful for the patient.

The decision to MEDEVAC will need to be prioritized. MEDEVAC is a very complex matter involving almost the entire ship. The more critical the patients condition, the more the ship will consider interrupting its mission to accomplish evacuation. This may include course changes, changes in port call, flight quarters, boat operations, and sometimes well deck operations that involve the entire ship.

( → Note ) It is important that MO prioritize MEDEVAC request properly, not using it for minor cases.

Target of a ROUTINE MEDEVAC is the next flight that can be arranged, however, this may take a week or even longer. URGENT should result in a 24 hrs MEDEVAC, but may also take much longer, due to weather condition and availability problems. Furthermore MEDEVAC flights may make frequent stopovers to pick up and discharge other patients, which slow down the process considerably.

( → Note ) If telemedicine advice is available during the waiting contacting the higher level of care by this means should be used.

All patients in a critical condition must be classified as URGENT in order to achieve timely MEDEVAC. Patients who are sick, but initially not critical, or who have injuries that are not life-threatening but require prompt treatment, need to be described in enough detail to let medical and flight organisers know that the patient needs prompt care.

( Note → ) For patients who are in need of a true medical escort, the MEDEVAC message must contain this request in clear letters, so a flight surgeon or flight nurse can be sent along to escort the patient.

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**20. Dental Management**

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**20.3.5.2.1 Emergency Therapy**

**20.1 Introduction**

The treatment of toothache and dental emergencies by the ship's surgeon requires comprehensive manual skills and theoretical knowledge. For this reason, an appropriate training and familiarisation with the use of instruments and the application of therapies is indispensable.

For medical staff in general (in the absence of a dental officer) this chapter is intended to serve as a useful tool on the subject of dental management, as well as a support if emergency dental treatment at sea has to be undertaken by them. It can also serve to support decisions for the medical evacuation of dental patients.

The availability of shipboard dental officers in advanced emergency dental surgery is not directly applicable to most of the smaller navies, where the majority of warships are fitted out for short mission durations. Invasive dental procedures on the tooth substance and surrounding tissues using burs and surgical instruments will require trained clinical skills. Knowledge of such procedures cannot be acquired through a textbook. However, the forms of dental and oral surgical treatment described here should be within the scope of a sufficiently trained shipboard Medical Officer (MO).

To avoid frequent casualties and repatriations special importance should be attached to healthy teeth and good oral hygiene of seafaring personnel. The importance of mandatory preventive dental care for all personnel at sea as well as in international missions cannot be underrated.

( Note → ) For dental readiness classification refer to → **Subchapter 2.1.2**).

( Note → ) For dental equipment refer to → **Subchapter 3.4.5**).

**20.2 Dental Examination**

**20.2.1 Preparation and Basic Set of Instruments**

Gloves, face mask and protective goggles are worn for personal protection during all treatments. Each treatment is to be planned in such a way that the required instruments are at hand. The basic set of instruments, dental rolls and cotton pellets are required for all examinations and treatments.

The basic set of dental instruments comprises 2 dental mirrors, 1 dental probe, 1 periodontal probe (WHO probe) and 1 pair of dental tweezers.

Instruments and material additionally required for the respective treatment are listed in the individual sections.

**20.2.2                  Anamnesis (Dental History), Dental Findings, Vitality Test and Percussion**

**20.2.2.1                Anamnesis**

The dental anamnesis precedes the examination of the patient. It is aimed at obtaining information on the patient's current symptoms and general state of health.

The toothache as the cardinal symptom of the dental emergency can give valuable clues to the cause of the ache. Of diagnostic relevance are: localisation of the ache, ache development over time, causative factors, ache intensity and ache quality. Questions concerning general health are asked to minimise a possible risk of treatment e.g. allergic reaction to anaesthetic agents.

**20.2.2.2                Findings of the Tooth Hard Substance**

Each tooth is individually assessed and examined to find out whether it needs treatment. The strength of the tooth hard substance is systematically checked by means of a dental probe. Here special attention is paid to fissures, interdental spaces, edges of fillings and crowns. Dental caries is present when the dental probe comes to rest at any place of the hard substance or penetrates the tooth.

**20.2.2.3                Findings of the Periodontics**

The healthy gingiva around the tooth is pinky, tough and immovable. It does not bleed when touched. In a healthy individual the circular sulcus around the tooth is up to 2 mm deep. The depth is measured with a scaled WHO periodontal probe. The probe tip being in contact with the tooth is inserted into the sulcus along the tooth centre line towards the tip of the root. The probing pressure is about 0.25 N. The depth of the sulcus can be read off the colour-coded probe. Sulcus depths of more than 3 mm, bleedings, pus and ache are to be considered pathological findings and require treatment.

**20.2.2.4                Sensitivity Test**

The sensitivity test for which a cryogenic CO<sub>2</sub> spray is used is to check the sensitive response of the tooth. Healthy teeth respond to a low-temperature stimulus with moderate cryalgesia (positive sensitivity) and immediate remission as soon as the stimulus stops. Due to their size mandibular incisors can sometimes respond strongly to cold - but here, too, with spontaneous remission.

A cotton pellet is held by tweezers and sprayed with the cryogenic aerosol until it is beaded with the coolant. Then it is pressed against the tooth. The patient is asked whether he feels the cold. Crowns or large fillings can cause delayed response or wrong negative results. Teeth with root-canal fillings show no sensitive response. Adjacent and opposite teeth are used for comparative control and for obtaining reference values.

#### **20.2.2.5                   Percussion Test**

The percussion test is a diagnostic measure to exclude the inflammation of the periapical tissue. The tooth to be tested is percussed with the probe handle at the incisal edge or the tip of cusp, first in the vertical and then in the horizontal direction. A pain reaction (positive response) in the case of an axial percussion indicates a beginning or advanced inflammation of the periapical region. A pain reaction in the case of a horizontal percussion indicates an acute periodontitis or a periodontal abscess. Healthy teeth do not react with pain when percussed. Adjacent and opposite teeth are also examined for the purpose of comparison.

### **20.3   Dental Emergency Treatment**

#### **20.3.1                   General Remarks**

##### **20.3.1.1                 Purpose of the Treatment**

The purpose of a dental emergency treatment by the MO is to reduce or to remove the patient's pain and to stabilize him to such an extent that his initial state of health does not change for the worse and he can be taken to a dental surgeon in the next port. To serve this purpose, therapies for frequent dental emergencies are proposed and described below. In individual cases the goals mentioned above can also be achieved by administering appropriate medications.

##### **20.3.1.2                 Dental Anaesthesia**

###### Material needed:

- Face mask, gloves, protective goggles.
- 2 mirrors, probe, tweezers.

- Carpule syringe.
- Ultracain DS cartridge ampoule, 1.7 ml.
- Long Miraject hypodermic needle.

Normally Ultracain DS is used for dental local anaesthetisation. The active substance is Articain, a Thiophene derivative in a 4 per cent solution. A quick onset of effect, a great power of diffusion, a high anaesthetic potency at a low dosage and duration of effect of 1 – 2 hours are the advantages of this compound. Adrenaline is added to Ultracain DS in a ratio of 1:200.000. Preservatives are not added to the cartridge ampoules. 6 cartridge ampoules are the maximum permissible dosage for an adult with a body weight of 70 kg

The carpule syringe consists of a metal device serving as a mounting bracket for the cartridge ampoule. The latter has a rubber stopper at one end and a rubber membrane at the other end. The ampoule is inserted into the syringe mounting bracket and the hooks of the syringe piston are screwed tightly into the rubber stopper. The tight fit is controlled by short aspiration (“suction”). Subsequently the short sharp end of the Miraject hypodermic needle is screwed to the screw collar of the carpule syringe. Thereby the rubber membrane is punctured. The carpule syringe is now ready for use.

#### **20.3.1.2.1            Local Anaesthesia Technique**

If possible, the patient should be in a horizontal position when the injection is administered to prevent a vasovagal syncope. Warm and tight clothing should be removed to ensure a better local blood flow in the head and neck. By tensioning the mucous membrane with the mirror while inserting the hypodermic needle and by exerting light pressure beside the insertion point the pain of insertion can be reduced.

Before the anaesthetic is finally administered suction must be applied to avoid an intravascular administration. This is indispensable since the intravascular injection can entail toxic general reactions. If blood is sucked, the injection is to be stopped and to be repeated with a new hypodermic needle and a new ampoule.

The anaesthetic should be injected slowly (1 ml per minute) and without pressure. The patient is to be informed that he should not eat or drink until the anaesthesia has worn off (risk of injury).

#### **20.3.1.2.2            Infiltration Anaesthesia**

In the case of infiltration anaesthesia the local anaesthetic is injected into the tissue to eliminate the terminal branching of the nerves. It is applied in the mouth by a vestibular submucosal, supraperiosteal injection in the tip-of-root area of the tooth to be anaesthetised.

In the upper jaw the lip or cheek is tensioned with the dental mirror. The point of insertion is below the tooth to be anaesthetized in the movable gingiva at the deepest point of the vestibule. The hypodermic needle is inserted in an axial direction toward the tip of the root at an angle of 30 – 40° with the outlet port of the hypodermic needle pointing to the bone. After aspiration 1 – 1.7 ml of the anaesthetic solution is injected slowly. In the molar tooth area a strict axial injection is not possible due to the anatomic conditions. Here an insertion mesial to the buccal tip of the root of the tooth to be anaesthetized is required. In infiltration anaesthesia haematomas can be caused by too deep an insertion. In addition the depot is placed too far away from the tip of the root so that the anaesthetic is insufficient. As to the lower jaw infiltration anaesthesia is only successful in the front tooth area. Here the technique described for the upper jaw is to be applied analogously.

#### **20.3.1.2.3            Anaesthetic Block**

In the lateral tooth area of the lower jaw the compact substance of bone is so thick that a sufficient anaesthetisation is not achieved through diffusion. Therefore the neural conduction must be interrupted directly at the point where the inferior dental nerve enters the lower jaw bone. Due to the close proximity to the lingual nerve this nerve is anaesthetised at the same time in most cases.

The point of insertion for the anaesthetic block is behind the last molar tooth in the area of the retromolar buccal pad of fat. This pad of fat is of triangular shape and extends distal to the jaw at an acute angle. The point of insertion is located in the depression directly below it. In case of an injection on the right side the attending surgeon puts the forefinger of the left hand on the ascending ramus of the mandible. The thumb rests on the angle of mandible so that the lower jaw is fixed. The insertion is made from the premolar tooth region of the opposite side. The hypodermic needle is inserted up to the half of its length until contact is made with the bone and then it is slightly drawn back again. After aspiration about two thirds of the local anaesthetic is slowly injected. The rest is injected while the hypodermic needle is carefully pulled out. Hence the lingual nerve which provides sensory supply to the lingual gingiva is anaesthetised.

If no contact with the bone is achieved when about half of the hypodermic needle has been inserted, the hypodermic needle must be slightly drawn back and turned to the molar tooth area of the opposite side to push the hypodermic needle forward again. In this way contact with the bone is achieved earlier. If contact with the bone is achieved too early, the hypodermic needle must be slightly drawn back and turned a little bit to the front tooth area of the opposite side. In this way contact with the bone is achieved later. The anaesthetic begins to take effect after approximately 5 - 10 minutes. The patient initially feels a tingling sensation in his chin region and, in most cases, in his tongue, too. This tingling develops into a sensation of numbness in this region.

If only the tongue is anaesthetised but not the lip, the first injection was placed too low (below the point of entry of the inferior dental nerve). The hypodermic needle is therefore to be inserted a little bit above the initial point of insertion when the anaesthetic is re-injected. If the patient states that he feels like having got an electric shock, then the tip of the hypodermic needle has touched the nerve. In such a case do not inject before the hypodermic needle has been drawn back for some millimetres and suction has been applied.

### 20.3.2 Defects of the Tooth Hard Substance Involving the Tooth Pulp

#### 20.3.2.1 Reversible Pulpitis

##### Symptoms and Character of Pain:

The patient describes a short (instant) pain following a stimulus. The tooth can be localised by the patient. The sensitivity test is positive. Vertical and horizontal percussions are negative. The tooth is rarely heat-sensitive. The examination of the hard substance of the tooth concerned normally reveals large fillings or a carious lesion. They can be proven by X-ray, also. A pathological change of the apical dental region cannot be identified.

##### Aetiology:

The soft tissue core of a tooth is called dental pulp. It consists of well vascularised and innervated connective tissue. The blood vessels enter the pulp cavity through the tip of the root. Functionally the pulp is a terminal vascular bed without collateral circulatory systems and it is completely surrounded by hard dental tissue. The beginning of any inflammation is marked by hyperaemia, a dilatation of the vessels. The non-reduction of the excitatory stimulus leads to plasma extravasation and thus to the swelling of the tissue concerned due to the increased permeability of the postcapillary venules. In most cases this inflammation is restricted to only a small part of the pulp and it is normally reversible in this stage. This reaction is often induced by dental caries. Other causes are dental fractures, thermal, mechanical, or chemical damage.

##### 20.3.2.1.1. Emergency Therapy

###### Material needed:

- Face mask, gloves, protective goggles.
- Basic set of dental instruments.
- Angle piece.
- Cylinder- or pear-shaped hard-metal or diamond bur.
- Rose-head bur.
- 20-ml-syringe with blunt-pointed hypodermic needle.
- Cooling water in kidney dish.

- Dental rolls and cotton pellets.
- Excavator.
- 3% H<sub>2</sub>O<sub>2</sub> solution.
- Filling spatula.
- Ball-tip plugger.
- Glass plate and mixing spatula.
- Calxyl ®.
- Zinc oxide-eugenol cement (ZOE).
- Articulating paper.

Course of Treatment:

1. Diagnosis: dental mirror and probe, x-ray pictures, if available, cold test, percussion test.
2. Anaesthetise the tooth concerned.
3. Remove the old residual filling and lay open the carious defect (brownish soft substance) by using a hard-metal or diamond bur. A cylinder- or pear-shaped bur is appropriate. The bur is fixed to the angle piece. During the drilling the bur tip must be cooled by the assistant with a syringe filled with water to avoid thermal damage.
4. Dry out the tooth. For this purpose a buccal and a lingual dental roll is placed in the lower jaw beside the row of teeth and only a buccal dental roll is placed in the upper jaw; the cavity is then dried with cotton pellets. If the gingiva is bleeding, a cotton pellet soaked with a 3 per cent H<sub>2</sub>O<sub>2</sub> solution is lightly pressed on the bleeding wound for one minute before re-drying. The dental rolls must be replaced as soon as they are soaked with saliva. Never replace dental rolls when they are dry for there is the risk of tearing off the upper epithelial tissue layer of the oral mucosa.
5. Remove the dental caries with the excavator or a rose-head bur at a low rotational speed until only dry white chips can be removed from the dentine. The dental caries is removed when the probe clatters on the cavity bottom and leaves no grooves. Do not press too much since otherwise there is a risk of penetrating the underlying pulp cavity with the probe.
6. Clean the tooth again with the 3 per cent H<sub>2</sub>O<sub>2</sub> solution and dry it.
7. Mix ZOE cement on the glass plate with the mixing spatula. The compound should have the consistency of knifing filler.
8. Fill the cavity with this compound by means of the filling spatula, press it with a dampened cotton pellet and remove the projections with the

probe or filling spatula.

9. Make the patient clench his teeth. Imperfections are eliminated. If necessary, they can be marked with the help of articulating paper. The articulating paper is put on the new filling. Then the patient is asked to clench his teeth. Now the imperfection stands out against the filling in contrasting blue.
10. The patient must not eat until the effect of the anaesthetic has worn off or, at least, for a minimum period of one hour.

**Note! →** If the pulp cavity is involved, proceed in accordance with paragraph

### **20.3.2.2 Irreversible Pulpitis / Pulp Necrosis**

#### Symptoms and Character of Pain:

The patient reports that pain manifests itself spontaneously which is felt for minutes or permanently. The tooth can rarely be localised by the patient. In most cases the tooth concerned responds hyper-sensitively to heat and cold and is therefore vital. Pain is rarely produced through vertical percussion. A widened periodontal space can be diagnosed in the x-ray picture. However, there is no translucence of the apical region.

#### Aetiology:

Irreversible pulpitis and necrosis of the pulp are those stages of inflammation within the pulp cavity that follow reversible pulpitis (refer to → **Subchapter 20.3.2.1**). If the stimulus is strong and long enough, the inflammation spreads over the whole pulp. If the tissue is destroyed extensively by the defensive reaction of the body, pus is discharged. In this case pain symptoms are very distinctive since the intra-pulp pressure increases. Without treatment the inflammation spreads more and more towards the apex and can finally lead to pulp necrosis.

### **20.3.2.2.1 Emergency Therapy**

The pain therapy includes the opening of the inflamed pulp cavity to enable a discharge of the exudate of the inflammation. Since the pain is caused by an intra-pulp pressure increase the patient is normally free from pain immediately after the opening of the pulp cavity. Medicinal inlays further the healing process and have an analgesic effect.

**( Note → )** The following pain therapy is represented in two steps. Only if the pain is not removed by the simpler measure 1 should the next therapeutic step be taken.

#### Measure 1 and Course of Treatment:

Material needed for measure 1:

- Face mask, gloves, protective goggles
- 2 mirrors, probe, tweezers
- Filling spatula
- Angle piece
- Cylinder-shaped hard-metal or diamond bur
- Rose-head bur
- Dental rolls and cotton pellets
- Anaesthesia, if appropriate
- 3% H<sub>2</sub>O<sub>2</sub> solution
- Ledermix ®

1. Diagnosis: Anamnesis, mirror and probe, x-ray pictures, if available, cold test, percussion test, heat test (give the patient hot coffee to drink).
2. Anaesthesia, if appropriate (when the tooth is still cold-sensitive).
3. A filling damaged or undermined by dental caries to a large extent must be removed. Visible dental caries must be removed, too. As to all other teeth the pulp cavity in the lateral tooth area is opened with a hard-metal or diamond bur from the occlusal direction in the middle of the masticatory surface towards the tooth centre line under permanent control of depth and direction. The tip of the bur must be cooled by the assistant with a syringe filled with water. If the tooth is crowned, the crown, too, is drilled through with a hard-metal or diamond bur under permanent depth and direction control.
4. Pulpotomy: When the pulp is reached, "the bur seems to fall into emptiness". Now the tooth is dried out with dental rolls. Starting from the point of opening, the whole pulpal roof is now carefully removed with a big rose-head bur. Importance is to be attached to a clear access cavity.
5. The pulp cavity is cleaned with a cotton pellet soaked with a 3 per cent H<sub>2</sub>O<sub>2</sub> solution. The canal entries are now visible. It must be possible to easily reach all canal entries with instruments
6. Canal entries are covered with a cotton pellet soaked with Ledermix ®.
7. Subsequently the tooth is closed above the cotton pellet with Cavit ®. To this end, some Cavit ® is pressed out of the tube. It is formed into a ball with the fingers and filled into the cavity with the filling spatula. Imperfections are removed and the rest is pressed with a wet cotton pellet and burnished. If much pus is discharged from the canals, the tooth can remain open for one day. On the next day it will be closed as

described above.

8. At the next port the patient is to be taken to a dentist for dental treatment.

Measure 2 and Course of Treatment:

( Note → ) The patient is not free from pain even if the tooth is open. It is excluded that the wrong tooth has been trephined.

Material needed for measure 2:

- Face mask, gloves, protective goggles.
- 2 mirrors, probe, tweezers.
- Filling spatula.
- Angle piece.
- Cylinder-shaped hard-metal or diamond bur.
- Dental rolls and cotton pellets.
- Anaesthetisation, if required.
- 3 per cent H<sub>2</sub>O<sub>2</sub> solution.
- Rose-head bur.
- Gates drill, size 3.
- Flexofiles, size. 15-80.
- 2-ml-syringe with root canal perfusion cannula and physiologic sodium chloride solution.
- Calxyl ® or CHKM ® or Ledermix ®.
- Paper tips.
- Cavit ®.

1. The cotton wool soaked with Ledermix is removed.
2. Anaesthetisation, if required.
3. The pulp cavity is cleaned with a cotton pellet soaked with a 3 per cent H<sub>2</sub>O<sub>2</sub> solution. The canal entries are now visible. The canals are enlarged with the Gades-Glidden drill operated at a low rotational speed. Here the drill must not be exposed to any stress (risk of instrument fracture). Subsequently the canals are a bit more enlarged with flexofiles. Begin with a size-15 file and enlarge the canal at least up to the size-40 file. Each file is inserted far into the canal until it encounters resistance. Then the circumference of the canal is enlarged by filing.
4. Irrigate canals with physiologic sodium chloride solution. The cannula is inserted into the canal as far as possible until it encounters resistance. The irrigating solution volume required per canal is about 0.2 ml.

5. The canals are dried out by inserting paper tips.
6. Calxyl ® CHKM ® can be used as medicinal inlays here. Both are inserted into the canals by means of paper tips. Calxyl ® is preferred but in case of continuing discomforts a CHKM ® inlay can nevertheless yield success. Due to the cytotoxicity of CHKM ® it may only be used for dental emergencies which cannot be controlled otherwise.
7. As a provisional cover a cotton pellet is initially put on the canal entries and then the whole is closed with Cavit ® (cf. measure 1).
8. The medicinal inlays should be changed weekly. For this purpose the provisional filling is removed and then the course of treatment described above is started with item 4.
9. In the next port the patient is to be taken to a dentist for dental treatment.

### **20.3.2.3        Acute Apical Periodontitis**

#### Symptoms and character of pain:

The patient says that he suffers from the severest pulsating pain. Patients often maintain that the tooth concerned is above the level of the other teeth of the dental arch. The tooth can intrude into the tooth socket through the patient's occlusal overlay. The occlusal overlay, however, increases the pain. The sensitivity test is negative. Pain is increased by vertical percussion. An apical translucence is visible in the x-ray picture.

#### Aetiology:

When the inflammation has spread over the entire pulp cavity it enters the surrounding periodontium through the apical foramen and propagates there (cf. 17.3.2.2). Apical periodontitis develops. Chronic apical periodontitis is clinically unremarkable and can only be verified by an x-ray photograph (shadow in the tip-of-root area). The tooth is pressed out of its bone socket by the inflammation process at the tip of root. This gives the patient the feeling that the tooth is too much above the level of the other teeth of the dental arch.

#### **20.3.2.3.1   Emergency Therapy**

For emergency therapy refer to → Subchapter 20.3.2.2!

### **20.3.3        Odontogenous Inflammations**

#### **20.3.3.1        Subperiosteal Abscess**

Symptoms and character of pain:

Severe, spontaneous soreness increased in synchronisation with the pulse. This is caused by the tension of the periosteum. A hemispheric hard protrusion without fluctuation can be palpated. The palpation of the tip-of-root area is painful. A soft and very much extended oedema of the covering facial soft tissues always develops, especially in the case of maxillary abscesses. The vitality test of the causal tooth is negative, the vertical percussion test is positive. Often the patient has the feeling that the tooth is extended; the tooth is also sensitive to occlusal overlay. Normally the general state of health is not impaired.

There is the risk that the abscess spreads into adjacent compartments. This is indicated by further symptoms such as: the border of the mandible cannot be palpated thoroughly, dysphagia, globus hystericus in the tongue, trismus, laterodeviation of the mandible when the mouth is opened, reduced general state of health, fever, accelerated blood sedimentation, disorder of breathing. However, depending on the compartment infected, the symptoms are very different. Even life is eventually threatened.

Aetiology:

- Exacerbation of a chronic apical parodontitis.
- Spread periodontal abscess.
- Difficult dentition.
- After traumas (e.g. of the front teeth).
- Empty alveoli after tooth extraction.
- Root residues.

**20.3.3.1.1              Emergency Therapy**Material needed:

- Face mask, gloves, protective goggles.
- 2 mirrors, probe, tweezers.
- Scalpel .
- Respiratory .
- Dissecting scissors or dressing forceps.
- Packing plugger.
- Packing strips (Iodoform) about 5 cm long.

- Antibiotic (penicillin 3x5 Mega I.V.) in the case of an angular vein sensitive to pain on palpation, compartment abscess, septic general symptoms.

#### **20.3.3.1.2 Threatening Abscess Formation**

In the case of an acute inflammation in the tip-of-root area of a tooth the mucous membrane covering the tip of root of the supposed causal tooth should be inspected and palpated carefully. As long as the turgescence is not fluctuating the threatening abscess formation can be forestalled by the trepanation and preparation of the tooth concerned (proceed in accordance with → **Subchapter 20.3.2.2**) and by administering an antibiotic (Penicillin).

#### **20.3.3.1.3 Submucosal or Periosteal Abscess**

In the case of a turgescence already fluctuating or in the case of an extreme pulse-synchronous painfulness the discharge of pus must be ensured by incision.

1. The causal tooth is opened and the canals are cleaned. Often pus is already discharged from the canals during this stage. The tooth does not receive medicinal treatment; it is only covered with cotton pellets and remains open.
2. Anaesthesia: anaesthetise copiously
3. Incision: the scalpel is led along the gingival line or in the fixed mucous membrane along the bone. The incision should have a length of 2-3 cm. A subperiosteal dissection is made with the raspatory up to the origin of the abscess. Often the bone cavity extending from the tip of root can be seen or felt. Pus must flow out of the cavity. If no pus is discharged from a previously definitely fluctuating turgescence the abscess cavity has not been opened yet. In this case dissect again with dissecting scissors or dressing forceps.
4. An Iodoform strip is inserted loosely into the wound for drainage purposes and is changed daily. In addition the wound can be irrigated with Betaisodona. The strip should jut out of the wound minimally to prevent indigestion. The root canals, too, are to be irrigated with the physiologic sodium chloride solution.
5. The administration of an antibiotic is only required when general symptoms develop additionally or when even after a careful incision no pus is discharged.

#### **20.3.3.1.4 Spreading into Adjacent Compartments**

Only submucous abscesses located in the reflection (vestibule) or at the palate should be opened. All other abscesses are treated with large-dose antibiotics and are to be attended by an oral surgeon as soon as possible. Do not forget that life can be threatened when the patient's general condition deteriorates rapidly.

Nearly all abscesses in the oral and maxillofacial region can spread towards the mediastinum or cranial base.

#### **20.3.3.2. Submucous Abscess**

##### Symptoms and character of pain:

A submucous abscess is a mostly vestibular soft, fluctuating and often hardly painful protrusion with an extended collateral oedema of the covering soft tissues. The vitality test of the causal tooth is negative, the vertical percussion test is positive. Palpation in the tip-of-root area is painful. Eventually the patient has the feeling that the tooth is extended and also sensitive to occlusal overlay. The patient's general condition is seldom reduced.

##### **20.3.3.2.1 Spreading into Adjacent Compartments**

Symptoms are different depending on the compartment infected. As soon as other symptoms manifest themselves in addition to the symptoms mentioned above (refer to → **Subchapter 20.3.3.1**) the infection of a compartment is probable. The infection may become life-threatening.

( Note → ) For aetiology and therapy refer to → **Subchapter 20.3.3.1**.

#### **20.3.3.3 Difficult Dentition**

##### Symptoms and character of pain:

The patient suffers from severe pain in the area of the erupting tooth. The mucous membrane above the tooth concerned is visibly reddened and oedematous to a large extent. Eventually the antagonist has painfully pierced the swollen mucous membrane. The opening of the mouth can be restricted. A local lymphadenitis can develop. In the advanced stage lockjaw, dysphagia and general symptoms such as fever and a feeling of illness can develop additionally.

##### Pathological findings:

1. Infection and inflammation are confined to the sulcus. The opening of the mouth is not restricted yet. The patient's general condition is good.
2. The inflammation spreads to the surrounding tissue. This results in a reflex lockjaw (restriction of the opening of the mouth). The patient's general well-being is disturbed. The body temperature is 38-39°C. The patient has a foul breath.
3. Finally infiltrates and abscesses develop in the facial and cervical compartments. Life can be threatened at this point. The patient's general condition is extremely reduced, the body temperature increases to more than 39°C. Severe dysphagia, respiratory obstruction and a feeling of a lump in the throat as well as a correspondingly impaired speech are serious signs for the lapse of the abscess into the cervical area.

Aetiology:

Difficult dentition means the complicated and mostly painful eruption of teeth. In young adults this is often the case with the third molar teeth, the so-called wisdom teeth. Normally difficult dentition is caused by an abnormal position of the dental germ; however, a lack of space can also be the cause. In most cases the tooth is unable to completely cut the gingiva. The tooth crown is more or less completely covered by soft tissue. Thus a den is created between tooth hood and tooth where food particle deposits cannot be removed by brushing the teeth. This can result in an infection.

**20.3.3.3.1                    Emergency Therapy**

Material needed:

- Face mask, gloves, protective goggles.
- 2 mirrors, probe, tweezers.
- 3% H<sub>2</sub>O<sub>2</sub> solution in a disposable syringe with blunt-pointed hypodermic needle.
- Dontisolon, white in a carpule syringe with blunt-pointed hypodermic needle.
- Packing plugger.

Additional material in advanced stage:

- Sickle-shaped scalpel (no. 12) or small scalpel (no. 15).
- Respiratory.

Difficult Dentition Stage 1:

The treatment consists of a careful cleaning of the sulcus surrounding the erupting tooth. The easiest method is to remove food particles with a cotton

pellet soaked with a 3 per cent H<sub>2</sub>O<sub>2</sub> solution and to subsequently fill Dantisolon white into the gingival pocket. A more successful method is to insert a syringe filled with a 3 per cent H<sub>2</sub>O<sub>2</sub> solution and fitted with a blunt-pointed hypodermic needle below the mucous hood and to empty it with light pressure in such a way that pus and food particles are washed out. Then Dantisolon white can be filled into the gingival pocket. This procedure can be repeated over a period of several days. Antibiotics are not required.

#### Difficult Dentition Stage 2:

If the measure mentioned above is insufficient or if the inflammation has already reached an advanced stage, an incision must be made to ensure a sufficient discharge of pus. For this purpose the mucous membrane is locally anaesthetised or made insensitive by a locally applied cold spray and subsequently an approximately 0.5 to 1 cm long slit is made to lay open the underlying tooth. Attention should be paid to the course of the lingual nerve. It can run closely along the lingual side of the tooth. Subsequently the wound is irrigated with a 3 per cent H<sub>2</sub>O<sub>2</sub> solution and a Jodoform gauze strip is laid loosely into the wound to enable a better discharge of pus. The strip should be replaced the next day. The healing process takes 7 days. The causal tooth should be removed by a dentist in the next port. Antibiotics are only indicated when the general well-being of the patient is substantially degraded. Antibiotics with a wide spectrum of activity are favourable.

#### Difficult Dentition Stage 3:

In this stage life is possibly in acute danger due to the spreading of the abscess into the mediastinum. The patient must be sent to a clinic for maxillofacial surgery as quickly as possible. If dysphagia should result in dehydrogenation, the patient must receive an infusion.

### **20.3.4 Periodontal Diseases**

#### **20.3.4.1 Gingivitis**

##### Symptoms and character of pain:

Redness of the gums, gingival tumefaction and eventually ulceration of the gums are characteristic features of the clinical picture of gingivitis. Gingival tumefaction entails increased probing depths of –3mm. Haemorrhages and pain are normally caused during probing. The tooth is vital and does not respond to percussion.

##### Aetiology:

Ubiquitous bacterial inflammation of the marginal gingiva is caused by dental plaque accumulations. With adults the prevalence rate is about 35 % – 50 %.

#### **20.3.4.1.1      Emergency Therapy**

##### Material needed:

- Face mask, gloves, protective goggles.
- 2 mirrors, probe, tweezers.
- Universal curette.
- Chlorhexidine .

The primary goal of the therapy of gingivitis is the reduction of dental plaque by improving domestic oral hygiene. The patient is instructed to brush his teeth at least twice a day and to use dental floss for interdental space care. If dental calculus is present, it is to be removed from the tooth surface with the universal curette. Owing to the mechanical irritation of the gingiva haemorrhages can be caused which stop in the course of 7 – 10 days. A chlorhexidine rinse solution (Chlorhexamed ®) can be used to support the therapy.

#### **20.3.4.2      Acute Necrotic Ulcerous Gingivitis (ANUG)**

##### Symptoms and character of pain:

In most cases ANUG begins abruptly with a painful inflammation of the interdental gingiva. Papilla tips undergo necrosis and ulcerate. Later the rest of the gingiva is also subject to these changes. Now and then kissing ulcers are found on the buccal mucosa. The infected gingiva is no longer covered with epithelial tissue but with a smearable yellowish membrane. During the removal of this pseudo-membrane intense pain and profuse haemorrhages develop. The symptoms of the mostly younger patients (18 – 30 years) are often foul breath, enlarged lymph nodes and seldom fever. If not treated, extended parts of the gingiva undergo necrosis.

##### Aetiology:

The aetiology is characterised by the triad of bad oral hygiene, smoking and emotional stress. It mainly develops in underfed and immunosuppressed patients. Microbiologically it is an infection with anaerobic bacteria

#### **20.3.4.2.1      Emergency Therapy**

Material needed:

- Face mask, gloves, protective goggles.
- 2 mirrors, probe, tweezers.
- Cotton pellet.
- 3% H<sub>2</sub>O<sub>2</sub> solution.
- Chlorhexidine.
- Metronidazole (Clont 400 ®), if required.

An immediate intervention is required. After the removal of the dental plaque the infected parts are cleaned twice a day with a cotton pellet soaked with the 3 per cent H<sub>2</sub>O<sub>2</sub> solution. This is to be continued until the end of the healing process. In support of this therapy the patient shall rinse the mouth with Chlorhexidine for 1 minute, 3 times a day. The patient is to be instructed to perform extremely careful but thorough oral hygiene measures after each meal as soon as they are bearable. For this purpose, an instruction on oral hygiene is necessary. The patient should buy himself a new toothbrush. Should there be no change for the better within 24 hours a systemic dose of 200 mg of Metronidazole 3 times a day over 3 days or the administration of another antibiotic effective against anaerobic bacteria is indicated.

**20.3.4.3        Periodontal Abscess**Symptoms and character of pain:

The periodontal abscess is confined to a periodontium and can develop into a submucous abscess if not treated. Pain, tumefaction and redness develop in the area of the immovable gingiva. Pus is often discharged when the sulcus is probed with the periodontal probe. Usually the associated tooth is sensitive. In the case of a lateral percussion the tooth can be sensitive to knocking.

Aetiology:

A periodontal abscess is caused by the exacerbation of the chronic infection within a gingival sulcus. Possibly this is due to the fact that food particles are bitten into the sulcus, a changed virulence of the germs or a changed status of the defensive system of the body.

The periodontium is connected with the endodontium by the apical foramen and the lateral canals of the pulp. In deep gingival sulci the inflammation can spread to the pulp and cause pulpal complaints. In this case the endodontic treatment of the tooth follows. The tooth concerned then responds positively to percussion and does not respond to cold.

**20.3.4.3.1        Emergency Therapy**

Material needed:

- Face mask, gloves, protective goggles.
- 2 mirrors, probe, tweezers.
- Periodontal probe.
- Packing plugger.
- Packing strips mit CHKM; better: Jodoform packing.
- Universal curette, if required.

Should no pus be discharged after probing, push the packing plugger, keeping contact with the tooth, carefully forward from the gingival line until pus is discharged. Then insert, without pressure, a strip soaked with CHKM or preferably a Jodoform packing and change it every day until the wound has healed.

Follow-on measures:

Though the present abscess receives emergency treatment the cause of the infection (subgingival concrements) nevertheless remains. To prevent new abscess formation the root surfaces must be cleaned. This should be left to an experienced dentist. Whether this cleaning can wait until the ship has reached its home port depends on the local findings after the performance of emergency measures. If the sulcus concerned is still visibly inflamed after 7 days, it should be curetted as soon as possible.

### **20.3.5 Traumatology of Teeth**

#### **20.3.5.1 Fracture of Crown or Root**

Symptoms and character of pain:

##### 1. Enamel crack

The enamel crack is an incomplete fracture of the enamel without loss of substance. The tooth is vital and responds negatively to percussion. There is no increased mobility of the tooth. An X-ray examination provides no pathological findings..

##### 2. Enamel fracture

The enamel fracture is a breakage in the enamel area with a minor loss of substance. The tooth is vital, the percussion test is negative. The mobility of the tooth is normal. Radiological findings reveal an interruption of the enamel contour or an enamel defect.

3. Crown fractures not involving the pulp

Fracture of the dental crown including loss of enamel and dentine substance with no involvement of the pulp. The tooth is vital and responds distinctively stronger to a low temperature stimulus. The percussion test is negative. Radiological findings reveal continuity interruptions and enamel defects.

4. Crown fractures involving the pulp

With this type of fracture a small or wide opening of the pulp cavity can be diagnosed in addition to the loss of enamel and dentine substance. The sensitivity test is very positive. The tooth can be slightly sensitive to percussion. The mobility of the tooth is normal. The x-ray picture reveals that the defect comprises the pulp cavity.

5. Root fractures

The abnormal mobility of the tooth concerned is typical of the root fracture. This mobility is a diagnostic indication of the fracture localisation. A great deflection indicates a coronal fracture and an apical fracture is indicated by a small deflection. Sensitivity test and percussion test do not clearly indicate a fracture. The whole spectrum of potential findings is possible here. The x-ray picture reveals a fracture line in the root area and eventually a dislocation

Aetiology:

The main reason for crown and root fractures is a traumatic event such as a brawl or foreign bodies hitting the teeth.

Front tooth traumas initially receive a minimal-invasive therapy. Most of the follow-on measures can be taken in the next port.

**20.3.5.1.1                    Emergency Therapy**

1. Enamel crack: No therapy.

2. Enamel fracture:

Only the sharp enamel edges are smoothed with the angle piece fitted with a carborundum stone or a diamond ball and operated at a low rotational speed (otherwise there is the risk of thermal damage).

3. Crown fracture with non-opened pulp cavity:

Smooth the sharp enamel edges with a carborundum stone or diamond ball at a low rotational speed (otherwise there is the risk of thermal

damage). Cover the exposed dentine with Kerr life. (Mix Kerr life in the ratio 1:1 on the glass plate put it on the fracture with the filling spatula and let it cure.)

4. Crown fracture with opened pulp cavity:

The form of therapy to be applied in the case of a crown fracture with opened pulp cavity depends on the size of the opened surface. If the opened surface is smaller than  $1 \text{ mm}^2$  it can be tried to keep the tooth vital by covering the pulp cavity defect with CaOH and filling the tooth provisionally.

In all other cases proceed in accordance with → **Subchapter 20.3.2.1.**

5. Root fracture

The therapy of the root fracture depends on the extent of the dislocation, the localisation and the condition of the pulp.

Fracture without dislocation, any localisation: rigid splinting for 2 months (refer to → **Subchapter 20.3.5.2**).

Fracture in the coronal third with connection to the oral cavity through the gingival sulcus: remove the coronal fragment and treat the root canal. (refer to → **Subchapter 20.3.5.2**).

Fracture in the coronal third with no connection to the oral cavity: try to treat the root canal through both fragments; if the attempt fails, remove the coronal fragment here, too.

Fracture in the central and apical third with fracture dislocation: treat the root canal up to the fracture and splint the tooth concerned.

### **20.3.5.2        Tooth Dislocation**

Symptoms and character of pain:

The tooth concerned is partly or completely displaced out of its alveolar cavity. If the tooth is displaced incompletely, it has a normal mobility due to an impaction in the labial cortical bone. In this case the tooth is devitalised and the percussion is painless.

Aetiology:

Post-traumatic condition

#### **20.3.5.1.1        Emergency Therapy**

Knocked out teeth without any serious periodontal or carious damage can be replanted into their alveolar cavities and have thus the continue growing. The most favourable healing results are achieved when the tooth is replanted immediately after the trauma. There are also favourable chances of success if, in the meantime, the tooth was kept in a physiologic sodium chloride

solution (or in the patient's mouth or in long-life milk) after the trauma. After a dry storage of 2 minutes there is only a chance of an ankylosis incorporation without the development of a periodontal space and normally with the later resorption of the root. Nevertheless teeth worth to be retained should be replanted even in this case if the patient has a correspondingly cared-for set of teeth.

#### **20.3.5.1.2            Splinting of an Individual Tooth**

##### Material needed:

- Physiologic sodium chloride solution of body temperature.
- Trim or Protemp or any other chemically curing dental plastic material.
- Dental instant glue.
- Container with iced water.
- Mixing spatula.
- Filling spatula.
- Resin mixing bowl.
- Tetanus booster shot, if required.

##### Course of Treatment:

- (1) Examine whether the alveolus of the tooth to be replanted is intact and clean. If not, the tooth cannot be replanted. Soft tissue injuries are closely adapted with sutures.
- (2) If required, rinse the tooth with a physiologic sodium chloride solution of body temperature. Manipulations such as mechanical irritation or disinfection must be avoided to not injure the sensitive periodontal tissue still adherent to the tooth.
- (3) Replant the tooth into its alveolus.
- (4) Splint production: Initially dry out the area of the teeth to be splinted with dental rolls. Two teeth on each side of the tooth to be splinted are to be included. (Hence the splinting covers 5 teeth.) Clear the teeth of blood and saliva.
- (5) Mix up Trim in the Resin mixing bowl, i.e. 1 ml of liquid is mixed with powder. The substance should just be workable.
- (6) Form a roll and press it against the buccal side of the 5 teeth to be splinted. The teeth should be well enclosed. The clenching of teeth

must not be impaired. The gingiva must be clear.

- (7) Wait until the plastic material begins to cure and keep a sample in your hand. When this sample stops to string the splint can be taken out of the patient's mouth and put into the prepared iced water to cure fully. Polymerisation is slowed down by the iced water and the dimensions of the splint remain unchanged. After approximately 10 minutes the splint is fully cured.
- (8) Remove all disturbing edges and ridges as well as excess plastic material on the buccal side with the angle piece and a big rounded hard-metal fraise. The interdental septa on the dental side must be kept – they enable a firm splinting.
- (9) Fit the splint – it should fit free of stress, occlusion should not disturb and the gingiva should be clear.
- (10) Set in the splint: dry the teeth; wash the splint with propanol to remove impurities and grease; dry the splint; put a tiny drop of dental instant glue on each tooth surface in the splint. Avoid covering the whole tooth surface with glue since otherwise excess glue can flow into the gingival sulcus and cause inflammation there. Then stick the splint to the teeth immediately and press it against them for 2 minutes.
- (11) Tetanus vaccination / booster shot.
- (12) Send the patient to a dentist in the nextport.
- (13) Treat the root canal not before the periodontal injury has healed up unless an earlier intervention is absolutely necessary due to a pulpitis.

## 21. Battle Conditions and Shipboard Medical Readiness

### 21.1 Battle Conditions

- 21.1.1 Emergency Bills
- 21.1.2 Battle Dressing Stations (BDS)
- 21.1.3 Main Battle Dressing Station
- 21.1.4 Mass Casualty Situation
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- 21.1.6 Nuclear, Biological, Chemical (NBC) Defence

### 21.2 Medical Readiness

- 21.2.1 Supplies and Equipment
- 21.2.2 Emergency Response Kits
- 21.2.3 Portable Medical Lockers/First Aid Boxes
- 21.2.4 Stretchers and Litters
- 21.2.4.1 Stretcher Bearers
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- 21.2.7 NBC Defence Materials
- 21.2.8 Civilian Evacuation Materials
- 21.2.9 Mass Casualty Supplies
- 21.2.10 Surgical Instrumental Sets
- 21.2.11 Sterilization Procedures

### 21.1 Battle Conditions

The organizational structure in the shipboard organization reflects routine, day-to-day activities which change drastically under battle conditions and special evolutions (flight quarters, fire drill, mass casualties etc.). A Watch, Quarter, and Station Bill is posted in each department to outline the responsibilities of each person in the medical department for all specific evolutions. The Watch, Quarter, and Station Bill also contains each person's berthing assignment, workstation, and lifeboat assignment, as well as every crewmember's location for special evolutions and different readiness conditions. This must be kept as accurately as possible, and all medical staff must be drilled to know their assignments.

( **Note →** ) Medical department personnel should be quizzed periodically, especially when the ship practices abandon ship, to make sure they know their lifeboat assignments. Medical personnel should be assigned to different berthing compartments as well as different lifeboats in order to prevent disastrous personnel resource consequences in a real emergency.

### 18.1.1 Emergency Bills

The MO is responsible for establishing and maintaining bills for handling emergency situations in accordance with ship's doctrine. He ensures that all assigned medical personnel are familiar with their responsibilities under each bill. All must be kept current, and circulated throughout the medical department. The bills may be included in the ship's organization and regulations manual (SORM) or medical department organization manual or, they may also be published as separate instructions in accordance with each ship's preference.

At a minimum, medical department will maintain the required bills listed below:

Mass Casualty Bill.

This outlines the responsibilities of medical department and other ship's personnel in the case of severe casualties that over-tax the ship's medical resources.

Battle Bill.

This outlines the responsibilities of medical department personnel under hostile and non-hostile emergency conditions.

NBC Defence Bill.

The MO must be conversant with the requirements of the medical responsibilities in NBC defence. The ship's NBC bill will include the responsibilities of medical department personnel in case of NBC contamination. It may be published as part of the ship's SORM, the medical department organizational manual, or as a separate instruction.

#### **21.1.2      Battle Dressing Stations (BDS)**

Battle dressing stations provide alternate sites that can be used by medical department personnel during emergency conditions to assess and treat casualties.

BDS are located in different areas of the ship affording maximum protection consistent with the availability of care for the wounded. Locations are in accordance with ship class drawings. BDS offering the best facilities for surgical procedures and care are equipped for this purpose and designated as the Main BDS.

( **Note →** ) Due to space limitations and small crew size, some vessels have no designated BDS. Ships without an assigned medical department representative (MDR) is not required to have a designated BDS.

On ships with separate BDS, these locations will not be used in any manner that will interfere with the designated purpose. Specifically prohibited is use in any manner that could:

- Impair the primary use of the space as a BDS.

- Restrict ingress/egress of casualty crewmembers.
- Compromise the maintenance and security of medical supplies and or equipment.
- Restrict medical department personnel from unlimited access to the spaces.

Each BDS will be outfitted with supplies and equipment sufficient to provide triage, resuscitation, initial stabilization, and limited care to casualties. BDS supplies and equipment shall be maintained in a state of readiness, ensuring appropriate quantities, quality control, management, and security thereof. All supplies and equipment in the BDS will be reflected in a BDS inventory list with inventories being conducted at least semi-annually.

The following will be utilized as the minimum standards of supplies and equipment for all battle dressing stations:

- Specified minimum requirement for consumable, durable, and equipment items required in each BDS including minor surgical sets.
- CBR medical materials are maintained at one central location for distribution to the crew, or equally distributed at each BDS, if proper security exists. CBR medical materials will be distributed by coordination with the Damage Control organization.
- Furniture and fixture items are listed in the appropriate instructions.
- When an operating table has not been permanently installed due to alternate use of the space, a Table, Operating, Field will be provided. Brackets for securing the table to the deck when in use must be functional.
- BDS will have at least one surgical light and four battle lanterns installed. An additional bracket flange must be provided for the alternative position of the surgical light. Additionally one general illumination fixture and two single receptacle connectors, powered by the emergency power system, will be available.
- An Emergency Potable Water Supply, a gravity fed water system will be posted in the immediate vicinity. It is the responsibility of the medical department to conduct the maintenance of the tank regularly according to the instructions, as well as have a water sample tested monthly to determine bacterial content.

( **Note →** ) Ships with battle dressing stations, including auxiliary stations, have marked routes leading to these stations and access markings.

### 21.1.3      Main Battle Dressing Station

In addition to the minimum standards for outfitting all BDS spaces, the designated main BDS will be augmented with items to provide for surgical procedures and definitive care after battle. The main Sick Bay is the most acceptable main BDS, but it may be unable to handle all of the casualties. Getting wounded to battle dressing areas requires navigational skills, strength, and determination on the part of stretcher bearers.

( Note → ) One of the biggest problems can be getting patients to the treatment areas. They may be far from where casualties come on board or appear.

#### **21.1.4      Mass Casualty**

BDS stations are designed for onboard mass casualties, not really for treating external casualties, except big warships with hospital-like facilities. A BDS can take care of most minor surgical problems but lacks x-ray and major surgical capacity, with the exception of the main BDS if that is also ship's Sick Bay.

( Note → ) Large ships with helicopter hangar or ships with MO are generally assigned to receive casualties. However, all ships can be confronted with "ship-generated" mass casualties, e.g. an explosion.

The mass casualty bill will list the medical responses, casualty receiving and treatment areas, and casualty evacuation routes for each mass casualty scenario. This is tailored to the ship's capabilities and is different for each type of scenario. Casualties are received in different areas depending on how they arrive: by sea/land/air-transfer. Casualty treatment areas are different if the ship is at General Quarters versus just receiving casualties.

Mass casualty drills should be completed and graded at least quarterly. The MO should plan his drills appropriately. It cannot be stressed enough to actually drill for each scenario so that problems arise during the drill and not in real, important points i.e. are (incomplete list of topics):

- Provisions for setting up intensive care monitoring and ward care for the casualties.
- Maintenance of charts and records accurately and maintained.
- Safely removing weapons and valuables from casualties.
- Providing adequate security on controlled medicines broken out for use.
- Arrange MEDEVAC for casualties requiring additional care.
- Required measurements if patients have died.

When a mass casualty drill or situation is imminent, the word will be passed, "Prepare to receive casualties, man all battle dressing stations." At this point, each BDS will be manned in accordance with the Watch, Quarter, and Station Bill. The corpsmen, assorted phone talkers, and stretcher bearers will man their stations. The MO will be in the main battle dressing station area, and the next senior Medical Department representative will man the main triage area.

**( Note → )** Mass casualty situation may generate needs for extra personnel. The MO should apply for necessary reinforcement as soon as possible.

Dental officers may also be assigned. An independent duty corpsman or Dental Officer may man one of the battle dressing stations on the opposite side of the ship from the MO. The most highly trained personnel will then be more available if damage prevents transporting patients from one side to the other.

Incoming casualties are taken from the flight deck or well deck, if brought in by boat, to the triage area by the stretcher bearers. Individual crew members specifically trained in first aid and litter bearing must be assigned the task of moving the patients. If casualties are received on the flight deck, they are first taken to a central point out of harm's way. If they are brought in by boat to the well deck, triage will be there. The triage officer will send less severely casualties and ambulatory patients to the BDS for treatment. More serious injuries should be transported to the main BDS for treatment by the ships physician.

**( Note → )** It is the ship's responsibility to get patients to the area where treatment can be given. Casualties seen in the BDS will be treated and sent back to duty or stabilized and held until they can be transferred to the Main BDS. Stretcher bearers go out and bring the patient back; the ship's own medical personnel or corpsmen do not go out.

**( Note → )** The main BDS is the staging area for casualties requiring higher levels of care or MEDEVAC.

Casualties should not be held at BDSs for extended periods. Once a flood of casualties has arrived and been treated, get the remaining casualties transferred over to the Main BDS, shut down the other stations, and get the manpower to your area. Centralize the patient flow as quickly as possible to consolidate manpower in one area only. By the end of the mass casualty, all patients and staff should be at the main BDS.

The situation is very similar when internal casualties are suffered during general quarters and the ship is damaged. Casualties will be routed to the nearest available BDS, as determined by the damage control assistant in Damage Control (DC) Central. This is a control system that prevents injured personnel from going to areas that are damaged, flooded, or on fire. DC Central is informed of all inaccessible areas and directs all movement about the ship during general quarters. Once casualties arrive at the local BDS, they are triaged, treated, and, when possible, transferred to the main BDS.

**( Note → )** During drill and actual scenarios medical department and DC Central are required to track each casualty exactly.

**( Note → )** Personnel casualties have third priority behind fire and flooding. If there is not someone specifically responsible for tracking them, casualties will get lost during the activity of a mass casualty scenario.

**( Note → )** In close cooperation with DC pre-established casualty evacuation routes from areas of potential damage may be determined. This greatly decreases the turnaround time for getting routes to stretcher bearers and, since these routes can be pre-printed and distributed ahead of time to the stretcher bearers, they improve accuracy.

Safe phone communication between BDSs and the main BDS is vital. Advice must be offered and instructions given to help stabilize patients until they are seen by the MO.

#### **21.1.5        Mass Casualties Drill**

One familiarized with his duties on board the MO should suggest to the CO a series of mass casualties drills. For this the entire ship is involved. The drills take prior planning and should be coordinated with medical, deck, engineering and repair departments.

When running mass casualties drills the MO should keep certain important points mind:

- Moulage the casualties. This will make the exercise as lifelike as possible. Encourage the casualties to act appropriately by screaming, crying, having a seizure, and displaying an altered mental status.
- Be certain there are enough personnel to assist in the BDS. Stretcher bearers trained to take vital signs will help tremendously when patient load increases and medical department is running out of corpsmen.
- As few as possible stretcher patients should be sent to the more inaccessible battle dressing stations. Walking wounded may be best served in these areas.
- During general quarters drills, arrange occasionally to walk through your BDSs where the corpsmen are assigned, then drill them on locating equipment and materials stored in the lockers. A good drill is to select ten items and give them one minute to find them. If the corpsmen are well versed in their inventory, they will retrieve these items at once.
- The emergency water tanks located in the BDSs may be rigged differently from station to station. Corpsmen assigned to a particular station must be able to open the tank and obtain fresh water. Be sure

they are familiar with which valves open and which valves close the tank.

- Very often BDSs are located in berthing areas and troop spaces. If MO does inspect these areas monthly, items will be missing. The only way to keep BDSs ready is to have them inspected frequently by the corpsmen assigned to that area. Make the area as secure as possible by locking all cabinets with padlocks and securing materials to bulkheads.

#### **21.1.6      Nuclear, Biological, Chemical Defence**

Nuclear, biological, and chemical warfare is an area that had been neglected in the past. The threat of using an “asymmetric” style of warfare, performed by small groups of not necessarily military organized opponents, fighting with cheap and portable weapons, from hidden locations, with no backing from a recognized nation, has much changed in all navies. Those groups may act against naval vessels in port and coastal areas as well as at sea.

The result has been a rethinking of response plans into a more beach-oriented style of warfare, Operational Manoeuvre from the Sea (OMFTS) as well as much more specific NBC defence capabilities on the platforms. Preparation requirements are for chemical warfare (by toxic industrial chemicals), weaponized biological agents and radiological terrorism. More emphasis is placed on properly training personnel to deal with radiation risks, chemical and biological warfare, and natural disasters.

**( Note → )** Critically important in medical defence during NBC warfare is the assurance of proper decontamination procedures before the treatment of injuries. Medical Department personnel cannot care for contaminated personnel. Medical department personnel must be thoroughly drilled in self-protection.

Proper protection in the form of masks, coveralls, gloves etc. must be readily available. Training in the use of protective masks must be an integral part of the medical department, as well as ship-wide, military training. Damage control personnel are in charge of decontamination, but medical personnel may be involved in decontamination stations. The procedures to follow are slightly different for each type of casualty. For details of decontamination and casualty procedures, refer to the specific NBC Defence Instructions.

#### **21.2    Medical Readiness**

The medical department is always prepared for all medical emergencies. When facilities are inoperable due to materiel casualties or personnel shortages, appropriate corrective action must be initiated and substitute support measures promptly defined and instituted. Sick bay must be set up to receive emergencies at all times. In addition to those medical supplies normally needed for routine

sick call, a suitable area within sick bay, if not designated as a Battle Dressing Station (BDS), must be supplied and equipped to treat medical emergencies.

#### **21.2.1            Supplies and Equipment**

First aid supplies and equipment are distributed throughout the ship and are to be utilized by crew members in the event of personnel casualties during battle or emergency conditions. Special publications list first aid materials as damage control readiness material and controlled equipage, thus requiring optimum management and security to ensure continuous readiness. The items of emergency first aid materials and stretchers are designated as damage control readiness materials and controlled equipage. As such, they will be managed and maintained under the damage control prevention maintenance system. Departments assigned responsibility for spaces where emergency first aid materials and stretchers are installed or located are responsible for the readiness of such material. They report noted discrepancies to the medical department. Inventory and restocking is the responsibility of the medical department.

**( Note → )** To ensure that emergency supplies are maintained in a high state of readiness, particular attention must be paid during inventories as to the material condition and potency dating of stock. Newly requisitioned supplies are to be rotated into reserve stock and older stocks utilized in sick bay in order to prevent loss through old and deterioration of existing materials.

Potency dated material is defined as material having a specified storage period. Such items should be rotated out of emergency stock in sufficient time to allow usage prior to expiration. When expiration dates are given as month and year only, the material is considered to expire on the last day of the month specified.

#### **21.2.2            Emergency Response Kits**

Emergency Response Kits must be readily accessible and located in the area designated for emergency treatment, all in a continuous state of readiness, ensuring appropriate quantities, quality control, and management. Inventory sheets listing will be maintained within the kit. Semi-annual inventories will be conducted to ensure readiness, and the kit should be replenished and re-inventoried whenever used. The kit can be augmented with additional items based on the expertise of medical department personnel assigned. Any item augmented will be added to the inventory sheet.

#### **21.2.3            Portable Medical Lockers/First Aid Boxes**

Portable Medical Locker (PML) provide pre-positioned medical supplies for use by the medical department to triage and treat casualties. They are located at or near designated triage areas. The location will be reflected in the battle doctrine and/or SORM. All supplies and equipment in PMLs is reflected in an inventory list. The medical department is assigned the responsibility for maintenance of all PMLs. Inventory should be checked at least semi-annually.

First Aid Boxes (FAB) provide a means for dispersing emergency supplies throughout the ship for use by the crew. FABs will be permanently mounted, at a minimum, in or near the below listed locations:

- Air control spaces.
- Anchor handling spaces.
- Ship control spaces including Bridge, After Steering and Repair Lockers.
- Cargo holds and magazines.
- Manned communication spaces.
- Hangers and hanger deck bays.
- Manned engineering spaces.
- Machine shops / industrial work centres.
- Weapon control spaces.
- Other FABs may be mounted at the discretion of the MO with special attention to areas where personnel are assigned major work stations, near flammable storerooms, and in major passageways.

#### **21.2.4      Stretchers and Litters**

The quantity of stretchers kept on board is in accordance with the ship's medical material documents. Determination of the type of stretcher or litter to be used for personnel casualty transfer is based on environmental conditions and the condition of the casualty. Safety appears to be paramount. Serviceability, inspection criteria, and accountability for all stretchers and litters will be per current maintenance system requirements.

Lines, which are spliced to the litter, have proven to be detrimental to accomplishing normal patient transport; causing trip hazards during routine transport. If the situation calls for extrication of a casualty up or down a ladder, a detachable safety or belaying line should be used on the head end of the litter only. The length of the safety line should be sufficient to work the stretcher from one deck to another and provide enough surplus to ensure the safety of the patient and manoeuvrability of the stretcher. Minimum line length

can be determined by identifying the longest span by which a casualty will be transported on board utilizing a handling line. This standard length of line should be used for all attached handling lines

Steel Stokes type stretchers will be stowed at or near areas that facilitate their use at the discretion of the MO. On smaller ships, since they cannot be used below decks due to narrow passageways, they should be located in helicopter hangers or similar open spaces where movement of casualties is possible. On larger ships, location should be based on accessibility and a potential for use (i.e., triage and casualty reception areas). Patient securing straps are attached to the lower bar of the stokes stretcher and coincide with the patient's chest, hips, thighs, and lower legs. Handling lines and patient securing straps are not placed on Stokes stretchers located in the hangar bay and flight deck areas. These stretchers are used for mass casualty situations and, based on the "scoop and run" theory, these lines and straps are not utilized and could present a hazard.

The Litter Splint ("Miller-Board") is designed to provide spinal immobilization during patient movement. It can also be used for vertical extrication, however, for all such lifts; a half-back harness assembly must be used in conjunction with the Miller Board. Litter splints should be located strategically, in areas accessible to the crew, to facilitate use in any part of the ship on short notice.

The halfback harness is to be used for vertical extrication in conjunction with the Miller Board. As with the litter splints, vests should be strategically located in areas accessible to the crew; preferably with a Miller Board. Lines used with the harnesses for extrication should be of sufficient length to allow extraction from the bottom of the deepest access trunk on the ship with enough line remaining to pass through a pad-eye or block and tackle for hoisting safely.

Underway transfer stokes stretcher is for ship-to-ship highline manoeuvre. This litter is rigged and maintained by the Deck Department.

#### **21.2.4.1      Stretcher Bearers**

Stretcher bearers are usually deck personnel who have been trained in first aid. Responsibility for this is with the medical department. The MO should use the ship's planned exercises to train stretcher bearers and crew to administer first aid.

( **Note →** ) For stretcher bearers frequent practise in first aid supervised by the medical department is necessary.

#### **21.2.5      Antidote Lockers**

A poison antidote locker will be installed on all ships with medical department personnel. Either the large locker that is normally installed during shipbuilding or a smaller unit, such as a standard first aid box, can be used for this

purpose. On ships with an MO assigned or in which the medical spaces are manned 24 hours a day, the locker will be located in the emergency treatment space. In other settings the locker must be located for ready accessibility for the crew. An alphabetical inventory list designating shelf location must be located on the inside of the door with a copy displayed outside as well. The locker will be secured with an easily breakable anti-theft seal. Inspections are conducted semi-annually or whenever the seal is broken. It is highly recommended that instructions and illustrations for management of poisoning and overdose be displayed for use by non-medical personnel. Training for non-medical personnel in first aid and use of the antidote locker must be incorporated in the medical long-range training plan.

#### **21.2.6 DECON-Lockers**

Lockers for stowage of NBC decontamination supplies are maintained at or near each NBC decontamination (DECON) station, as designated in the ship's design. Cabinets are lockable and located on the clean (exit) side of DECON stations. The medical department is often asked to support the Damage Control organization in stocking DECON lockers; personnel should be aware of the stocking material. As a general rule, outfitting will support 10% of the possible exposed personnel at each DECON station. Stocking, inventory, labelling and route markings are the responsibilities of the engineering department and Damage Control Officer/Assistant.

#### **21.2.7 NBC Defence Material**

The MO responsible for the quality control of all medical items used for NBC defence. An itemized inventory list is maintained where stored. If stored at BDSs, they may be added to the BDS inventory sheets. NBC supplies are to be inventoried at least semi-annually. Required material is Atropine Sulfate Inj, Atropine Autoinjector, Pralidoxime Chloride Autoinjector, Pyridostigmine Bromide Tablets. Pyrodistigmine bromide, requires refrigeration to extend shelf life. The other supplies should be stored in divided amounts in or near BDSs, when practical, or in storerooms ready for issue to each BDS.

#### **21.2.8 Civilian Evacuation Materials**

Afloat units may potentially be called upon to perform humanitarian operations or evacuate civilian personnel. Ships that list this mission area must be prepared to respond. This mission may place an extraordinary burden on various departments aboard. However, the medical and supply departments play a vital role once civilians are aboard ship. In addition to appropriate quantities of standard medical items that may be used for all categories of evacuees, the medical department may need to stock paediatric, gynaecological and obstetric materials in addition.

### **21.2.9 Mass Casualty Supplies**

Medical departments may wish to establish standard supply sets for response to mass casualty situations. There is currently no prescribed listing for such supplies however, if established, such supplies should meet the same basic requirements as other emergency response gear. Inventory lists should be generated and stowed with the gear, reflecting the amount of each item required and on hand. Supplies should be located to provide most rapid deployment to major triage locations. All items should be protected from heat and humidity by enclosing in plastic bags and stowage containers should be securable to discourage theft. Containers should be mounted in such a way as to be secured for sea. Supplies should be inventoried not less than semi-annually as a quality control measure.

### **21.2.10 Surgical Instrumental Sets**

All required surgical trays or sets must be prepared in accordance with the appropriate instruction and maintained in sterile condition. Surgical knife blades with the foil wrapping intact and sutures packed in plastic packets are not to be steam autoclaved due to the deteriorative effect of heat on these items. Pre-sterilized items, such as knife blades and suture materials, required for packs are attached to the exterior of the pack and included on the inventory sheet.

Surgical packs and sets are plainly marked on the outside of the pack with a description of the pack, sterilization date, and expiration date (if applicable). Each pack contains a contents list attached that can be examined without breaking the integrity of the pack. It is imperative that all emergency trays be of such size that they can be re-sterilized in the medical department's autoclave.

### **21.2.11 Sterilization Procedures**

**Steam sterilization is as effective as gas sterilization and is more cost effective.** Shipboard sterilizers are sufficient to perform steam autoclaving of all required surgical packs; shipboard sterilization is therefore encouraged. Intensive surveillance monitoring of surgical packs has revealed that the following conditions potentially compromise sterility:

- Improper washing techniques.
- Rips, tears, or holes in cotton fabric wrappers.
- Deterioration of cotton fibres, which results in the harbouring of bacteria.
- Compromise of the dust cover.

Gas sterilization is used for items that would be deteriorated. Only large shipboard medical facilities can gas autoclave materials. Items that have been gas autoclaved and placed in heat sealed dust covers, or have been packaged in gas autoclave pouches will have a shelf life of 1 year.

Event related sterilization. When this method is accomplished properly, there is no expiration date assigned and unless the package is compromised, it is considered sterile indefinitely. These packs will be inspected for integrity during routine inspections.

Other Methods. In certain emergencies or when the above methods are not possible or indicated, cold disinfectant may be utilized. When this method is used, a log must be maintained that includes: item description, disinfectant used, length of time, and procedure for which the item was used.

On ships with operating room capabilities a record of sterilization must be maintained.

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**22.1 Shipborne Aviation**

**(NOTE →)** This sub-chapter section should be read in conjunction with National Flight Surgeons Manuals and, for aircraft mishap investigations, STANAG 3318.

**22.1.1 Physiology of Flight**

Aviation physiology is normal physiology in an altered environment, primarily with the effects of altitude (hypobaric/ hypoxic effects) and acceleration (G force effects). With increased altitude, inspired pO<sub>2</sub> falls, total air pressure falls and air

becomes drier. Gasses dissolved in tissue or trapped in body spaces are no longer compressed by sea level high ambient pressure. On some fixed wing aircraft, the effects of altitude are partially diminished by cabin pressurization. Transport aircraft are typically pressurized to about 2000m altitude equivalent pressure. This means that air pressure in the “pressurized” cabin is about 600mm of Hg or 160 mmHg less than at sea level. The arterial pO<sub>2</sub> at that altitude in a healthy person is about 70mmHg (30mmHg lower than sea level). Un-pressurized helicopters may fly at altitudes of 3000m (with an expected fall of arterial pO<sub>2</sub> to about 60 in a healthy person). Combat aircraft such as jets are only pressurized to a pressure of about 300 mm Hg (7500m altitude with an arterial pO<sub>2</sub> of 30mmHg without supplemental oxygen). This lightens the aircraft and lessens explosive decompression when the cabin integrity is compromised.

Decreases in ambient pressure cause an gas expansion. This can result in ascent injuries caused by expansion of gas trapped in an ear, sinus, dental filling/abscess, bowel, pneumothorax or tissue (aviation decompression sickness). Occasionally, this expansion of gas in an ear may be complicated by the patient doing a Valsalva manoeuvre during ascent resulting in severe vertigo due to vestibular round window implosion. Descent injuries are caused by the retention of lower pressures of gases in spaces such as sinus or ears. The relative vacuum of descent may cause exudation or bleeding into the sinus or middle ear. Antibiotic treatment is considered appropriate when haemorrhage has occurred. Oedema may increase significantly with altitude decreases of as little as 1500m. Persons at risk of not being able to clear their ears or sinuses should be grounded. Flight Surgeons should be consulted for guidance on return to flight status.

### **22.1.2 Acceleration and Vibration**

Acceleration may alter physiology by redistributing blood flow. Axial downward acceleration can cause loss of consciousness in a few seconds. Relatively small (2g) lateral acceleration can interrupt major vessels in the mediastinum. Vibration, particularly in helicopters, can cause loss of coordination and faulty proprioception. It also interferes with such tactile tasks as feeling a pulse or starting an IV.

### **22.1.3 Vestibular Function**

Disorientation is frequent in flight due to lack of perceived horizon, confusing perceptions of orientation and movement. Motion sickness may occur in flight even in a sailor who does well on ship. Seasickness may or may not clear while flying.

### **22.1.4 Aeromedical Evacuation**

Evacuation by air from ships is covered in STANAGs 1412, 2132, and 3204. Preparation should include stabilizing the patient including placement of a chest tube for any pneumothorax and prophylactic intubation if needed, as these procedures cannot be performed in flight. Detailed medical records with times in GMT should accompany the patient. Appropriate survival gear should be placed on the patient including a floatation device, a hoist combatable restraint system, and cold-water immersion suit if conditions require. At least a 24-hour supply of medication should be provided if possible in case the aircraft is diverted due to weather or hostilities. Air inflatable devices such as endotracheal tube cuffs, air splints, or anti-shock garments, must be monitored and adjusted during ascent or descent. Rigid casts or other non-expanding devices must be bi-valved or removed to prevent the development of compartment syndrome. High flow oxygen should be administered enroute in any pulmonary or cranially compromised patients. Oxygen bottles must be well secured to prevent injury during aircraft motion. Eye injuries with ruptured globes or head injuries with intracranial air may require altitude restriction or surface transport to avoid further herniation due to pressure changes even at 300m altitudes. If defibrillation is required, it may be administered with due caution not to have bystanders touching the patient. In patients with burns, spinal or abdominal abnormalities, a naso/oro-gastric tube should be placed prior to flight to manage gas expansion in the bowel.

#### **22.1.5 Medication and Flight**

Altitude alters the “blood/brain barrier” and allows increased passage of some medications from the blood to the central nervous system. Thus a medication that causes no drowsiness at sea level may cause significant drowsiness at 200m altitudes. In general, medications should be avoided in aircrew. If aircrew requires medication for a respiratory ailment, they should be grounded. Passengers may require decongestants to prevent ear and sinus barotraumas. An occasional passenger or evacuation passenger may require treatment for anxiety (fear of flying) or airsickness. If aircrew requires sedation for sleep, a flight surgeon should be consulted regarding time duration until they may resume flying.

#### **22.1.6 Aircraft Mishap Investigations**

Normally, a flight surgeon will be assigned to assist with flight mishap investigations. If your ship has no onboard flight surgeon, the following steps may be prudent:

**(NOTE →)** Assess the patient thoroughly for injuries. Pilots extracted from water following ejection should be assumed to have spinal fractures. Remove the helmet while manually stabilizing the cervical spine.

A serum blood specimen may be obtained and saved for any accident board. If possible, a detailed history of medication, sleep, activity, and any recent illness

should be obtained while the information is fresh in the aircrew's mind. A flight surgeon should be contacted as soon as practicable.

## **22.2 Diving Emergencies and Underwater Medicine**

**(NOTE →)** This subchapter section should be read in conjunction with National Diving Manuals and ADivP-1/ ADivP-2.

### **22.2.1 General Remarks**

Diving Activities are necessary for different purposes like salvage operations, ship safeness, mine countermeasures and combat operations. Diving operations have to be carried out under difficult, changing and sometimes hazardous environmental conditions such as cold or warm water exposure, current, low visibility, diving in confined spaces etc. In addition to the depth and time profile of a dive, these conditions could create special risk factors for each dive.

All NATO Nations have established rigid national regulations for safe diving operations, as documented in the national Diving Manuals. Usually the national Diving Manuals are available at every dive site, and for most diving operations, a direct medical „on scene“ support by a DMO (Diving Medical Officer) or a special trained DMT (Diving Medical Technician) is required. In the event of a diving mishap, these regulations ensure specially trained personnel are present to provide proper medical treatment and management of the diving casualty/ies.

Within NATO, ADivP-1 and ADivP-2 address the different diving capabilities, support of diving operations, safety rules and treatment procedures of diving casualties. General guidelines and specific national policies are contained in these documents. ADivP-2 is a pure medical document (designed as a handbook), containing detailed information about the diving environment, personal and general risk factors influencing a dive, signs and symptoms of diving related diseases, treatment and management procedures for diving accidents, treatment tables of different NATO Nations and information on national Points Of Contact (PoC) for diving related questions or emergencies.

The purpose of this section is not to recapitulate the content of the original diving related NATO publications but to give a very brief overview about diving related medical problems. If a diving related problem occurs, time often becomes a very important factor for the proper management of the diving casualty. Any delay in initiating proper medical treatment may result in deteriorating patient status, as well as death or permanent disability. In case of a diving emergency, it is strongly recommended that medical personnel without special training or qualification in diving medicine immediately contact the national authorities for the management of diving accidents or refer to → Annex 22-1 for further information.

It should be noted

- (1) This section should be read only in conjunction with National Diving Manuals as well as the ADivP-1 and ADivP-2.
- (2) Most accidents in diving are the result of a combination of several adverse circumstances, rather than a single cause. Anything impairing the mental or physical response of a diver in emergency will reduce his chances of correcting a hazardous situation.
- (3) Divers, in particular when inexperienced, may be dangerously disorientated from sensory deprivation, induced by weightlessness, silence and limited visibility.
- (4) The diver's environment is wet and often cold. These factors frequently play a significant role in underwater accidents.
- (5) A casualty could suffer from severe additional medical problems like near drowning. It is self-explainatory that resuscitation measures and the stabilization of the patient with the standard procedures have the first priority in these cases.

### **22.2.2 Physiological Basics**

A good understanding of the behaviour of gases under changing pressure conditions is essential for understanding diving related medical problems (i.e. Boyle's Law, Henry's Law, Dalton's Law and Gay-Lucas's Law). In addition environmental, psychological, and technical factors may play an important role in the cause of a diving accident.

### **22.2.3 Barotraumas**

Barotrauma results (in accordance with Boyle's Law) when pressure acts on the gas-filled cavities of the body. The contained volumes of gas will contract on descent and expand on ascent. Compensation can only occur by the introduction or deflation of gas with increasing or decreasing pressure. If compensation is impossible, damage may occur in the gas-filled structures or the surrounding tissues.

#### **22.2.3.1 Middle and Inner Ear**

Barotrauma commonly occurs in the middle and inner ear. If, during descent or ascent, the pressure in the middle ear cannot be equalised through the pharyngotympanic tube, otic barotrauma may occur; ranging in degree from injection to rupture of the tympanic membrane (sometimes complicated by

sero-sanguinous transudate in the middle ear space with or without rupture). Deafness, vertigo, tinnitus and nausea are further symptoms (mainly inner ear), which may be immediate or delayed. Back at the surface these conditions are usually transient. A history of difficulty with "clearing the ears" may help to distinguish vertigo due to middle or inner ear barotrauma from the inner ear problems of serious decompression sickness. Inner ear barotrauma could lead to round window damage, and early recognition is necessary for surgical repair to restore the hearing loss. "On scene" differential diagnosis might be difficult due to the similarity of symptoms.

#### **22.2.3.2 Sinuses**

Trouble occurs in sinuses if their openings to the upper respiratory tract are blocked (catarrhal swelling, polyps or deviated nasal septum). During descent the volume of air within a sinus is reduced and, if uncompensated, may become filled with transudate or blood. This is often accompanied by significant pain. During ascent the air re-expands and may make the pain worse or cause blood stained, and occasionally, muco-purulent nasal discharge or even frank, profuse haemorrhage.

#### **22.2.3.3 Pulmonary Barotrauma**

Pulmonary barotrauma (Pulmonary Over inflation Syndrome: POIS) is a consequence of the expansion of gases in the lungs in accordance with Boyle's law during rapid (uncontrolled) ascent of the diver through the water. POIS, and its neurological complications, have occurred in dives as shallow as 1 m.

Characteristically the symptoms and signs of POIS and its complications occur suddenly or within a few minutes after reaching the surface. Only rarely is the onset of symptoms delayed for more than 15 minutes. Symptoms are produced when air filled alveoli rupture, resulting in the introduction of air bubbles in the arterial system. The particular signs and symptoms in the individual depend upon the site of the arterial gas emboli (AGE) so almost any neurological deficit can occur, including paresis, ataxia, loss of consciousness, or convulsions. Differentiating between AGE and decompression sickness (to be discussed later) is often difficult. Treatment of arterial gas embolism follows the treatment of decompression sickness (refer to → Subchapter **22.2.6 – 22.2.7**).

Additional consequences of pulmonary barotrauma are, sometimes, pneumothorax, mediastinal and subcutaneous emphysema. Pneumothorax may remain undetected until the expansion of gases within the thorax causes dyspnoea some hours later during the decompression from a therapeutic recompression.

#### **22.2.3.4 Additional Injuries**

Additional injuries may result from effects of pressure in other gas filled cavities like the bowel, teeth and within the diving equipment. Compression of gas within a dry-suit on descent may produce pain skin nipping, unless the volume reduction is compensated by adding gas from a suit inflation bottle. Marks are left on the skin, which can be distinguished, from the more diffuse skin rashes seen in some cases of decompression sickness. Similarly if the pressure in the facemask cannot be equalised, oedema of the facial tissues and sub-conjunctival haemorrhages can occur. These conditions require no treatment, apart from reassurance, but they need to be considered in any differential diagnosis.

#### **22.2.4 Gases at Pressure**

At elevated pressure, gas constituents may become toxic. The toxic effect of a gas depends on the concentration of the gas in the breathing media, the absolute pressure, and the resulting partial pressure of the gas. During descent, the partial pressure of a gas increases proportional to the increasing ambient water pressure (Dalton's law). It should be noted, non-toxic gases under normal atmospheric conditions could show increasing toxic effects with the increasing depth of a dive.

##### **22.2.4.1 Pulmonary Toxicity of Oxygen**

The pulmonary toxicity of oxygen is only important in relatively long dives (i.e. special warfare operations). A sensation of "tight chest", tracheo-bronchial irritation with cough and a reduction of vital capacity, precede pulmonary oedema in those who have exceeded the threshold levels of oxygen partial pressure for the predicted duration. An oxygen partial pressure ( $pO_2$ ) less than 0.5 bars is defined to be safe over extended periods, but a  $pO_2$  greater than 0.5 bar can produce pulmonary toxicity. A  $pO_2$  of 2.0 bars may produce symptoms within a few hours.

Oxygen and its radicals can act as a neurotoxin. If breathed at pressures greater than 2.0 bars, it may cause seizures. With physical work during diving operations, the threshold approaches 1.6 bars. Underwater convulsions can lead to the loss of the mouthpiece and to drowning. Pulmonary barotraumas can occur if the convulsing diver is brought to the surface with his airways closed during the tonic phase of the convulsion. Air breathing interludes are known to delay the onset of acute oxygen toxicity and are used routinely during hyperbaric treatment of decompression sickness.

##### **22.2.4.2 Carbon Dioxide Toxicity**

Carbon dioxide toxicity most commonly occurs in closed or semi closed circuit breathing sets by the failure of the soda lime to remove the exhaled carbon dioxide from the re-breathed gas. Symptoms progress from initial

respiratory stimulation through dyspnoea, mental disturbance, convulsions and the loss of consciousness.

#### **22.2.4.3 Nitrogen Narcosis**

The narcotic effect of nitrogen on mental and physical performance when breathing compressed oxy-nitrogen mixtures is proportional to the nitrogen partial pressure. The effect is directly comparable with the various levels of anaesthesia. Individual susceptibility is great and some, especially the inexperienced, may have significant impairment of memory and decision-making at depth. When breathing compressed air the effects of nitrogen narcosis start at around 30 m. Around 60 to 70 m the effects of nitrogen narcosis could account for the total ineffectiveness of the divers in completing set tasks and coping with possible emergencies. Reducing the partial pressure on ascent quickly reverses the narcosis.

#### **22.2.4.4 Carbon Monoxide Poisoning**

Carbon monoxide (CO) should not be contained in breathing gas. Nevertheless air contamination could result from a compressor dysfunction or by sucking contaminated air through the compressor inlet (close to exhausts). Breathed on the surface the contaminated air might show no toxic effects, but with the increasing partial pressure of CO during diving it could lead to a severe CO-intoxication. Therefore care must be taken to ensure proper air filling techniques of diving cylinders.

#### **22.2.5 Decompression Sickness**

Decompression sickness (DCS) may be considered as a “bubble disease” caused by gases, which were dissolved in the tissues of the body during the time spent at depth (Dalton’s Law, Henry’s Law). In addition to mechanical effects of the bubble, complex biochemical changes take place at the gas-blood interface. Decompression sickness only follows a dive of sufficient depth and duration to acquire a critical load of dissolved gas in the body.

From some dives it is safe to ascend directly to the surface (no-decompression dives). The prevention of decompression sickness from deeper or longer dives is achieved by slowing the rate of ascent and the inclusion of decompression stops at designated depths. The decompression requirements are a function of the depth and time of a dive and are listed in diving tables or calculated by dive computers. For the majority of dives these decompression procedures ensure the proper elimination of dissolved gas from the tissues. Occasionally a case of decompression sickness will follow the use of even the safest diving tables. Particularly hazardous are dives involving hard physical work (e.g. in strong currents), diving in very cold water, repetitive diving within one day or over a couple of days, or flying too soon after diving.

#### **22.2.5.1 Classification of Decompression Sickness**

Two forms of decompression sickness (DCS) are described:

- (1) Mild: in which only joint pain (limb bends) and other minor manifestations are present. (Type I DCS)
- (2) Serious: in which there is involvement of the central nervous system and / or pulmonary or cardiovascular system (Type II DCS).

This classification has little merit unless it is remembered that about one third of patients with acute decompression sickness have both minor and more serious lesions concurrently. Since the signs and symptoms of more serious lesions may be relatively subtle, there is a danger that they may be overlooked in the presence of joint pain. It is also necessary to remember that the minor manifestations may precede the more serious ones. Thus the inexperienced practitioner may treat the patient incorrectly for the minor symptoms when more vigorous therapy is required.

#### **22.2.5.2 Onset of Symptoms**

Onset of symptoms occurs in the majority of cases within the first hour after surfacing, but occasionally it may be delayed for over 24 hours. Any unexplained signs or symptoms occurring de novo within 36 hours of diving must be regarded as decompression illness.

Type I DCS includes pain (which can be severe) in or around the joints, subcutaneous oedema especially of the limbs.

The more serious manifestations of acute decompression sickness are neurological, circulatory, and pulmonary. Skin rashes in the form of patches of cutaneous vascular stasis with central cyanotic areas ("marble skin") can occur. Neurological decompression sickness most commonly affects the central nervous system. Any neurological deficit may be present: girdle pains of the trunk, muscular weakness, monoparesis, paraplegia, vertigo with nausea and vomiting (staggering), blurring of vision and other visual defects, migraine's headaches, and different levels of mental disturbances.

After diving every diver is dehydrated due to immersion effects and the resulting increased urine production. In decompression sickness, the effects of intravascular bubbles increase capillary permeability and aggravate the hypovolaemia by an extra-vascular fluid shift (tissue oedema). The resulting hemoconcentration will worsen the reactions at the gas-bubble interface, lead to more bubble formation, slow down the gas elimination of tissues, and impair tissue oxygenation.

#### **22.2.6 First Aid**

Normobaric 100% oxygen should be given as soon as possible to a diver with suspected DCS or AGE. The most sufficient First Aid measure is the rapid administration of pure oxygen breathing with a demand regulator or with a high flow reservoir system. Under normobaric conditions pure oxygen breathing could lead to a rapid stop in the progression of symptoms, in many cases to a decrease in symptoms and in some to a complete resolution. Pure oxygen breathing could be carried out for several hours without causing oxygen toxicity.

Oxygen breathing prevents the development of tissue oedema and enhances tissue oxygenation. The administration of oxygen with a flow of just 2 – 6 l/min via a nasal probe is ineffective because it does not raise the oxygen partial pressure to a sufficient inspiratory level, which should be close to 100 %. If symptoms of decompression sickness resolve completely under normobaric oxygen breathing, hyperbaric treatment is still required. If the treatment ends with the administration of normobaric oxygen breathing this could lead to a severe and therapy resistant relapse of symptoms even hours later. Therefore in every case, casualties should be transferred to a hyperbaric treatment facility.

#### **22.2.7 Hyperbaric Treatment and Additional Measures**

The specific treatment of DCS or AGE is the recompression in a therapeutic recompression chamber. Recompression leads to a reduction of the bubble size, hyperbaric oxygen breathing results in a better tissue oxygenation, a decrease in tissue oedema, and the safe and enhanced elimination of the dissolved gases. Recompression therapy should begin at the earliest opportunity and be conducted in accordance with recognized therapeutic tables contained in ADivP-2.

To prevent a delay in the beginning of the hyperbaric treatment the diagnostic measures should be reduced to an urgent minimum.

Auxiliary treatment of decompression sickness is the administration of fluids. This counteracts the haemodynamic changes associated with diving and decompression sickness. Depending on the patient's status fluids can be administered orally or intravenously in a rate of 2 l within the first 2 hours after the onset of symptoms. Analgesics such as morphine should be avoided because of the danger of masking symptoms.

If a urinary catheter has to be placed in a plegic patient, its balloon should be filled with water to prevent volume changes during the hyperbaric treatment. Similarly changes of air volume in endotracheal tubes and intravenous sets should be remembered.

#### **22.2.8 Investigation of Diving Accidents**

For further investigation of a diving accident → **Annex 22-2** should be used to record the history of the diving accident, all important data of the dive and possible factors influencing the dive.

## 22.3 Submarine Escape and Rescue

**(NOTE →)** This chapter should be read only in conjunction with ATP 57, which contains detailed information for submarine escape or rescue measures. The term “escape” stands for actions, taken by the submariners of the disabled submarine themselves (e.g. ascent to the surface by buoyant ascent or using a submarine escape tower) whereas “rescue” means actions or support from outside of the disabled submarine by special rescue teams, support vessels or submarine rescue vehicles (SRV).

### 22.3.1 Scenarios

The type of casualties and the severity will be determined by the circumstances of the accident, the method of submarine escape or rescue, the depth of water, the internal atmosphere (gas partial pressures, toxins) of the submarine, if the submarine is pressurised, the surface conditions and the time interval between the accident and the availability of treatment facilities at the surface. It is most probable that the rescue of survivors from a sunken submarine will be undertaken by specialized ships, whose MOs are trained in diving medicine and provided with detailed instructions for the management of these casualties.

If the pressurised DISSUB and the submariners could be transferred under pressure (TUP) to another pressurized system (e.g. SRV) and is properly decompressed, there should be no casualties resulting from decompression problems. Decompression obligations and the risk for pulmonary barotrauma arise when the internal pressure of the submarine is increased, the submariners have to initiate escape procedures with a SET-system (Submarine Escape Tower) or flooding of the submarine and pressure equalization is necessary for a compartment escape.

The decision of how and when escape procedures are necessary depends on several factors like internal pressure of the DISSUB, toxic substances in the submarine atmosphere, CO<sub>2</sub> build-up, and lack of O<sub>2</sub>, increasing and uncontrollable flooding, general survivability in the distressed submarine, radiation and the time when rescue is available. Guidelines for SEALs (Submarine Escape Action Levels) are given in national manuals, depending on the special situation and construction of a submarine. Theoretically, the best time to escape is after the submarine has been located and assistance is available on the surface. However, for a number of reasons this may not be possible and the rescue vessel may find that the survivors are already waiting on the surface.

All survivors should wear an immersion suit with only portions of the face exposed. If not removed from the water immediately, trials have predicted an average survival time of 24 hours under cold-water conditions. Additional medical problems could be physical trauma, barotrauma, decompression

illness, pulmonary barotrauma with arterial gas embolism, water inhalation and near drowning, dehydration, seasickness, intoxications from the submarine atmosphere (i.e. chlorine, CO), problems from cold or heat exposure, and psychological injuries. These conditions sometimes could interfere with signs and symptoms of decompression related problems.

The possibility of survivors escaping from a nuclear submarine following a major reactor accident is remote, but possible. In this event, survivors might suffer from acute whole body gamma radiation exposure, contamination of clothing, skin, wounds, and absorption of radioactive substances by ingestion or inhalation. Where circumstances suggest that radioactive contamination is present decontamination procedures should be carried out. In the handling of survivors requiring urgent recompression or other clinical treatment these conditions should not interfere with the special procedures required.

### **22.3.2 Treatment of Submarine Survivors**

Beside possible medical conditions listed in the above paragraphs, decompression sickness and air embolism casualties are most likely to occur. If the escapes from a pressurised DISSUB have been delayed until the rescue vessel is present, the medical officer might be confronted with a high number of decompression sickness and air embolism casualties (refer to → **Subchapter 19.1 – 19.5**), possibly spread over several hours and probably with very limited recompression treatment facilities.

If possible all escapers should be given normobaric 100% oxygen. Priority should be given to the treatment of neurological symptoms and/or impaired consciousness. The medical procedures are the same as listed in the section for the treatment of diving casualties. When there is just one recompression chamber available, this must be reserved for the use of severe cases until all the escapes have been completed. Only then may it be used for milder cases of decompression sickness. A more difficult situation exists when there is no recompression chamber available. Similarly, it must also be anticipated, that from very deep escapes out of pressurized submarines; the number of persons requiring treatment may exceed the capacity of the available chamber. In these circumstances, urgent consideration must be given to possible evacuation of these casualties.

Unless there is another obvious injury or cause, all escapers who lose consciousness within a few minutes after surfacing must be treated by recompression.

Other medical conditions have to be treated in conjunction with the special measurements for these cases and are mentioned in other chapters of this book. Life threatening problems (e.g. compromised airways, impaired breathing or severe bleeding) have to be treated before initiating hyperbaric treatment. In a mass casualty situation triage becomes an important factor in the proper management of the patients.

## **23. Stress Management**

### **23.1 Stress, Critical Incidents and Traumatic Stress**

#### **23.1.1 Acute Stress Disorder (ASD)**

#### **23.1.2 Post-traumatic Stress Disorder (PTSD)**

### **23.2 Levels of Crisis Intervention**

### **23.3 Critical Incident Stress Management (CISM)**

#### **23.3.1 Pre-Deployment Training**

#### **23.3.2 Individual Crisis Intervention**

#### **23.3.3 Large Group Crisis Intervention**

##### **23.3.3.1 Demobilisation**

##### **23.3.3.2 Critical Incident Stress Management Briefing (CMB)**

#### **23.3.4 Defusing**

#### **23.3.5 Critical Incident Stress Debriefing (CISD)**

#### **23.3.6 Family and Organisational Support**

#### **23.3.7 Follow-up and Referral**

### **23.4 Other Aspects to Consider**

#### **23.4.1 Emergency Medical Measures**

#### **23.4.2 Prohibited Actions**

### **23.5 Psychotherapy of the Post-Traumatic Stress Disorder**

### **23.1 Stress, Critical Incidents and Traumatic Stress**

The chapter covers traumatic stress, measures to reduce the amount of traumatic stress and to mitigate its consequences.

Traumatic stress or acute distress is the stress response produced when a person is exposed to a disturbing event in which the usual coping mechanisms of the individual have failed in the face of a perceived challenge or threat. It results in functional impairment the degree of which may be mild, or it can be severe and quite disabling. Critical incident or psychological crisis are other terms for the disturbing event. Examples onboard ships are fire, severe accidents with death or serious injuries of shipmates or buddies, massive destruction caused by collisions or by missile impact, salvage of dead bodies from the sea, near drowning or shipwreck. These events are outside the normal range of situations which the sailor encounters in his or her life. In order to support the individual during and following such stressful events, Critical Incident Stress Management Technique (CISM) may be prudently applied.

CISM is a comprehensive crisis response programme developed by *Everley and Mitchell*<sup>3</sup> in the United States of America for rescue personnel. It has been recommended for several civil and military organisations (e.g. U.S. Coast Guard) in the USA. It has been adopted by several countries in Europe. Some of them have adapted it to their specific population.

The specific characteristics of work and life onboard ships require some changes in crisis intervention as compared to the management of critical incidents ashore. Firstly, on a ship, which has to be run in spite of a crisis, replacement of work groups after experiencing a critical event is often impossible. Secondly, a crisis intervention team can easily be brought on the scene ashore. This is more difficult onboard. The medical teams (with or without doctors) and the → peers are the first points of contact in and after traumatic situations. Their task is carrying out the activities of → level 1 and the assessment of the severity of the acute crisis and of the mental health of the affected personnel.

### **23.1.1 Acute Stress Disorder (ASD)**

Acute stress disorder is a temporary severe disturbance reaction to extraordinary physical or psychic stress (WHO-ICD-10). It develops in mentally and emotionally normal individuals who have been exposed to an overwhelming traumatic event (critical incident). During the event they respond with fear, helplessness, or horror. In general, the symptoms occur within few minutes after the distressing event and usually diminish after several hours or days.

The individuals show marked symptoms of increased arousal and panic such as sweating, paleness, and tachycardia. Typical for this disorder are a subjective sense of numbing, detachment, absence of emotional responsiveness and a reduction in awareness of one's surroundings. Behavioural changes like isolation or irritability may occur. Affected individuals have a higher risk of committing suicide or taking aggressive actions towards themselves or others. They may ignore risks to themselves and may also constitute a risk for others. It is possible that commands are not obeyed to and skills cannot be applied.

### **23.1.2 Posttraumatic Stress Disorder (PTSD)**

PTSD develops as a delayed or protracted reaction to a distressing event or to an extraordinary situation with excessive threat which would provoke deep desperation in almost everyone (WHO-ICD-10). Typical symptoms are:

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<sup>3</sup> Everly, G.S. and Mitchell, J.T. Critical Incident Stress Management - CISM - A New Era and Standard of Care in Crisis Intervention. 2<sup>nd</sup> edition. Elliott City, MD 1999: Chevron Publishing Corporation

- Re-experiencing of the trauma: The traumatic event is persistently re-experienced, e.g. through recurrent and intrusive distressing recollections of the event, through recurrent distressing dreams of the event or through intense psychological distress at exposure to cues that symbolises or resemble aspects of the event.
- Avoidance and numbing: Persistent avoidance of stimuli associated with the trauma, and numbing of general responsiveness as indicated by e.g. efforts to avoid thoughts, feelings, or conversations associated with the trauma, by efforts to avoid activities, places, or people that arouse recollections of the trauma, or by feeling of detachment or estrangement of others, or by restricted range of affect.
- Arousal: Persistent symptoms of arousal as indicated by e.g. difficulty falling or staying asleep, irritability or outbursts of anger, difficulty concentrating, hyper-vigilance or exaggerated startle response.

This disturbance follows the traumatic event with a latency of weeks up to months, in most cases not longer than 6 months.

Not every instance of ASD is necessarily followed by a PTSD. However, PTSD sometimes has a delayed onset. Even in individuals who did not develop ASD symptoms PTSD may occur.

## **23.2 Levels of Crisis Intervention**

The care that is provided to individuals affected by traumatic stress belongs to one of three levels depending on the kind of care and the qualification of the provider.

### Level 1:

This level comprises self help and buddy help and measures which are carried out by peer support personnel. Peers are sailors who know the working and living conditions of the affected individuals. They have specific knowledge of traumatic stress, critical incident stress management, and communication techniques for specific crisis situations. They have been trained in providing care in and after psychological crisis. Peer support personnel are paraprofessional personnel and may do one-on-one intervention and → defusing.

### Level 2:

Level 2 contains preventive measures which go beyond level 1 but contain no psychotherapy. These measures are provided by crisis intervention teams. These teams consist of a mental health professional (psychologists, social workers, counselors or physicians) and peers.

Level 3:

This level encompasses psychotherapy techniques. They are provided by psychologists, social workers or psychiatrists.

### **23.3 Critical Incident Stress Management (CISM)**

As defined by *Everly and Mitchell* (1999) Critical Incident Stress Management is a comprehensive crisis response programme which embodies

- primary prevention (i.e. identification and mitigation of pathogenic stressors),
- secondary prevention (i.e. identification and mitigation of acute distress and dysfunctional symptom patterns).
- third prevention (i.e. follow-up mental health treatment and rehabilitation service).

The general goal of CISM is the prevention of acute, disabling psychological discord and the rapid restoration of adaptive functioning in the wake of a critical incident. In particular, CISM aims at reducing the incidence, duration, severity of traumatic stress and of impairment arising from crisis situations. Furthermore, it is applied to facilitate advanced follow-up mental health interventions, if necessary.

There are seven components of CISM:

1. Pre-incident training.
2. Individual crisis intervention (One-on-One).
3. Large-Group Intervention (Demobilisation and Group Information).
4. Defusing.
5. Critical Incident Stress Debriefing.
6. Family and Organisational Consultation.
7. Follow-up; Referral to psychotherapy.

These components will be described below in the following format:

- Description of the activity.

- Time of the activity.
- Provider of the activity.

The source of the following paragraphs may be found in *Everly and Mitchell* 1999.

### **23.3.1 Pre-Deployment Training**

Description:

Pre-incident preparation has two goals. One is to set the appropriate expectancies for personnel as to the nature of the crisis and trauma risk factors they face. This goal is met by teaching basic crisis coping skills in a proactive manner. The other goal is to teach skills for psychological first aid (self help and buddy help).

Time:

PDT should be conducted before deployment and/or before a specific event.

Provider:

Superiors, psychologists, doctors, medical teams

### **23.3.2 Individual crisis intervention**

Description:

On-scene and directly after the event self and buddy help will be applied, thus carrying out supporting measures for stabilising affected individuals. Most crisis response interventions are done individually. The frequently used intervention for an individual who is in crisis is the SAFER model. SAFER may be used on-scene or after the event whenever necessary. Its goal is to mitigate the acute distress and to facilitate access to follow-up mental health assessment and treatment, if needed. In addition, this type of intervention serves to avoid contagion.

The five stages of the model are:

- **Stabilisation of the situation:** Removal of the person in crisis from provocative stressors, thereby mitigating further escalation and constituting the possibility for assessing the mental status of the person.
- **Acknowledgement of the crisis:** Letting the person describe what happened and in which way he or she reacted, thereby giving way for ventilation and for reduction of arousal.
- **Facilitation of understanding:** Explaining symptoms in context of traumatic stress symptoms, thereby conveying the impression that the reactions are normal, although problematic for the person.

- Encouragement of Adaptive Coping: Teaching basic stress / crisis management techniques, thereby improving immediate and short term coping.
- Restoration of independent functioning, or referral for continued care: Assessing current adaptive functioning as adequate or seeking further assistance, thereby re-establishing psychological equilibrium and creating the possibility of continued care.

Activities of **SAFER** are one-on-one techniques (one individual support person assisting one (or perhaps two) individual(s) in crisis). It is important to note that these activities give the opportunity for assessment of mental status, for deciding whether further monitoring is needed and/or whether additional help must be called in, e.g. a crisis intervention team.

Time:

On-scene or after the event whenever necessary (and possible).

Provider:

Peers or mental health professional (psychologists or ship's doctor).

### **23.3.3 Large Group Crisis Intervention**

#### **23.3.3.1 Demobilisation**

Description:

Demobilisation can be used with large numbers of affected individuals immediately after the event has ended or the personnel are disengaged from the scene. The goal is to bring the personnel back to normality, to take the stress from the persons, to set realistic expectations for the psychological consequences of the crisis event, to provide education concerning practical stress management techniques, and to give some advice with reference to other psychological and/or physical support systems. Normally an informational briefing about stress, trauma and coping techniques takes place in a safe area. It usually takes 20 - 30 minutes.

Time:

Immediately after being disengaged from the scene.

Provider:

Peers, mental health professionals.

#### **23.3.3.2 Critical Incident Stress Management Briefing (CMB)**

Definition:

The group informational briefing is a technique which is used with large groups that have been affected by a critical incident. It aims to provide relevant information pertaining to the event, at reducing subsequent rumours and misinformation, and at facilitating access for follow-up resources, if necessary. It reviews the relevant facts surrounding the incident, presents the psychological dynamics of the incident, and introduces professional resources which can be used for follow-ups.

Time:

Up to several days after the event.

Provider:

Peers, Mental health professionals.

#### **23.3.4 Defusing**

Description:

Defusing may be done at the crisis venue after disengagement from the crisis activity or anywhere in the post-crisis phase within 12 hours after a crisis.

Defusing is 20 - 45 minute group discussions of the crisis event designed to reduce acute stress and tension levels

Defusing has three phases:

1. Introduction (introduction of the intervention team, explanation of the reason and the goals of the intervention, and setting expectations as to the goals),
2. Exploration (exploration of the nature and impact of the crisis, asking about the facts and asking about the individual reactions to the crisis),
3. Information (educational phase as to the normal nature of the symptoms and to practical coping strategies).

Time:

Within 12 hours of the crisis.

Provider:

Peers, Mental health professionals, and Crisis intervention team.

#### **23.3.5 Critical Incident Stress Debriefing (CISD)**

Description:

Critical incident Stress Debriefing (CISD) is used with a homogeneous group of individuals who have experienced a crisis or a traumatic event. As with defusing,

the goal is to mitigate the adverse impact of a traumatic event by reducing the intensity and chronicity of symptoms related to the trauma. It differs from defusing in several aspects: (1) it is carried out later than a defusing; (2) it is more detailed and more structured than defusing; (3) it is designed to bring psychological closure to a traumatic event.

CISD has seven phases:

1. Introduction (introduction of the crisis intervention team, explanation of the process).
2. Fact phase (participants are encouraged to describe the traumatic event from his/her perspective).
3. Thought phase (participants describe their cognitive reactions to the event; and start to transition to the affective domain).
4. Reaction phase (identification of the most traumatic aspect of the event and thus giving the opportunity of ventilation).
5. Symptom phase (identification of symptoms of distress or psychological discord, transition back to the cognitive domain).
6. Teaching phase (supporting the return to the cognitive domain by normalisation and psychological education).
7. Re-entry phase (provision of closure to the CISD process).

CISD is usually most effective if done two to ten days after the crisis has concluded. In some cases, they may be effectively done three to four weeks after the event. They usually take one to three hours to complete.

Time:

Two to ten days after the traumatic event.

Provider:

Crisis intervention team.

### **23.3.6 Family and Organisational Support**

Description:

Support services are provided for families and/or organisations of which the affected individual is part. The goal is to convey information how to deal with the affected individual and in case of organisations to which degree the individual's

work capacity may be reduced and what the organisation can do to facilitate the return to normal functioning.

Time:

Any time after the event whenever required.

Provider:

Mental health professionals, crisis intervention teams, and chaplaincy.

### **23.3.7 Follow-up, Referral**

Description:

After conclusion of the intervention activities it is necessary to check whether the activities were successful or not. On the basis of the individual and group intervention activities and following assessment of the mental status individuals may be referred to additional professional psychological or psychiatric assistance.

Time:

After the conclusion of the activities or later whenever needed.

Provider:

Mental health professionals.

## **23.4 Other Aspects to Consider**

### **23.4.1 Emergency Medical Measures**

Sedatives should be used only in cases of acute crisis. Special care has to be provided to affected individuals who show risk of suicide. They have to be observed carefully.

In order to prevent suicide fixation may be recommended.

### **23.4.2 Prohibited Actions**

- Carrying out CISM measures by individuals who were affected themselves, or who are not fully trained.
- Consumption of alcohol within 48 hours after the traumatic event.
- Sedation by Benzodiazepine derivates.
- Medication by psychopharmacology during the phase of acute stress disorder.

### **23.5 Psychotherapy of the Post Traumatic Stress Disorder**

Following the WHO-ICD definition of PTSD, therapy must not start before four to six weeks after exposition to the traumatic event. At this time, therapy is called “acute trauma therapy”.

The duration of the therapy depends on several factors such as trauma severity, onset of symptoms, or social support. Pre-requisite of any therapy is that the individual is in a safe environment. Consequently, PTSD therapy is not carried out onboard.

The phases of the therapy are:

1. Creating a safe environment.
2. Stabilising.
3. Confrontation.
4. Integration.

Techniques and methods of PTSD therapy are drawn from various therapy schools. As an example, components of behaviour therapy such as cognitive re-framing or confrontation may be combined with hypnotherapeutic methods (imagination) and new techniques like Eye Movement Desensitisation and Reprocessing (EMDR).

It is important that the central Phase 3 (Confrontation) is adequately prepared for by Phases 1 and 2. Furthermore, the results of the trauma confrontation have to be integrated in the individual's life history.

**24. Sea Survival**

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- 24.4.3 Physiological Effects of Removal from the Water**
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**24.5 Wounded or Ill in Sea Survival Situations**

- 24.5.1 Wind Chill**
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- 24.5.8 Skin Ulcers**
- 24.5.9 Toxic Chemicals**
- 24.5.10 Triage of Survivors**
- 24.5.11 Psychological Considerations**

**24.1 Rescue Equipment**

#### **24.1.1      Immersion Suits Development**

In most navies it is noted that equipment in service for military operations at sea had performed surprisingly poorly during real accidents, notwithstanding previous testing.

Many of the tests are innocuous and not realistic.

( **Note →** ) A common problem is the incompatibility for clothes or survival suits and lifejackets worn.

Up until 1945, there were only rudimentary suits in service; however, in 1941, by defining the Clo value for clothing insulation, first steps were taken. Post war research on survival statistics revealed that the problem was more serious than originally imagined. Several critical scientific papers and textbooks are cited as mandatory reading for all students involved in survival at sea and its application to immersion suits such as the effects of leakage, the hydrostatic squeeze on the suit, Clo value and difficulty with protecting the hands.

This realization spawned research principally in those maritime countries operating in cold water. The first generation of post war suits did not meet expectations; they were hot, bulky and leaked badly. Much of this was due to poor fabrics, unreliable wrist and neck seals, lacking spray-hoods, non-water-tight zippers and poor quality control in the manufacturing process.

By the mid 1980s, spurred by the IMO immersion suit standards and the offshore oil industry's demand for better quality, improvement in fabrics, insulating material, waterproof zips, introduction of the spray-hood and better quality control, there was an improvement in the suit design and reliability. This is also reflected in the number of applied physiological papers cited during this period.

Progress has become much more rapid due to international military-commercial investigation of the problems.

#### **23.1.2      Immersion Suit Characteristics**

Some key physical issues of design of immersion suits are of vital importance.

Leakage of as little as half a litre of water into the suit reduces the insulation (immersed Clo value) by 30%. This is why a dry suit is required to protect from the long term effect of hypothermia.

The insulation value of material on a flat surface is directly related to its thickness. Practically speaking, this means that one can achieve about 4 Clo of insulation per 2.5 cm of clothing thickness. Increasing the thickness beyond this severely limits a human's physical function. However, the insulative value of material on a cylinder, i.e. the fingers and toes does not increase linearly with added thickness no significant improvement in insulative value occurs when

over one inch in thickness is added. This is why it is so difficult to protect the hands and feet.

The human produces (even at rest), approximately 500-850 ml of insensible sweat every 24 hours. Therefore, if a waterproof suit is to be worn, there has to be some method of removing this sweat from the skin surface. It is this skin wetness that causes complaints that the suit is hot and unbearable. Recent work has shown that in open water the insulative value is reduced by 15% compared to pool water.

The overall buoyancy of a very large percentage of immersion suits negates the self-righting ability of approved lifejackets.

### **23.1.3        Key Issues of Immersion Suits**

The only proven, reliable way of achieving a good neck seal is to use a continuous rubber collar around the neck. Split neck seals tend to leak.

Wrist seals are also best designed using a continuous rubber collar, but suits can be very quickly made unserviceable if the seals are not well powdered and the occupant punctures the seal with a finger or thumb.

Entry into the suit can be made from the front or the back. There are pros and cons to both methods, but whichever method is used, it must be possible to don the suit single-handedly and the zip closure must be of good quality, otherwise the suit will leak badly.

Gloves are better provided for as a separate item stowed on the sleeve rather than incorporating them into the suit itself.

Rubber Wellington type boots integrated into the suit are the best option for footwear, but must be sized. Necessity and cast may require the substitution of expandable socks.

There are now a large variety of outer shell fabrics for the suit and inner thermal liners. Having a separate inner liner makes it easier to launder and maintain the suit and match the required insulation with the thermal environment.

**( Note → )** The quick-don, once-only suit with drawstring around the neck provides a cheap, practical compromise that was well proven during the Falklands War. It is very useful for donning quickly over existing clothing prior to ship abandonment.

Naval (professional) ship abandonment suits protect well with their 0.75 immersed Clo, but an integrated suit should better include the lifejacket.

This will solve the problem of inability of current lifejackets to self right humans wearing high buoyancy suits.

#### **23.1.4 Life-Jackets**

There are several key issues that need respect:

- the requirement for self righting
- whether the requirement for self righting is necessary when wearing an immersion suit
- the mandatory wearing of lifejackets on small vessels
- continuous education of the improvement of performance with the use of crotch straps and face shields
- the importance of wearability (user compliance).

In the design of any flotation device, the most important criteria are:

- to return the victim back to the surface as quickly as possible to protect from drowning from cold shock
- to provide good oronasal clearance to prevent drowning during the subsequent period following the cold shock stage
- to require it to produce an unstable position in the prone position and a stable position in the supine position to protect from drowning during the development of hypothermia.

Flotation devices can be categorized as either lifejackets for (military or professional) open water operations and personal flotation devices (PFD) for recreational and domestic use. The groups share many of the same features.

### **24.2 Survival in the Water**

#### **24.2.1 Physiological Remarks**

There are some essentials to know about the applied physiology of a sudden cold water immersion situation.

Up until fifty years ago, no one really understood the reason why people suddenly immersed in cold water died. It was attributed to an inability to stay afloat and vague terms such as "exposure". Nor was anyone particularly concerned about the steady cost of life. It was simply accepted as an occupational hazard at sea and fate. Any early attempt at saving ship-wrecked mariners was to provide them with flotation in rather than out of the water.

Death may occur from one of the four stages of immersion:

- Stage 1: Cold shock (3 -5 minutes)
- Stage 2: Swimming failure (3-30 minutes)
- Stage 3: Hypothermia (after 30 minutes)
- Stage 4: Post rescue collapse (during or hours after rescue).

Stages 1 and 2 were considered only of academic interest initially. As a result, physiologists, procurement agencies, teaching establishments and survival suit manufacturers all concentrated their efforts on protecting the human from hypothermia. They did this with great progress.

Even though there is good progress, there are still in the order of 140 000 open water deaths each year (according to WHO). What has been overlooked is the significance of the first two stages - cold shock and swimming failure as a cause of death.

**( Note → )** Cold shock and swimming failure has been cause of death especially in recent accidental cold-water immersions of naval personnel.

The severity of the effects of cold shock is directly proportional to the water temperature peaking between 10-15°C.

Accident investigators are often surprised that some people do not survive a lengthy immersion. Theoretically they are within the "safe" boundaries of one or more of the survival curves that have been developed to predict death from hypothermia. These people do not die of hypothermia per se. They die from a variety of problems in which moderate hypothermia is enough for them to lose their physical ability and mental determination to keep their backs to the waves. Thus, they inhale the next wave and die from drowning in spite of wearing a life jacket.

**( Note → )** Subsequent vomiting is frequent; aspiration of vomit makes the life-threatening situation even worse.

From all the combined research on cold water accidents and scientific research, it has become clear that sudden immersion in cold water, i.e. below 15°C is very dangerous. It has now been shown that a person's swimming ability in warm water bears no relationship to that in cold water. A conscious decision to swim (and rescue oneself) or stay floating still in the water (and be rescued) should not be taken lightly without assessing the pros and cons.

**( Note → )** Below a muscular temperature of 28°C muscle contraction becomes impossible. Upper and lower extremities are cooling down rapidly under cold water immersion conditions because of the reduction in core temperature leading to swimming failure.

In water below 15°C, crew must abandon ship dry shod. If it is not practical to stow a life-raft, i.e. on small vessels, then crew must wear a modern inflatable lifejacket at all times. Cold water immersion suits should be considered in addition.

( **Note →** ) As the majority of deaths following immersion occur in the early stages 1 and 2 before hypothermia develops, preventative measures should be directed toward providing against the short term incapacitating effects of cold and protection from drowning.

### **24.3 Survival in Life-Rafts**

The two great physiological threats to survivors in life craft are cold and insufficient drinking wafer. The ability to deal with these comes from understanding the physiological principles covered below.

#### **24.3.1 Thermal Insulation**

The outstanding priority is thermal insulation. Implementation of a strategy to help maintaining thermal balance is necessary. If possible, an order of priority to eliminate the biggest source of heat loss or gain first and continue thereafter in descending order of priority should be established. Practical considerations, however, often dictate the order in which measures can be taken. For example, it is obvious that if the buoyancy tube in an inflatable raft is only partially inflated and waves are continually breaking inboard, there is little point in wasting energy bailing until control of water ingress is achieved. This may involve closing the windward entrance, fixing a leak, or simply pumping more air into the buoyancy tube.

Life-raft manufacturers recommend inflating the floor to reduce conductive heat loss to the sea. In practice it is almost impossible to exert sufficient pressure to counter the downward pressure from the weight of the seated body. Furthermore, any free water in the raft will accumulate in these depressions in the floor, thereby intensifying conductive heat transfer. In the short term, once there is confidence that the risk of capsizing is small, it is better to take off the life jacket and use it as an insulating cushion to stern heat loss from this source.

Provided a good canopy seal can be maintained, the heat given off by the occupants will help warm the environment within the raft, thus reducing convective heat loss. If everyone is wearing survival suits or waterproof clothing, however, less body heat will escape to warm the atmosphere. Clothing and head coverings will help reduce heat loss through radiation.

Those in wet clothing should remove the outer layers, squeeze them dry, and put them back on. Some body heat will be lost in drying the clothing, but by now the immediate cold threat will have passed. The body should be able to defend this minor thermal challenge with activity or shivering. For those not wearing specialized protective clothing, evaporation will be the main source of body heat

loss; this will continue as long as clothes are warm and wet and the environmental water vapour pressure is less than that at the surface of the clothing. If the internal environment of the raft can be well contained by sealing the apertures, it will warm up reasonably quickly and the water vapour pressure will increase, thereby reducing evaporative heat loss. However, good seals are often difficult to make and maintain in these circumstances, and thus cooling through evaporation is likely to continue.

With protracted survival in cold conditions and insufficient rations to meet the extra energy demands, shivering intensity will diminish. With starvation, it may be totally absent. Therefore, deep body temperature will fall. The risk of cold injury significantly increases in this situation, particularly if dehydration is also present.

#### **24.3.2 Water and Food**

Fluid and energy balance are intimately related. Their maintenance can be critical to performance, health, and survival.

Dehydration in excess of about 5 percent body weight may be associated with headache, irritability, and feelings of light-headedness. With losses of 8 to 10 percent, performance declines significantly. Further losses lead to hallucinations and delirium.

Death usually occurs with acute losses in the range of 15 to 20 percent of body weight. In a marine environment this occurs in 6 to 7 days.

In well-hydrated individuals, physical and mental capabilities do not decline until bodyweight loss exceeds 10 percent. Death from starvation takes 40 to 60 days.

( **Note →** ) For the average resting adult, daily fluid loss is 1500 ml, and daily energy expenditure is 1400 kilocalories. The recommended minimum daily requirement for fluid is 1 litre, and for energy it is 1400 kilocalories. In a survival situation in optimal conditions, these quantities may be reduced to a daily intake of 110 to 220 ml of water and 600 to 1400 kilocalories for a limited period. To reduce catabolism and dehydration, these calories should be in the form of carbohydrate.

The survivor can reduce food and water requirements by minimizing energy expenditure and water losses. This can be done by:

- drinking nothing in the first 24 hours
- never drinking seawater
- never mixing seawater with fresh water,
- avoiding eating protein unless fresh water is freely available

- minimizing activity
- resting during the heat of the day and working in the cool of the evening or early morning
- optimizing the use of shade and breeze
- employing "artificial" sweating (wetting) when appropriate.

The potential life-raft survivor should consider alternative means of acquiring water (for example, ways of collecting rain and condensation; reverse-osmosis pumps and solar stills; fish lymph, spinal fluid, and eyes; turtle blood).

Fat reserves are plentiful, but glucose is required to enable the metabolism of fat. Protein reserves are also reasonably plentiful and can be used to provide the glucose to light the "flame to burn" the fat, but muscle wasting and protein deficiency disorders quickly follow. A minimal daily intake of carbohydrate will help offset this.

( **Note →** ) The absence of vitamins, minerals, or trace elements is unlikely to pose a problem to life-raft survivors in the short term within a two months period.

#### **24.3.2.1 Minimum Water Requirements**

About 450 ml/day appears to be the minimum requirement to keep an inactive individual fit for about 6 days. However, 1 to 1.5 litres/day is required for indefinite periods. Wartime survivors demonstrated that the critical amount of water for a 6-day period appeared to be about 150 ml/day but this was associated with 22% mortality. If the amount of water available was between 150 and 450 ml/day, the mortality rate was reduced to 0.6%.

Survival packs in life-rafts should contain sufficient water, in cans, to supply each person with 540 ml/day for 5 days. The advice given is that no water should be drunk on the first day except by the injured. Thereafter 180 ml 3 times a day are allowed and graduated measuring beakers should be supplied for accurate measurement.

( **Note →** ) Water should be preserved the first day in favour of the ill and injured.

#### **24.3.2.2 Pathophysiological Consequences of Body Water Loss**

Losses in excess of about 5 percent of body weight, especially in warm environments, may be associated with headache, irritability, and light-headedness. The skin loses its elasticity.

When water loss is reaching 10 percent of body weight, performance deteriorates dramatically. Dizziness, faintness, rapid pulse, rapid shallow breathing, possibly associated with needles and pins of the fingertips and around the mouth may be present.

Thereafter, deterioration increases, and hallucinations and delirium become common.

**( Note → )** Death usually occurs in the range of 15 to 20 percent of body weight.

#### **24.3.2.3 Water Conservation**

In a survival situation body water may be conserved by careful dietary and physical behavior. The obvious importance of reducing fluid loss by vomiting is to ensure that all survivors take their anti-motion sickness tablets as soon as possible on boarding the life-raft.

Water balance can best be maintained on a diet which is rich in fat and carbohydrate but low in protein. This is because the oxidation of fats and carbohydrates yields more water than protein and, more important since the major end-products of fat and carbohydrate metabolism is CO<sub>2</sub>, which can be excreted by the lungs.

In contrast the major end-product of protein metabolism is urea which requires water for its excretion in the urine.

Survival situations associated with starvation will produce increased catabolism of the tissue protein with a resultant increased urea production and excretion. In healthy young men about 100 g of carbohydrate a day ingested without food or water reduces protein catabolism from 78 to 43 g, resulting in a reduction in urinary output from 680 to 360 ml. The practical implication is that a ration of 100 g carbohydrate per day will conserve more than its own weight in water. This fact forms the basis of the food rations in the "survival packs".

#### **24.3.2.4 Rain as Supplementary Water Source**

It is fortunate that in the tropical oceans, where water requirements are greatest, rainfall is also the heaviest. Together with the relative absence of cold, this accounts for many of the lengthy survivals at sea.

Rain is often the only source of water available to the survivor at sea. Even in the presence of apparently adequate stores, it should never be wasted as one may be forced to wait for rescue much longer than was initially considered conceivable. It is important that, as soon as one has performed the initial actions necessary to save life, plans be made for the collection and

storages of rain water, otherwise a life-saving rain squall may pass before the survivors have time to organize a suitable collection and storage system.

The initial wetting by the rain should not be collected but, instead, used to wash the salt crystals from the collecting awning or canopy. The raft commander may have difficulty in curbing the "party spirit" after a good rain storm but no excess over the daily ration should be permitted until all storage containers are full.

#### **24.3.2.5                  Unsafe Alternative Water Source: Seawater**

For all practical purposes the sea is a desert. However, the copious quantities of sea water all around undoubtedly increases the psychological stress to the dehydrated castaway.

The concentration of body fluids approximates to about a 1% solution of salt (e.g. approximately 350 m osmol/l): In dehydration, the maximum concentration of salts in the urine is about 2%, corresponding to an osmolarity of about 700 m osmol/l. It is obvious that if sea water is consumed by an individual who is already suffering from dehydration, it will only tend to increase the salt concentration of his body fluids. Secondly, excess salt consumed can be excreted only at a cost of a volume of water which is greater than the volume of sea water drunk. This is because only about half of the total concentration of urine is made up from salt, the remainder being from urea.

The distribution of the excess salt retained in the body worsens the overall effect. The retained salt from sea water tends to remain in the extra-cellular compartment causing an intracellular to extra-cellular fluid shift. The phenomenon may give an impression of initial benefit as most of the signs and symptoms of water depletion are dependent on the state of the extra-cellular compartment. Cell function, however, becomes severely affected and the cells in the vital centres of the brain usually begin to fail.

Deaths in life-raft following the drinking of sea water seem to be due to a fairly rapid onset of respiratory failure often preceded by mental derangement, but not accompanied by the usual signs of dehydration. Delirium leads to apparent insanity, suicide or death.

**( Note → )** There is no beneficial effect in mixing one's fresh water ration with sea water for the same reasons. It has been shown that it only increases the shift of intracellular to extra-cellular fluid and thus hastens death. Hoarding of fresh water should be actively discouraged. If a few drops of sea water inadvertently get into the fresh water ration, then this should be of no great cause for concern.

#### **24.3.2.6                  Safer Alternatives Sources of Water**

Solar Stills:

A variety of these are available commercially and some navies include them in their survival packs. The amount of potable water produced from the still depends on its size, the daily solar energy, duration of exposure and the skill and care of the individual operator. A good solar still may produce up to 1800 ml of potable water per day and even on a cloudy overcast day may produce 600 ml. Solar stills have the great advantage over other methods of producing potable water. The work necessary to prepare the still may be completed while the survivors are still relatively fit and active. Thereafter all that needs to be done is to empty the reservoir each day. In inexperienced hands, careless handling may reduce the output and permit contamination of the drinking water by sea water.

Fish Lymph (Extracellular Fluid):

The practicality of using fish-juice squeezed from the flesh as a source of supplementing the fresh water ration is uncertain as it is impossible to predict how many fish might be caught by a survivor or how much juice might be obtained from them since, to obtain any useful amount of juice, an efficient mechanical press is necessary. Because such fluid will have about the same salt concentration as human body fluid, it will be helpful only to someone who is very dehydrated and therefore has more concentrated body fluid than normal.

The energy expended to squeeze a small amount of fluid without sufficient mechanical aid can outweigh the benefits.

Turtle Blood:

The plentiful and easily accessible supply of turtles in tropical oceans makes them an obvious target as a source of food and fluid to the survivor in these regions. The blood of these creatures has been described as extremely palatable by dehydrated survivors. The turtle, like other marine reptiles, has salt-extruding glands in the region of its eyes and consequently it may seem palatable but, like fish lymph, the electrolyte content would be such as to make it unlikely to produce any worthwhile alleviation of the high salt content of the body fluids. In addition, beneath the shell of the turtle is a quantity of fat, which will provide both a valuable source of food and metabolic water. By reducing catabolism, the fat will also conserve body water.

Desalination Kits:

When sea water is mixed with silver-barium zeolite in a container, the salts contained in the sea water are precipitated, enabling them to be more easily filtered from the resulting solution. Although the filtrate looks clear it still contains sufficient salt to render it unpalatable to many. Commercially available desalination kits currently available have a yield rate of about 600 ml/kg of silver- barium zeolite. Such a yield is not sufficient to justify the space and weight of the kit as a survival aid

Reverse Osmosis:

Forcing sea water by means of a high head of pressure through a semi-permeable membrane which filters out the various salts has long been considered as a possible way of producing potable water at sea. This

technique, so-called "reverse osmosis" is in use with some navies. For use in a life-raft a device with a manually operated high pressure pump and semi-permeable membrane is available. Reverse osmosis is probably the biggest breakthrough in solving the problem of shortage of potable water for survivors at sea. The fluid obtained should be regarded as supplement, rather than a replacement, for a water ration.

( **Note →** ) The potential life-raft survivor should consider alternative means of acquiring water (for example, ways of collecting rain and condensation; reverse-osmosis pumps and solar stills; fish lymph, turtle blood). Those at risk of becoming life-raft survivors should prepare emergency water containers for life craft.

#### **24.3.2.7                  Food**

Modern communications, location devices and search-and-rescue techniques make it unlikely that survivors from large ships will spend sufficient time adrift to suffer any major nutritional deficiencies.

The craving for food is secondary to the desire for water and, in a dehydrated state; man's thoughts dwell on fluids and those foods which have a high fluid content. When thirst has been quenched, however, gastronomic fantasies become the topic of conversation and food may be sought. Accounts of hunger among survivors at sea are extremely rare and are usually to be found only in those exceptional cases where there were long sea voyages with an adequate supply of drinking water.

If a resting man is to remain in metabolic balance indefinitely, sufficient food to provide him with some 1500 to 2000 kilocalories is necessary. The form such food should take depends on physiological, practical and, to a lesser degree, psychological considerations.

Fat, as well as providing more calories than equivalent weights of carbohydrate or protein, also yields more water than either when it is completely oxidized during metabolism. Pure fat, however, would be both extremely unpalatable and indigestible to a dehydrated survivor. Although protein is likely to be the most attainable food available to the castaway, its deleterious effect on the body water conservation must exclude any form of protein from the diet of a survivor unless there is abundant drinking water. Carbohydrate, in some readily digestible form, has many advantages over both fat and protein from the physiological, practical and psychological standpoints.

The addition of 96.5 g of carbohydrate to the diet improves the water balance on the third day of the diet by about 200 ml which is about twice its own weight.

The daily ration is limited by practical considerations of storage space and weight. For example, each survivor may be supplied with 100 g of

carbohydrate per day, for 5 days, other rations will vary slightly from these levels. These are prepared as bland-flavored sweets and, although this diet supplies only some 400 calories per day, it is considered sufficient to keep the survivor in reasonably good condition until he is rescued. It is important however, that the carbohydrate is bland as, when dehydrated, conventional fruit flavored sweets may become unacceptable.

As a general rule, survival voyages are not of sufficient duration to demonstrate vitamin-deficiency states.

( **Note →** ) Fat reserves are plentiful, but glucose is required to enable the metabolism of fat. Protein reserves are also reasonably plentiful and can be used to provide the glucose to light the "flame to burn" the fat, but muscle wasting and protein deficiency disorders quickly follow. A minimal daily intake of carbohydrate will help offset this. The absence of vitamins, minerals, or trace elements is unlikely to pose a problem to life-raft survivors in the short term (two months).

## 24.2 Problems during Rescue-Operations

Apart from the practical difficulties of rescuing survivors, analysis of rescue statistics reveals that in some situations a percentage of those who die as a result of immersion in cold water do so just before, during, or shortly after rescue.

The percentage varies between incidents but on average appears to be about 20% . Those whose experience is based on the rescue of one or two casualties at a time often dispute the existence of this problem. Only when large numbers are being rescued does the phenomenon become noticeable. For example, in the U.K. immersion-incident survey, 20 percent of those recorded as unconscious at rescue were dead when delivered to medical care.

In retrospect one can find evidence of similar incidents in one-off rescues.

At the time of rescue the immersion victim is likely to be suffering from one or more of the following life threatening conditions:

- Near drowning.
- Significantly impaired peripheral neuromuscular (nerve and muscle) function.
- Blood volume alterations.
- Cardio-vascular function impairment.
- Hypothermia.
- Trauma.

Consideration of the preceding anecdotal evidence suggests that three phases of the rescue process have particular risks:

1. Pre-rescue - just before rescue.
2. During rescue - during or immediately following removal from the water.
3. Post-rescue - following rescue.

#### **24.4.1            "Afterdrop"**

The so-called "afterdrop" cannot account for the majority of post-immersion deaths because these must occur at deep body temperatures that are well above lethal cardiac levels. In any case, the afterdrop is primarily a phenomenon of rectal rather than cardiac temperature.

( **Note →** ) Afterdrop is largely of academic interest and not critically important to either the rescue or treatment of immersion casualties provided the casualty is adequately re-warmed.

An alternative explanation for post-immersion collapse and death therefore seems to be required. Although it is conceivable that a mechanism similar to the one we outlined for collapse just before rescue may also explain collapse during rescue, other factors now come into operation. Identified by the anecdotal evidence, several factors could produce a sudden and dramatic alteration in cardiovascular function:

- Prolonged exposure (in water or life-raft).
- Mode of rescue (posture of victim, requirement for physical activity).
- Hypovolaemia.
- Hypothermia.

( **Note →** ) Although listed separately, these factors are inextricably linked and, more importantly, will present a greater hazard when they occur in combination.

#### **24.4.2            Physiological Changes under Immersion Conditions**

Physiological changes under head-out immersion are primarily the result of a reduction of the influence of gravity, together with the hydrostatic pressure. With regard to collapse during rescue, the most important of these changes are those that influence the cardiovascular system and blood volume.

The responses, observed during resting, upright, head-out immersion in thermoneutral water, include

- 250-milliliter average enhancement of diastolic filling.
- Increase in right atrial pressure of 12 to 18 millimeters of mercury.
- 32 to 66 percent increase in cardiac output.

This increase in cardiac output during immersion is entirely due to enhanced venous return to the heart.

Diuresis is also invoked by increases in central blood volume following immersion because the body senses hypovolaemia, despite the fact that total blood volume remains constant initially. In fully hydrated subjects, head-out, upright immersion in thermoneutral water can result in urination reaching 350 milliliters per hour.

Immersion in cold water is likely to increase this figure because of cold-induced diuresis and, if severe hypothermia occurs, because of the direct inhibitory effect of cooling on kidney function. These alterations cause the immersion victim to be hypovolaemic in absolute terms, although central blood volume adjusts to meet the requirement of the immersed state. As a consequence there is no adverse effect, from this cause, experienced by the individual while immersed. General body cooling also induces a relative hypovolaemia through fluid shifts from blood to tissue fluid.

#### **24.4.3            Physiological Effects of Removal from the Water**

When rescuing an individual from water following a prolonged period of immersion, the hydrostatic assistance to circulatory function suddenly vanishes just as the full effect of gravity re-imposes itself on the body. The blood volume of the individual may now be hypovolaemic for the air environment. Gravity tends to induce a redistribution of blood with venous pooling in the lower limbs when the victim assumes a vertical posture - postural hypotension.

The resulting reduction in blood returning to the heart will affect cardiac output and, if not corrected, the person will faint as the blood supply to the brain falls.

Under physiological circumstances, baroreceptor reflex detects falling blood pressure, resulting in vasoconstriction. Evidence suggests that moderate cooling impairs the baroreceptor reflex.

In cooled individuals, the compensating regulatory response may be dulled or even absent, permitting a fall in blood to occur. The consequence of this redistribution of blood on from the water is compounded by the loss of circulating fluid. The resulting associated fall in pressure may be severe enough to cause a shortage of cerebral blood flow, temporary loss of consciousness or even a shortage of perfusion of the coronary vessels, resulting in cardiac arrest.

#### **24.4.4 Causes of Deaths During Rescue**

Most deaths result from drowning.

The remainder of the deaths results not from the “afterdrop” but from the following causes:

- Collapse in blood pressure associated with
  - prolonged exposure,
  - hypothermia,
  - mode of rescue (posture, activity),
  - loss of the hydrostatic assistance to venous return,
  - reintroduction of the full effects of gravity,
  - hypovolaemia
  - increased blood viscosity,
  - dulled baroreceptor reflex responses.
- Increase in the work rate of a cold heart when aiding in one's own rescue (e.g., climbing up ladders in high-sided ships), especially in people with pre-existing cardiac problems.
- Excessively rapid re-warming, leading to re-warming collapse.
- Haemorrhage from an internal injury aggravated during the rescue process, or later as blood pressure recovers.

#### **24.4.5 Rescue Position and Initial Management**

It follows from the preceding that the transition from water to air during rescue from water at any temperature is likely to be less traumatic if subjects are lifted horizontally.

**( Note → )** Survivors whose airways are not under threat of aspiration should be rescued with care, preferably horizontally, and handled as if they were critically ill, however survivors still in the water and whose airways are under threat of aspiration of water should be rescued as quickly as possible by whatever means are available.

Once onboard the rescue craft, the victim should be placed in the optimum position to offset any potential problem in maintaining blood pressure. In a fast rescue craft, it is desirable to lay the casualty in a feet-forward, head-aft attitude; in a helicopter the head should be forward and the feet aft.

A competent person can then assess the victim's general condition and begin appropriate first-aid action.

The major aim of immediate management at the rescue site is to ensure that the airway is clear and ventilation (EAV) is provided if required.

Because the most important cause of post-immersion death is hypoxia secondary to the aspiration of water (and vomit), near-drowning victims should receive oxygen as soon as a clear airway has been established.

All near-drowning and/or accidental hypothermic survivors should receive medical attention as soon as possible. Care should be exercised to ensure that those who require resuscitation do not aspirate vomit.

Cold survivors must be protected from further heat loss, in particular evaporative heat loss and heat loss through forced convection. Re-warming regimes must start as soon as possible (refer to → **Chapter 16.2** ).

## **24.5 Wounded or Ill in Sea Survival Situations**

Sea survivors will suffer from immersion hypothermia, near drowning burn injuries or inhalation trauma (refer to → **Chapter 16**).

### **24.5.1 Wind Chill**

Wind chill is a major contributory factor in the aetiology of cold injury. Relative air movement disturbs the boundary layer of air (forced convection) around the body and increases heat loss. For wind chill index (WCI) refer to → **Annex 24.1** to show the physical relationship between temperature and wind speed.

The index lacks a scientific basis in physical and biological terms. The application of the WCI to the clothed body unnecessarily exaggerates the danger. It is worth remembering that wind chill slows the cooling power of the environment, not air temperature. It is impossible for skin temperature to fall below ambient temperature, regardless of wind speed.

Although ambient temperature must be well below freezing to produce a freezing cold injury (FCI) of naked skin, the same is not true for non-freezing cold injuries (NFCI). Tissue cooling to NFCI-threshold levels may occur at higher ambient temperatures if the insulative value of the clothing decreases through compression from wind or wetting. Evaporative heat loss, which is enhanced by forced convection, will further extract heat from the surface of the clothing, thereby increasing the thermal gradient across it.

### **24.5.2 Non-Freezing Cold Injury**

Tissue temperatures between about 17 °C and -0.55 °C lasting for a protracted period can result in a non-freezing cold injury. For those whose feet are in

water, the colder the water, the higher the risk of injury. But NFCI can occur without immersion of the feet. They do not even have to be wet, although evaporation of water from the surface of the foot will greatly enhance cooling and increase the likelihood of sustaining a cold injury in adverse conditions.

The skin of the affected body part, very often legs and hands, is usually pale or mottled in appearance on rescue, but quickly becomes hyperaemic after rescue and remains so for hours. The affected part feels numb and heavy, although in mild cases tingling pains will occur on re-warming. In more severe cases there will be some peripheral anaesthesia, and in bad cases there will be loss of joint position sense. Oedema may be severe and extend up to the knees. The peripheral pulses are usually absent and capillary filling is very sluggish. The skin is macerated and susceptible to severe damage from relatively minor trauma.

In mild cases the pulses will be full and bounding while the initial hyperemia will disappear within hours. There may be no anaesthesia or other neurological symptoms at this stage, but these may appear in about 5 to 10 days when the patient may complain of pain in the affected limbs at night in bed. If so, there may be some oedema and pain on weight-bearing making walking difficult. The peripheral pulses usually feel normal but there may be differences in skin temperatures between the feet.

( → Note ) Treatment of mild cases, in which there are good peripheral pulses and no gross oedema, is to encourage early ambulation. Treatment of severe cases should be conservative until sufficient time has elapsed to permit accurate assessment of whether surgical interference is necessary. Initially, great care should be taken to prevent infection and not to damage the extremely macerated skin. The limbs should be elevated and exposed to cool room air (20 °C), preferably with a gentle air current from an electric fan. The trunk may be actively re-warmed as required. Broad-spectrum antibiotic cover is advisable and steroids may have some value in the early oedematous phase but, in established cases, may delay nerve regeneration. Dry absorbent dressing should be placed between the toes and pressure on the heels relieved.

Several hours after rescue a reasonably adequate circulation begins to return to the injured region and this is accompanied by severe pain for which analgesia may be required. The recovery tends to move down the limb and the skin over the recovering area usually becomes hot and red. Peripheral pulses are full and some arterio-venous shunting may occur. In severe cases, blistering and gangrene may occur. If the injured regions have been actively re-warmed then the oedema may burst through the skin and the likelihood of gangrene will be increased. If peripheral pulses are absent 6 to 8 hours after rescue then the likelihood of gangrene is high.

( → Note ) The hyperaemic recovery phase may last up to 18 months. Vascular tone gradually recovers but complete recovery is dependent on the extent of nerve damage. A state of sensitivity to cold may persist for years or even decades.

**24.5.3 Freezing Cold Injury (FCI)**

After exposure to extreme cold (below freezing), particularly when the wind chill index is high, the temperature of exposed peripheral tissues may drop below  $-0.55^{\circ}\text{C}$ , the point at which tissue fluid freezes, although skin can freeze at  $-0.53^{\circ}\text{C}$ .

Individuals immersed in seawater near freezing face a theoretical danger of suffering frostbite because the water temperature will be below the freezing temperature of tissue fluid. Seawater does not freeze until around  $-1.9^{\circ}\text{C}$  although actual freezing varies with salinity. But reports of FCI in survivors immersed in water at these temperatures are rare, perhaps because the victims do not survive long enough to suffer the effects of frostbite.

Cold injuries caused by sub-zero temperatures are, when still frozen, white and hard to touch (like wood). When thawed the clinical picture resembles that of NFCI. The part swells, and eventually blisters containing blood might develop. A distinction between different degrees of frostbite cannot be made before thawing and does not influence first aid treatment.

**24.5.4 Heat Illnesses and Sunburn**

The early stage of heat illness is often termed heat exhaustion. If it is untreated, heat exhaustion can, in the right conditions, progress to heat stroke, which is rapidly fatal. Continued exposure to less intense heat, insufficient to cause heat stroke, may however result in chronic heat exhaustion. In the context of survival at sea, those who exercise while wearing special protective clothing are at particular risk of heat illness.

( **Note →** ) This group could include those fighting a fire or conducting other damage-control measures.

Dehydrated, resting occupants of a survival craft in a hot, humid environment are at risk of heat exhaustion but are unlikely to develop heat stroke.

( **Note →** ) The best treatment is prevention of dehydration.

Survivors in open boats are at particular risk of severe burning from direct and indirect solar ultraviolet (UV) rays. This UV radiation is partially absorbed and scattered by the earth's atmosphere before reaching sea level. The distance and obliqueness of the pathway it takes through the atmosphere will determine the dosage received. Thus, the dose received in equatorial waters is significantly greater than that received at higher latitudes.

**24.5.5 Seasickness in Life-Raft**

Despite taking seasickness tablets before boarding, several occupants may still feel nauseous. Accordingly, if polyethylene bags are part of the contents of a grab bag, now is the time to distribute them. It is better to contain vomit in a personal bag rather than vomit over others, possibly making them sick too. In addition, mixing the residue with the free water in the partially flooded floor is unpleasant and can trigger vomiting in others. If one is already vomiting, swallowing extra seasickness tablets is pointless because the tablets are unlikely to dissolve sufficiently before being regurgitated. Alternatively, if the person retains all the tablets, they could produce serious side effects. If transdermal patches are unavailable, it is worth trying to chew or retain a tablet beneath the tongue. Some of the slowly dissolving tablet may be absorbed through the lining of the mouth. The vomiting of small amounts of bloodstained fluid sometimes accompanies protracted seasickness. Although alarming to some people, this is rarely dangerous and will decline as vomiting subsides with habituation. An alteration of sea state or a burst of activity involving head movement may trigger another bout, so tablets should be provided for susceptible individuals if deterioration in weather is expected.

#### **24.5.6 Osmotic Diarrhea**

Survivors who have swallowed large volumes of salt water may suffer from osmotic diarrhoea. This condition results from the presence in the bowel of an abnormal volume of fluid with a solute concentration much above that of normal body fluid (3.5 %). The high concentration of salt in the bowel will attract, through osmosis, additional fluid across the gut wall from the body. This process will increase the overall volume of water in the bowel, although it will tend to dilute its solute content. At the same time, the cells of the intestinal wall attempt to conserve water by pumping it in the opposite direction across the gut wall into the blood. But passive flow by osmosis dwarfs the volume of fluid being transported into the blood stream. The result is an increase in the distension of the gut wall, resulting in contraction of the intestines and expulsion of the contents. The resulting diarrhoea rids the body of the undesirable salt but takes fluid with it.

#### **24.5.7 Oil Contamination**

Shipwreck survivors are frequently covered in fuel oil. Survivors may even have swallowed or inhaled some. In small quantities, oil is not toxic to the system, although if swallowed it may cause vomiting and if inhaled it may produce aspiration pneumonia. In the eyes it will produce conjunctivitis, which may last several days. After rescue, the best method of cleansing the oil is to remove the outer clothing and place the survivor under a hot shower, provided it is safe for the survivor to do so and gently wipe with cloths or paper towels to remove the excess oil from the skin. Shampoo and bath soap may be used, and specialized skin cleansers, such as Swarfega, will deal with any obdurate patches. Avoid using solvents and other scouring compounds not intended for use on skin. The eyes may be cleansed with mineral oil (liquid paraffin) followed by a topical steroid to relieve the conjunctivitis. When dealing with multiple survivors, initial

cleansing from around the mouth, nose, and eyes is all that is required. The remainder of the body can be cleansed later when time permits.

#### **24.5.8            Skin Ulcers**

Ulcers that have developed on pressure areas or because of minor skin damage from abrasions or boils are difficult to treat and will require patience and care. Prevention is the best cure. Once the skin is broken, however, it is notoriously difficult to heal in the damp, salty environment of a life craft. Bacteria found on the skin, which are relatively harmless on intact skin, will grow and multiply in an open wound and delay healing. Concurrent starvation and body protein deficiency will further delay healing or even inhibit it totally.

Therefore, wounds should be gently washed with fresh water, preferably containing some mild antiseptic. Keeping the wounds dry and elevated will encourage healing.

In a life raft, occupants can use some fresh, non-potable water for cleansing wounds.

Saltwater boils, or pustules, are often the forerunner of ulcers in pressure-point areas and elsewhere. The boils frequently occur in hair follicles because of constant dampness and poor hygiene. In hot weather, the constant warm dampness of the skin beneath damp underwear promotes bacterial growth. It is better to go without underwear in such conditions and, if possible, expose the affected area to a moderate amount of sunlight periodically during the day.

( → Note ) Washing two or three times a day with fresh water containing mild antiseptic will be helpful. After drying, gently massage some emollient into the skin over the pressure points. If pus is present, it should be released before cleansing, and the area dotted with iodine or other suitable antiseptic. In severe cases, antibiotic treatment may be required; but the infecting agent will often be resistant to commonly used antibiotics.

#### **24.5.9            Toxic Chemicals**

Although it is usual to have some preliminary warning of the possibility of having to treat some rescued survivors, it is prudent to give the matter some thought in advance. While in transit to a stricken ship it is advisable, if possible to acquaint oneself with the nature of her cargo. A large variety of toxic chemicals are currently carried by a number of ships - not always designated "chemical carriers". The chemical containers may be damaged in the incident leading to the "shipwreck", thereby creating a chemical hazard of known entity, or in the case of mixtures ("cocktails"), an unknown entity.

( Note → ) Closed-circuit breathing apparatus and specialized clothing, together with other precautionary measures may therefore be necessary.

#### **24.5.10        Triage of Survivors**

An easily accessible sheltered compartment on the upper deck should be chosen, where a cursory examination of survivors as they are rescued in order to decide on disposal and priorities for treatment is possible. Clinical conditions requiring management will vary from mild acute hypothermia to drowning in immersion victims, and chronic hypothermia to dehydration/ malnutrition in those rescued from survival craft. In addition, some survivors may be suffering from burns, traumatic injuries etc, while survivors rescued from the water may frequently be contaminated by oil with local effects to eyes, lungs and stomach.

Many hypothermic casualties collapse during or shortly after rescue and their lives are in danger. For this reason survivors should not be required to walk down ladders etc. to treatment areas. They should not be unattended at any time.

The nearest easily accessible sheltered area should be used for triage.

#### **24.5.11        Psychological Considerations**

An assortment of physical and psychological ailments, either alone or in combination with other stressors, can erode morale or decrease survivability at sea. These ailments include osmotic diarrhoea, oil contamination, skin ulcers, thermal (hot and cold) injuries, and seasickness. It can be demoralizing and energy sapping at a time when survivors need to be both alert and active.

The extent to which individuals are psychologically prepared for disaster and their psychological response to it can significantly affect their chances of survival.

In a survival scenario the boundary between psychological and physiological responses becomes blurred.

The prospects for survival increase significantly if a survivor reacts calmly, appropriately, and effectively in an emergency. Training and experience can influence the psychological response observed in a survival situation.

The survivor should maintain a positive mental attitude until rescue and recovery are complete.

(Note ( ) Survivors may suffer from post-traumatic stress at some later stage. The best treatment for post-traumatic stress and its possible progression to PTSD is group counseling with fellow survivors (refer to ( Chapter 20 ).

25. Medical Logistics

25.1 Medical Equipment and Supplies

25.2 Special Problems with Shipping of Materials

25.2.1 Medications

25.2.2 Biological Products

25.2.3 Specimens

25.3 Blood

25.4 General Remarks

25.4.1 International Equivalents and Standards

25.4.2 General Supply Storage Considerations

25.4.3 Buying / Installing Medical Equipment

25.1 Medical Equipment and Supplies

In an effort to make NATO forces more compatible, NATO has devised a series of Standardization Agreements which include many in the medical area. While not all member nations carry all the same medications and supplies aboard their vessels, most have at least equivalent drugs.

Specifically, the following STANAGs are applicable to surface ships:

- STANAG 1208 Minimum Requirements for Emergency Medical Supplies on Board Ships.

This document lists a generic index of types and classes of emergency medical supplies followed by appendices listing member countries' actual drug lists used to fulfill these requirements.

- STANAG 1412 Litters for Ship to Ship or Air Transport.

Specifications for stretchers for ship to ship transfer are given.

- STANAG 2105 NATO Table of Medical Equivalents.

This implements AMED P-1 which lists international drug equivalents.

- STANAG 2179 MED (EDITION 1) –Minimum Requirements for Medical Care of Women Aboard Ships.

This documents attempts to define necessary drugs to diagnose and initially manage women's health at sea.

- Others that may be applicable depending upon type of ship include
  - STANAG 1065 (replenishment at sea),
  - STANAG 1185 (minimum essential medical and survival equipment for ship life rafts...),
  - STANAG 1200 (procedures for logistical support between NATO Navies...),
  - STANAG 1319 (minimum medical supplies located on board submarines for escape/rescue),
  - STANAG 2021 (cross servicing of medical gas cylinders),
  - STANAG 2128 (medical and dental supply procedures),
  - STANAG 2040 (stretchers, bearing brackets, and attachment supports),
  - STANAG 2357 (x-ray film and cassettes),
  - STANAG 2361 (minimum essential medical supply items in theaters of operations),
  - STANAG 2469 (external bone fixation devices),
  - STANAG 2871 (first aid material for chemical injuries),
  - STANAG 2939 (medical requirements for blood, blood donors, and associated equipment),
  - STANAG 2979 (essential characteristics of electro-surgical apparatus).
- STANAG 2150 gives the NATO uniform standard of supply coding.
- Useful NATO publications include:
  - ALLIED JOINT MEDICAL SUPPORT DOCTRINE - AJP-4.10(A),
  - MULTINATIONAL JOINT LOGISTICS CENTRE (MJLC) DOCTRINE - AJP-4.6,
  - ALLIED JOINT HOST NATION SUPPORT DOCTRINE AND PROCEDURES - AJP-4.5

## 25.2 Special Problems with Shipping of Materials

### 25.2.1 Medications

Most drug manufacturers design and test drugs to be stored under controlled environmental conditions with stable environmentally controlled shipping assumed. This presents problems for drug shipping for ships where the shipping containers may be left on a pier in freezing or very hot conditions.

Dermal patch medications may crystallize when too cold or too hot (less than 20° or over 40° C) and may not reconstitute. Some drugs are very climatically stable such as Ciprofloxacin which handles heat and cold and maintains long shelf lives. However, many drugs have short shelf lives and may be outdated on arrival after a long supply chain.

When manufacturers' shelf life recommendations are made, they are usually based on the longest time tested if the shelf life is several years. Some countries have programs to continue shelf life testing past the manufacturing labeled date for stable drugs such as Atropine and Oximes for chemical war defense. Other drugs such as Tetracycline deteriorate over time to toxic compounds and should not be retained past their shelf life.

( **Note →** ) Narcotics and other controlled medications may have special handling prescribed to avoid loss during the shipping process.

#### **25.2.2            Biological Products**

Biological products such as live vaccines, bacteriological culture plates, and laboratory reference material require close attention to shipping details to assure no lapse in temperature control.

#### **25.2.3            Specimen**

Shipping specimens from the ship to reference labs may require special packaging (hazardous material shipping requirements) as well as coordination with host nations affected, particularly if the specimen may be infectious. In the rare instance that potentially fragile/labile blood laboratory testing such as coagulation studies is required, it may be prudent to send a control (normal) blood specimen along with the patient's blood to ensure shipping doesn't cause abnormalities in the control specimen as well as the patient's serum.

### **25.3 Blood**

Refer to → **AMedP-12!**

## **25.4 General Remarks**

### **25.4.1 International Equivalents and Standards**

Often the same drug has different names in different countries and occasionally different drugs have the same name in different countries.

AMEDP-1 lists equivalencies.

Standards for medications may vary from country to country and manufacturer to manufacturer. Caution should be exercised. New standards for medical gas purity and medical gas fittings/cylinders are being defined but are not yet ratified.

### **25.4.2 General Supply Storage Considerations**

Besides the temperature considerations listed above on shipping that apply equally to storage, other factors should be considered when storing medical supplies aboard ship.

Disaster and damage control planning generally recommend that medical supplies be kept in more than one location so that a single strike or accident doesn't destroy all medical supplies. When at war or heightened likelihood of attack, it may be prudent to either pre-distribute essential medications such as narcotics, bandages and oxygen to various battle stations or place them in portable containers for rapid transport to a usable part of the ship.

### **25.4.3 Buying / Installing Medical Equipment**

When purchasing medical equipment, it should be remembered that shipboard electrical systems are not equivalent to shore facilities and may have different voltage per line, cycle, grounding and phasing requirements than for what the equipment was designed. Frequent power outages for damage control drills may require an uninterruptible power device to be installed to prevent power drops and outages from damaging electrical cards in the equipment. Choosing laboratory equipment should be done cautiously to ensure the reagent shelf life will fit the ship's mission and deployment.

## **26. References**

### **26.1 Reference List**

#### **26.1.1 Military Committee Documents**

#### **26.1.2 Standardization Documents with Actual or Potential Medical Implications**

### **26.2 Glossary of Terms**

### **26.3 Abbreviations**

### **26.1 Reference List**

This is a list of documents, not all of which are medical-specific, but which have medical implications. Note that some of these documents are still under development or are out for national ratification as the time of this publication. Not all are therefore currently valid and agreed Alliance documents, but are included simply for completeness.

#### **26.1.1 Military Committee Documents**

MC 020/8, "Military Committee Policy on Standardisation" (Currently under revision to include changes made by the establishment of the NATO Standardisation Agency)

MC 075/1, "Policy for the Control of Air Transport and Troop Carrier Resources Made Available for the Major NATO Commanders" (Mentions use of aircraft for air evacuation)

MC 128/3, "Guidance for Intelligence Support to NATO"

MC 248/1, "The Relationship Between NATO and the Interallied Confederation of Reserve Officers." (The CIOMR is a subordinate group to the CIOR)

MC 292, "Guidelines for NATO Maritime Forces Operating in a Refugee Environment"

MC 299/5, "Guidance For Defence Planning"

MC 317, "NATO Force Structures for the Mid 1990's and Beyond"

MC 319/2, "NATO Principles and Policies for Logistics". (This is the guideline document--all derivative medical documents must be in accord with it.)

MC 326/2, "NATO Medical Support Principles and Policies"

MC 327/2, "Military Concept For NATO Peace Support Operations".

MC 334/1, "NATO Principles and Policies for Host Nation Support (HNS) Planning"

MC 335, "Establishment of the Committee of the Chiefs of Military Medical Services in NATO (COMEDS)" (Corrigendum # 5 was issued in 2006.)

MC 336/2, "The Movement and Transportation Concept For NATO"

MC 343, "NATO Military Assistance to International Disaster Relief Operations". (This is an outdated document, which is currently being revised.)

MC 389, "MC Directive for the Military Implementation of the Alliance's CJTF Concept"

MC 400/2, "MC Guidance For The Military Implementation Of Alliance Strategy"

MC 402, "NATO Psychological Operations Policy"

MC 411/1, "NATO Civil-Military Co-operation (CIMIC) Policy". (A new revision to this document is currently in draft.)

### **26.1.2 Standardization Documents with Actual or Potential Medical Implications**

AAP-3 (I), "Procedures For The Development, Preparation, Production, And The Updating Of NATO Standardisation Agreements (STANAGs) And Allied Publications (APs)". (This is the "Bible" of standardisation document production.)

AAP-4 (2006), "NATO Standardisation Agreements And Allied Publications". (Issued annually, this is the listing of all current STANAGs and APs.)

AAP-6, "NATO Glossary Of Terms And Definitions"

AAP-15, "Glossary Of Abbreviations Used In NATO Documents"

ACCP-1, "Heat Transfer And Physiological Evaluation Of Clothing"

ACodP-2, "The NATO Supply Classification Handbook"

ADivP-1 (A), "Allied Guide To Diving Operations"

ADivP-2 (A), "Allied Guide To Diving Medical Disorders"

AEP-10, "Handbook For The Sampling And Identification Of Chemical Warfare Agents"

AJP-1 (B), "Allied Joint Doctrine"

AJP-3.4.1, "Peace Support Operations".

AJP-4 (B), "Allied Joint Logistic Doctrine"

AJP-4.6 (A), "Multinational Joint Logistics Center Doctrine"

AJP-4.10 (A), "Allied Joint Medical Support Doctrine".

AJP-9, "NATO Civil-Military Co-operation (CIMIC) Doctrine".

ALP-8, "Index Of NATO Logistic Directives, Instructions, And Manuals" (To be reissued as AJP-4.8)

ALP-9 (B), "Land Forces Logistic Doctrine"

ALP-4.1, "Multinational Maritime Force (MNMF) Logistics"

ALP-12, " Guidance For the Planning and Preparation of Host Nation Support Agreements" (To be reissued as AJP-4.5)

AMedP-1 (E), "NATO Table Of Medical Equivalents"

AMedP-3 (B), "Chemical Methods of Insect And Rodent Control"

AMedP-5 (B), "Multilingual Phrase Book For Use By The NATO Medical Services"

AMedP-6 (B), "NATO Handbook On The Medical Aspects Of NBC Defensive Operations"

AMedP-7 (C), "Concept Of Operations Of Medical Support For Nuclear, Biological, And Chemical Environments". (NOTE: NATO Restricted.)

AMedP-8, "Planning Guide For The Estimation Of Battle Casualties (Nuclear)" (To be replaced by the following three documents, which are under development.)

AMedP-08 (A) VOL. I, "Medical Planning Guide For The Estimation Of NBC Battle Casualties (Nuclear)" (Currently under development.)

AMedP-08 (A) VOL. II, "Medical Planning Guide For The Estimation Of NBC Battle Casualties (Biological)" (Currently under development. NOTE: NATO Restricted.)

AMedP-08 (A) VOL. III, "Medical Planning Guide For The Estimation Of NBC Battle Casualties (Chemical)" (Currently under development.)

AMedP-12 (A), "NATO Blood Brochure"

AMedP-13, "NATO Glossary of Medical Terms And Definitions".

AMedP-14, "Handling of Casualties in Extreme Climatic Environments". (Currently under development.)

AMedP-15, "Military Medical Support In Disaster Relief".

AMedP-16, "Comparative Tables Of Medical Treatment Facilities" (Currently under development.)

APP-9, "Compendium Of Allied Land Forces Messages"

ATP-10 (D), "Search And Rescue"

ATP-17 (C), "Naval Arctic Manual"

ATP-57, "Submarine Rescue Manual"

AXP-6 (B), "Nuclear Casualty And Damage Assessment For Exercises"

AXP-7 (A), "Chemical Casualty Assessment Exercise Publication"

AXP-8, "The Effects Of Wearing Individual Protection Equipment On Individual And Unit Performance During Exercises"

EXTAC 1010, "Non-Combatant Evacuation Operations"

EXTAC 1011, "Humanitarian Assistance Operations"

STANAG 1185, "Minimum Essential Medical and Survival Equipment for Ship Life Rafts Including Guidelines For Survival at Sea"

STANAG 1196, "Naval Arctic Manual"

STANAG 1208, "Minimum Requirements of Emergency Medical Supplies on Board Ships"

STANAG 1301, "Minimum Conditions For Survival In A Distressed Submarine Prior To Escape Or Rescue"

STANAG 1308, "Radhaz to Ships Personnel During Helicopter (and VSTOL Aircraft) Operations on Ships"

STANAG 1319, "Minimum Requirements for Medical Stores Located on Board Submarines in Support of Escape/Rescue"

STANAG 1372 (ADivP-1), "Allied Guide to Diving Operations"

STANAG 1380, "NATO Naval Radio and Radar Radiation Hazards Manual AECP-2"

STANAG Study 1388, "Treatment of Refractory Decompression Sickness".

( → NOTE ) Studies such as this one are not yet approved by the nations, but are currently under development. Some of these studies may be withdrawn in the future without finalization or ratification.)

STANAG 1390, "Submarine Rescue Manual (ATP-57)"

STANAG 1406, "Multinational Maritime Force (MMNF) Logistics (ALP-11)"

STANAG Study 1412, "Minimum Requirements For A Litter To Transfer Patients Ship to Ship Or Ship To Air"

STANAG 1432, "Allied Guide to Diving Disorders, ADivP-2"

STANAG Study 1439, "Content and Frequency of Diving Medical Examinations"

STANAG Study 1441, "Minimum Qualifications For Diving Medical Officers"

STANAG 2037, "Vaccination of NATO Forces"

STANAG 2040, "Stretchers, Bearing Brackets, and Attachment Supports"

STANAG 2048, "Chemical Methods of Insect and Rodent Control (AMedP-3)"

STANAG 2050, "Statistical Classification of Diseases, Injuries and Death"

STANAG 2060, "Identification of Medical Materiel For Field Medical Installations"

STANAG 2061, "Procedures for Disposition of Allied Patients By Medical Installations"

STANAG 2068, "Emergency War Surgery (Emergency War Surgery Handbook)"

STANAG 2070, "Emergency War Burial Procedures"

STANAG 2083, "Commander's Guide on Nuclear Radiation Exposure of Groups"

STANAG 2087, "Medical Employment of Air Transport in the Forward Area"

STANAG 2105, "NATO Table of Medical Equivalents (AMedP-1 (E))"

STANAG 2121, "Cross-Servicing of Medical Gas Cylinders"

STANAG 2122, "Medical Training in First Aid, Basic Hygiene, and Emergency Care"

STANAG 2126, "First Aid Kits and Emergency Medical Care Kits"

STANAG 2127, "Medical, Surgical, and Dental Instruments, Equipment, and Supplies"

STANAG 2131, "Multilingual Phrase Book For Use By the Medical Services (AMedP-5 (A))"

STANAG 2132, "Documentation Relative to Medical Evacuation Treatment and Cause of Death Of Patients"

STANAG 2136, "Minimum Standards of Water Potability in Emergency Situations"

STANAG 2177, "Methodology For Anthropometric Data"

STANAG Study 2178, "Medical Tubing And Connectors In The Field"

STANAG Study 2179, "Minimum Requirements For Medical Care Of Women On Ships"

STANAG 2182, "Allied Joint Logistic Doctrine (AJP-4)"

STANAG 2219, "Medical Preventive and Protective Measures Associated With Missile Operations"

STANAG Study 2227, "Military Medical Support In Disaster Relief (AMedP-15)"

STANAG Study 2228, "Allied Joint Medical Support Doctrine (AJP 4.10)"

STANAG Study 2235, "Pre- & Post Deployment Medical Examination Within NATO Forces"

STANAG 2342, "Minimum Essential Medical Equipment and Supplies for Motor Ambulances at All Levels"

STANAG 2345, "Control and Evaluation of Exposure of Personnel to Radio-Frequency Fields—3KHz to 300 GHz"

STANAG 2346, "Standard Method of Writing Prescriptions for Spectacles"

STANAG 2347, "Medical Warning Tag"

STANAG 2348, "Basic Military Hospital (Clinical) Records"

STANAG 2350, "Morphia Dosage and Casualty Marking"

STANAG 2357, "X-Ray Film Formats, Cassettes, Screens, and Hangers".

STANAG 2358, "First Aid and Hygiene Training in NBC Conditions"

STANAG 2361, "Minimum Essential Medical Supply Items in Theatres of Operations"

STANAG 2406, "Land Forces Logistic Doctrine (ALP-9)"

STANAG 2408, "NATO Blood Brochure (AMedP-12)"

STANAG Study 2409, "NATO Glossary of Medical Terms and Definitions (AMedP-13)"

STANAG 2412, "Exercise Data On The Effects Of Wearing Individual Protection Equipment On Individual And Unit Performance During Exercises (AXP-8)"

STANAG 2434, "Compendium of Allied Land Forces Messages (APP-9)"

STANAG 2437, "Allied Joint Operations Doctrine (AJP-1)"

STANAG 2449, "Annual Training On The Law Of Armed Conflict"

STANAG Study 2453, "The Extent of Dental and Maxillofacial Treatment and Minimum Essential Dental Field Equipment at the First-Third Echelon"

STANAG Study 2458, "Handling of Casualties in Extreme Climatic Environments (AMedP-14)"

STANAG Study 2461, "NATO Handbook on Medical Aspects of NBC Defensive Operations (Nuclear) (AMedP-6(C) Vol. I)"

STANAG Study 2462, "NATO Handbook on Medical Aspects of NBC Defensive Operations (Biological) (AMedP-6(C) Vol. II)"

STANAG Study 2463, "NATO Handbook on Medical Aspects of NBC Defensive Operations (Chemical) (AMedP-6 (B) Vol. III)"

STANAG Study 2464, "Military Dental Field Identification"

STANAG 2465, "Tasks for the Appropriate Staffing and Training of Dental Officers and Dental Ancillary Personnel for Wartime Operations and Operation Deployments"

STANAG 2466, "Dental Fitness Standards for Military Personnel and A Dental Fitness Classification System"

STANAG Study 2469, "External Fixation Devices for Bone Injuries"

STANAG Study 2472, "The Effect Of Wearing NBC Individual Protective Equipment (IPE) On Individual and Unit Performance"

STANAG Study 2473, "Commander's Guide on Low Level Radiation Exposure in Military Operations"

STANAG Study 2474, "Recording of Low Level Radiation For Medical Staffs"

STANAG Study 2475, "Planning Guide For The Estimation Of NBC Battle Casualties (Nuclear) (AMedP-8 (A), Volume I)"

STANAG Study 2476, "Medical Planning Guide For The Estimation Of NBC Battle Casualties (Biological) (AMedP-8 (A), Volume II)"

STANAG Study 2475, "Planning Guide For The Estimation Of NBC Battle Casualties (Nuclear) (AMedP-8 (A), Volume III)"

STANAG Study 2478, "Medical Support In A Nuclear, Biological, And Chemical Environment"

STANAG Study 2481, "Medical Information Collection And Reporting"

STANAG Study 2499, "The Effect Of Wearing NBC Individual Protection Equipment On Individual And Unit Performance During Military Operations (ATP-65)"

STANAG 2500, "NATO Handbook on the Medical Aspects of NBC Defensive Operations (AMedP-6 (B))"

STANAG 2517, "Development and Implementation of Teleconsultation Systems"

STANAG 2871, "First Aid Materiel For Chemical Injuries"

STANAG 2872, "Medical Design Requirements For Military Motor Ambulances"

STANAG 2873, "Concept of Operations of Medical Support For Nuclear, Biological, and Chemical Environments (AMedP-7(C))"

STANAG 2874, "Planning Guide For the Estimation of Battle Casualties (Nuclear) (AMedP-8)"

STANAG 2879, "Principles of Medical Policy in the Management of a Mass Casualty Situation"

STANAG 2885, "Emergency Supply of Water in War"

STANAG 2899, "Protection of Hearing"

STANAG 2900, "Laser Radiation-- Medical Surveillance and Evaluation of Over-Exposure"

STANAG 2905, "Basic Voltage and Current Characteristics of Electro-Medical Equipment"

STANAG 2906, "Essential Physical Characteristics of Field Type High Pressure Steam Sterilizers"

STANAG 2907, "Procedures For Reporting and for Initial Disposition of Unsatisfactory Medical Materiel and Drugs"

STANAG 2908, "Preventive Measures For An Occupational Health Program"

STANAG 2910, " Nuclear Casualty and Damage Assessment for Exercises (AXP-6)"

STANAG 2917, " Chemical Casualty Assessment Exercise Publication (AXP-7 (A))"

STANAG 2931, "Orders For The Camouflage Of The Red Cross and Red Crescent on Land in Tactical Operations"

STANAG 2937, "Survival, Emergency, and Individual Combat Rations-- Nutritional Values and Packaging"

STANAG 2939, "Medical Requirements For Blood, Blood Donors and Associated Equipment"

STANAG 2954, "Training of Medical Personnel for NBC Operations"

STANAG 2979, Essential Characteristics of Electrosurgical Apparatus"

STANAG 2981, "Prevention of Cold Injury"

STANAG 2982, "Essential Field Sanitary Requirements"

STANAG 3114, "Aeromedical Training of Flight Personnel"

STANAG 3204, "Aeromedical Evacuation"

STANAG 3318, "Aeromedical Aspects of Aircraft Accident/Incident Investigation"

STANAG 3381, "NATO Standard Procedures For Compensation And Form For Request And Receipt Of Support In The Form Of Supplies And Services"

STANAG 3474, "Temporary Flying Restrictions Due To Exogenous Factors Affecting Aircrew Efficiency"

STANAG 3497, "Aeromedical Training of Aircrew in Aircrew NBC Equipment and Procedures"

STANAG 3526, "Interchangeability of NATO Aircrew Medical Categories"

STANAG 3527, "Aircrew Flying Time and Rest Periods"

STANAG 3606, "Evaluation And Control Of Laser Hazards On Military Ranges"

STANAG 3614, "Electromagnetic Compatibility (EMC) Of Aircraft Systems"

STANAG 3680, "NATO Glossary Of Terms And Definitions (AAP-6)"

STANAG 3744, "Minimum Requirements of Medical Equipment in Search and Rescue Aircraft"

STANAG 3745, "Medical Training for Search and Rescue Personnel"

STANAG 3746, "Minimum Essential First-Aid and Survival Equipment in Aircraft"

STANAG Study 4510, "Approved Drug for Use by Service Personnel in the Prevention of Radiation- Induced Nausea and Vomiting"

STANAG Study 4511, "Criteria and Evaluation Procedures For Approval of Drugs For Use By Service Personnel in the Prevention of Radiation-Induced Nausea and Vomiting"

STANAG Study 7112, "Minimum Standards For Medical Equipment For Aeromedical Evacuation"

## **26.2 Glossary of Terms**

**ADVANCED LOGISTIC SUPPORT SITE:** Advanced Logistic Support Site. An ashore site, located in the secure location within the theatre that provides logistic and medical support to the MNMF, ensuring that all PMC (Personnel, Mail and Cargo) are processed and transferred as expeditiously as possible. An ALSS may be the primary transhipment point for material and personnel to and from afloat units or, more often, may use Forward Logistic Site(s) as a bridge.

**ALLIED JOINT OPERATION:** An operation carried out by forces of two or more NATO nations, in which elements of more than one service participate.

**AEROMEDICAL EVACUATION:** The movement of patients under medical supervision to and between medical treatment facilities by air transportation.

**AEROMEDICAL EVACUATION CONTROL CENTRE:** The control facility established by the commander of an air transport division, air force, or air command. It operates in conjunction with the command movement control centre and coordinates overall medical requirements with airlift capability. It also assigns medical missions to the appropriate AE elements in the system and monitors patient movement activities.

**AEROMEDICAL EVACUATION COORDINATING OFFICER:** An officer of an originating, in-transit or destination medical facility/establishment who coordinates AE activities of the facility/establishment.

**AEROMEDICAL EVACUATION, FORWARD:** That phase of evacuation which provides airlift for patients between points within the battlefield, from the battlefield to the initial point of treatment, and to subsequent points of treatment within the combat zone.

**AEROMEDICAL EVACUATION (INTER-THEATRE), STRATEGIC:** That phase of evacuation which provides airlift for patients from overseas areas or from theatres of active operations, to the home base, to other NATO countries, or to a temporary safe area.

**AEROMEDICAL EVACUATION (INTRA-THEATRE), TACTICAL:** That phase of evacuation which provides airlift for patients from the combat zone to points outside the combat zone, and between points within the communication zone.

**AEROMEDICAL EVACUATION OPERATIONS OFFICER:** An officer of the airlift force or command who is responsible for activities relating to planning and directing AE operations, maintaining liaison with medical airlift activities concerned, operating an Aeromedical Evacuation Control Centre, and otherwise coordinating aircraft and patient movements.

**ALLIED OPERATIONS:** Operations carried out by forces of two or more NATO nations.

**CAPABILITY PACKAGES:** A combination of national and NATO funded infrastructure associated running costs which, together with the assigned military forces and other essential requirements, enable a NATO Commander to achieve a specific NATO Military Required Capability.

**CASUALTY:** In relation to personnel, any person who is lost to his organization by reason of having been declared dead, wounded, injured, diseased, detained, captured or missing.

**CASUALTY, BATTLE:** Any casualty incurred as the direct result of hostile action, sustained in combat or relating thereto or sustained going to or returning from a combat mission.

**CASUALTY, DISEASE NON-BATTLE INJURY:** A grouping of casualties which are due to disease or injury not acquired in combat or relating to combat.

**COMBINED JOINT OPERATIONS:** Operations carried out by two or more military forces of two or more allied nations acting together for the accomplishment of a single mission.

**CONFLICT PREVENTION:** Different activities, in particular under Chapter VI of the UN Charter, ranging from diplomatic initiatives to preventative deployments of forces intended to prevent disputes from escalating into armed conflicts and from spreading. Conflict prevention can include fact finding missions, consultation, warning, inspections and monitoring. (See also *Humanitarian Operations, Peace Building, Peace Enforcement, Peacekeeping, Peace Making and Peace Support Operations*).

**COORDINATING AUTHORITY:** The authority granted a commander or individual assigned responsibility for coordinating specific functions or activities involving forces of two or more countries, or two or more forces from the same Service. He has the authority to require consultation between the agencies involved or their representatives, but does not have the authority to compel agreement.

In case of disagreement between the agencies involved, he should attempt to obtain essential agreement by discussion. In the event he is unable to obtain essential agreement, he shall refer the matter to the appointing authority.

**DOCTRINE:** Fundamental principles by which the military forces guide their actions in support of objectives. It is authoritative but requires judgment in application.

**ECHELON:** Term used in the maritime medical field as a numeric descriptor (from 1 through 4) to classify treatment facilities according to their capabilities – now referred to as ROLE 1 through 4 (refer to → Levels of Medical Care).

**EMERGENCY SURGERY:** Surgery urgently necessary to preserve life, limb or functions.

**ENVIRONMENTAL HEALTH:** The control of all those factors in man's physical environment which exercise, or may exercise, a deleterious effect on his physical development, health or survival.

**EVACUATION, MEDICAL:** The medically controlled process of moving any person who is wounded, injured or ill to and/or between MTF.

**EVACUATION POLICY:** Command decision indicating the maximum length of time that a patient will be allowed in the theatre for treatment, recovery and return to duty. If the prognosis is that recovery will take longer than the evacuation policy, then the patient will be evacuated as soon as he/she is considered suitable for evacuation.

**FORWARD LOGISTIC SITE:** Normally the final land transhipment point which provides the bridge between an Advanced Logistic Support Sites (ALSS) and units at sea.

**HOST NATION SUPPORT:** Civil and military assistance rendered in peace and war by a HN to allied forces and NATO organizations which are located on or in transit through the HN's territory. The basis of such assistance is commitments arising from the NATO Alliance or from bilateral or multilateral agreements concluded between the HN, NATO organizations and (the) nation(s) having forces operating on the HN's territory.

**HOST NATION SUPPORT, MEDICAL:** Civil and/or military medical assistance rendered by a nation to foreign forces within its territory during peacetime, times of crisis/emergencies, or war-based upon agreements mutually concluded between nations or a NATO Command and a nation

**HUMANITARIAN OPERATIONS:** Missions conducted to relieve human suffering, especially in circumstances where responsible authorities in the area are unable, or possibly unwilling, to provide adequate support to the population. (See also *Conflict Prevention, Peace Building, Peace Enforcement, Peacekeeping, Peace Making and Peace Support Operations*).

**INTELLIGENCE, MEDICAL:** That category of intelligence resulting from collection, evaluation, analysis and interpretation of medical, bio-scientific, epidemiological and environmental information.

**INTENSIVE CARE:** That degree of care, which is extensive, highly technical and required because of the patient's actual or threatened inability to maintain vital function.

**INTEROPERABILITY:** The ability of systems, units or forces to provide services to and accept services from other systems, units or forces and to use the services so exchanged to enable them to operate effectively together.

**JOINT FORCE COMMANDER:** A general term applied to a commander (e.g. COMAJF) authorized to exercise command authority or operational control over a joint force.

**LEAD NATION:** One nation assumes the responsibility for procuring and providing a broad spectrum of logistic support for all or a part of the multinational force and/or headquarters. Compensation and/or reimbursement will then be subject to agreements between the parties involved. The lead nation may also assume the responsibility to coordinate logistics of other nations within its functional and regional area of responsibility.

**LEVELS OF MEDICAL CARE:** Numeric description (from ROLE 1 through 4) to classify treatment facilities according to their capabilities

**MASS CASUALTY SITUATION:** A Mass Casualty Situation is one in which an excessive disparity exists between the casualty load and the medical capabilities locally available for its conventional management.

**MEDICAL ADVISOR:** A medical officer (doctor) with wide medical, military and staff experience, assigned to a command HQs staff in order to ensure proper consultation on, and recognition of, all matters affecting medical operational planning and the forces' health. The medical Advisor has at all times the right of direct access to the HQ Commander.

**MULTINATIONAL FORCES:** Forces of more than one nation under a NATO commander or non-NATO commander within a NATO-led operation.

**NATIONAL SUPPORT ELEMENT:** Any national organization or activity that supports national forces which are part of the NATO force. NSEs are OPCON to the national authorities, they are not normally part of the NATO force. Their mission is nation-specific support to units and common support that is retained by the nations.

**ORGANISATIONS, GOVERNMENTAL:** Organizations that are sponsored and financed by individual governments (e.g. UK Department for International Development (DfID), British Overseas Rescue Board, US Office for Foreign Disaster Assistance, etc).

**ORGANISATIONS, INTERNATIONAL:** Organizations that are sponsored and financed at an international level (e.g. United Nations High Commissioner for Refugees (UNHCR), World Food Programme, Office for Coordination of Humanitarian Activities, International Committee of the Red Cross (ICRS), World Health Organization (WHO) etc).

**ORGANISATIONS, NON-GOVERNMENTAL:** Organizations that are financed entirely by voluntary contributions and have no International or Governmental support (e.g. Medicins Sans Frontiers, Danish Refugee Council, International Rescue Committee).

**OPERATIONAL COMMAND:** The authority granted to a commander to assign missions or tasks to subordinate commanders, to deploy units, to reassign forces, and to retain or delegate operational control, and/or tactical control, as may be deemed necessary. It does not, of itself, include responsibility for administration or logistics. It may also be used to denote the force assigned to a commander.

**OPERATIONAL CONTROL:** The authority delegated to a commander to direct forces assigned, so that the commander may accomplish specific missions or tasks which are usually limited by function, time or location; to deploy units concerned, and to retain or assign Tactical Control (TACON) of those units. It does not include authority to assign separate employment of components of the units concerned. Neither does it, of itself, include administrative or logistic control.

**OPERATIONAL LEVEL:** Level at which military operations are planned and forces are employed to attain campaign objectives within a designated AOR. At this level, tactical successes achieved in engagements and major operations are combined to achieve strategic objectives.

**PATIENT REGULATING:** The process of directing, controlling and coordinating the transfer of patients within and without a TOO.

**PATIENT TRACKING:** The precise and continuous monitoring of the location and the intended destination of the patient in the medical treatment and evacuation chain.

**PEACE BUILDING:** Post conflict actions to identify and support political, economical, social and military measures and structures which tend to strengthen and solidify political settlements in order to avoid a return to conflict. This includes mechanisms to identify and support structures, which tend to consolidate peace, advance a sense of confidence and well being and support economic reconstruction. They may require military as well as civilian involvement. (See also *Conflict Prevention, Humanitarian Operations, Peace Enforcement, Peacekeeping, Peace Making and Peace Support Operations*).

**PEACE ENFORCEMENT:** A coercive military operation under Chapter VII of the UN Charter to restore peace in an area of conflict without the consent of all parties but in support of diplomatic efforts to reach a long term settlement. This can include dealing with an inter-state conflict or with internal conflict to meet a humanitarian need, or where internal state institutions have largely collapsed. (See also *Conflict Prevention, Humanitarian Operations, Peace Building, Peacekeeping, Peace Making and Peace Support Operations*).

**PEACEKEEPING:** The containment, moderation and/or termination of hostilities between or within states achieved with the general consent of the parties in dispute. This is usually through the medium of an impartial third party intervention, organised and directed internationally using military forces and civilian to complement the political process of conflict resolution, to restore and maintain peace through a long term settlement. PK is normally authorized under Chapter VI of the UN Charter. (See also *Conflict Prevention, Humanitarian Operations, Peace Building, Peace Enforcement, Peace Making and PeaceSupport Operations*).

**PEACE MAKING:** Any diplomatic action conducted after the commencement of a conflict aimed at establishing a cease-fire or rapid peaceful settlement. This can include the provision of good offices, mediation, conciliation and such actions as a diplomatic pressure, isolation or sanctions. (See also *Conflict Prevention, Humanitarian Operations, Peace Building, Peace Enforcement, Peacekeeping and Peace Support Operations*).

**PEACE SUPPORT OPERATIONS:** Multi-functional operations conducted impartially in support of a UN/OSCE mandate involving military forces and diplomatic and humanitarian agencies and are designed to achieve a long term political settlement or other conditions specified in the mandate. They include peacekeeping and peace enforcement as well as conflict prevention, peacekeeping, peace building and humanitarian operations. (See also *Conflict Prevention, Humanitarian Operations, Peace Building, Peace Enforcement, Peacekeeping and Peace Making*).

**POST OPERATIVE CARE:** Care occurring soon after a surgical operation.

**PREVENTIVE DEPLOYMENTS:** Deployment of operational forces possessing sufficient deterrence capabilities to avoid a conflict. Normally consists of civilians and/or military forces.

**PREVENTIVE MEDICINE:** The services that are concerned with identifying, preventing and controlling acute and chronic communicable and non communicable diseases and illnesses with food and environmental hygiene, and vector control.

**RAPID RESPONSE MEDICAL TEAM:** A medical team at 24 hour readiness, able to be transported by air or road to the site of an incident.

**REDISTRIBUTION AUTHORITY:** The authority given to a NATO commander to redistribute certain resources, designated in peacetime and assigned to his command, and made available by nations, in order to support operations.

**RESUSCITATION:** The restoration of tissue perfusion and oxygenation.

**ROLE SPECIALISATION:** One nation assumes the responsibility for procuring a particular class of supply for all or a part of the multinational force. Compensation and/or reimbursement will then be subject to agreements between the parties involved.

**STABILISATION:** The maintenance of tissue perfusion and oxygenation.

**STANDARDISATION AGREEMENT:** The record of an agreement among several or all member nations to adopt or similar military equipment, ammunition, supplies and stores; and operational, logistic, and administrative procedures. National acceptance of a NATO allied publication issued by the Military Agency for Standardization (MAS) may be as a STANAG.

**STRATEGIC LEVEL:** Level at which military operations are planned and forces are employed with other instruments of power to secure strategic objectives.

**SUPPORT PLANS (SUPPLANs):** Plans that provide detailed amplification for particular planning areas and must be directly linked to a specified Contingency Plan (COP) or OPLAN.

**SUSTAINABILITY:** The Ability of a force to maintain the necessary level of combat power for the duration required to achieve its objectives.

**TACTICAL LEVEL:** level at which, military operations are planned and forces are employed to conduct military tasks in pursuit of campaign objectives.

**TRIAGE:** It is a system of dealing with patients when the number and severity of casualties exceeds the resources available. In such situation the medical response is focused on providing the greatest benefit to the largest number of patients rather, than providing early definitive treatment to each patient on the basis of individual needs. The triage can be described as “to do the most for the most”.

**THEATRE:** The geographical area where a military operation is being conducted.

**THEATRE SURGEON:** A medical officer assigned as Medical Advisor to the Theatre Commander.

## 24.3 Abbreviations

### A

ACE	Allied Command Europe
ACLANT	Allied Command Atlantic
ACTORD	Activation Order
AE	Aeromedical Evacuation
AECC	Aeromedical evacuation Control Centre
AECO	Aeromedical Evacuation Coordinating Officer
AELT	Aeromedical Evacuation Liaison Team
AEOT	Aeromedical Evacuation Operations Team
AJF	Allied Joint Force
ALCC	ACE Logistics Coordination Centre
ALSS	Advanced Logistic Support Site
AMCC	Allied Movement Control Centre
AOR	Area of Responsibility
APOD	Air Point of Debarkation
APOE	Air Point of Embarkation

### B

BC	Battle Casualty
BI	Battle Injuries
BI-SC MEDAG	Bi-Strategic Command Medical Advisory Group

### C

CAPC	Civil Aviation Planning Committee
CASSIM	Casualty Simulation
CASORG	Casualty Organisation
CECC	Civil Emergency Crisis Cell
CIMIC	Civil-Military Cooperation
CIS	Communications and Information System
CJTF	Combined Joint Task Force
CN	Contributing Nations
COA	Course of Action
COMMZ	Communication Zone
COP	Contingency Operation Plan
CP	Capability Package
CRONOS	Crisis Response Operations in NATO Open Systems
CSU	Casualty Staging Unit

### D

DCI	Defence Capabilities Initiative
DEPMEDS	Deployable Medical Systems
DISTAFF	Directing Staff
DNBI	Disease Non-Battle Injury(ies)
DPQ	Defence Planning Questionnaire
DRR	Defence Requirements Review

**E**

EAPC	Euro-Atlantic Partnership Council
EPG	Exercise Planning Guide
EXCONOPS	Exercise Concept of Operations
EXOPLAN	Exercise Operation Plan
EXOPORD	Exercise Operation Order
EXPI	Exercise Planning Instruction
EXSPEC	Exercise Specifications

**F**

FLS	Forward Logistic Site
FOPC	Final Operational Planning Conference
FPG	Functional Planning Guide
FSA	Forward Support Area

**H**

HICON	Higher Control
HN	Host Nation
HNS	Host Nation Support

**I**

ICR	In-Country Resources
ICRC	International Committee of the Red Cross
IEF	In-Transit Evacuation Facility
IO	International Organisation
IOPC	Initial Operational Planning Conference
IPC	Initial Planning Conference
IRF	Immediate Reaction Force(s)
ITV	In-Transit Visibility

**J**

JMC	Joint Medical Committee
JOC	Joint Operations Centre
JTCC	Joint Transportation Coordination Centre

**L**

LCC	Land Component Command
LN	Lead Nation
LOCON	Lower Control
LPX-MED	Logistic Processor Medical

**M**

MASCAL	Mass Casualty
MC	Military Committee
MCC	Maritime Component Commander
MEDAD	Medical Advisor
MEDCC	Medical Coordination Centre
MEDHNS	Medical Host Nation Support
MIMU	Multinational Integrated Medical Unit

MJLC	Multinational Joint Logistic Centre
MNCCS	Multinational Component Command Surgeon(s)
MNFS	Multinational Force Surgeon
MNLC(A)	Multinational Logistic Centre (Air)
MNLC(L)	Multinational Logistic Centre (Land)
MNLC(M)	Multinational Logistic Centre (Maritime)
MNMF	Multinational Maritime Force
MOA	Memoranda of Agreement
MOPC	Main Operational Planning Conference
MOU	Memorandum of Understanding
MRG	Medical Resource Guidance
MSA	Mutual Support Agreement
MSC	Major Subordinate Command
MTF	Medical Treatment Facility

**N**

NAC	North Atlantic Council
NAMSA	NATO Maintenance and Supply Agency
NATO	North Atlantic Treaty Organisation
NGO	Non-Governmental Organisation
NMCC	National Movement Coordination Centre
NMLT	National medical Liaison Team
NPS	NATO Precautionary System
NSE	National Support Element
NSMO	National Senior Medical Officer

**O**

OCE	Officer Conducting the Exercise
OMF	Originating Medical facility
OPCOM	Operational Command
OPCON	Operational Control
OPLAN	Operational Plan
OSCE	Organisation for Security and Cooperation in Europe
OSE	Officer Scheduling the Exercise

**P**

PAR	Population at Risk
PCRS	Primary Casualty Receiving Ship
PE	Peace Establishment
PECC	Patient Evacuation Coordination Centre
PfP	Partnership for Peace
PI	Public Information
PIO	Public Information Operations
PIR	Priority Intelligence Requirement(s)
PKO	Peace Keeping Operations
POW	Prisoners of War
PSO	Peace Support Operations
PTSD	Post Traumatic Stress Disorder
PVO	Private Voluntary Organisation(s)

**R**

RALCC            Regional Airlift Control Centre  
RC                Regional Command(er)s  
RFI              Request for Information  
ROE              Rules of Engagement  
RRF              Rapid Reaction Force(s)  
RS                Role Specialisation  
RSA              Rear Support Area  
RSN              Role Specialisation Nation

**S**

SACEUR          Supreme Allied Commander Europe  
SACLANT         Supreme Allied Commander Atlantic  
SC                Strategic Command(er)  
SCEPC            Senior Civil Emergency Planning Committee  
SDC              Strategic Direction Centre  
SMO              Senior Medical Officer  
SOFA             Status of Forces Agreement  
SOP              Standing Operating Procedure  
SOR              Statement of Requirement  
SPOD            Sea Point of Debarkation  
SPOE            Sea Point of Embarkation  
STANAG          Standardisation Agreement  
SUPLAN         Support Plan

**T**

TOA              Transfer of Authority  
TOO              Theatre of Operations  
TS                Theatre Surgeon

**U**

UN                United Nations

**W**

WEU             Western European Union

## Annex 4-1

### Phonetic Alphabet

**A – Alpha**

**J – Juliet**

**S – Sierra**

**B – Bravo**

**K – Kilo**

**T – Tango**

**C – Charlie**

**L – Lima**

**U – Uniform**

**D – Delta**

**M – Mike**

**V – Victor**

**E – Echo**

**N – November**

**W – Whiskey**

**F – Foxtrot**

**O – Oscar**

**X – X-ray**

**G – Gulf**

**P – Papa**

**Y – Yankee**

**H – Hotel**

**Q – Quebec**

**Z – Zulu**

**I – India**

**R – Romeo**

## **Annex 5-1**

### **Triage Priorities**

#### **Immediate Treatment (Group T1).**

To include those requiring emergency life saving surgery. These procedures should not be time consuming and should concern only patients with high chances for survival.

#### **Delayed Treatment (Group T2).**

To include those badly in need of time-consuming major surgery, but whose general condition permits delay in surgical treatment without unduly endangering life.

#### **Minimal Treatment (Group T3).**

To include those with relatively minor injuries who can effectively care for themselves or who can be helped by untrained personnel.

#### **Expectant Treatment (Group T4).**

This group comprises patients who have received serious and often multiple injuries, and whose treatment would be time-consuming and complicated with a low chance of survival. If fully treated, they make heavy demands on medical manpower and supplies. Until the mass casualty situation is under control, they will receive appropriate supportive treatment only.

**Annex 7-1**

**Recommendations and Rules for Nutrition**

**1. General**

***Make your body understand what you want***

If you are trying to reduce your body-weight and you eat less and less your body may think it is being starved and starts to use its fat reservoir. This can also happen if you do not eat regular, sufficient quantities of a balanced diet.

***Eating regularly and adequately***

The body needs a regular intake of the various food groups. Eating regular, balanced meals feeds your body the nutrition it needs to fuel your body's physical activities. Irregular meals results in the body using its fat reservoirs. Missing or delaying meals is not problematic if it occurs only occasionally. Meal portions should be adequate but not excessive. The body requires different amounts of food at different times of the day, taking account of the time of the last meal and the level of physical activity planned.

**2. 10 Rules of Nutrition**

***1.) Eating well Balanced and Variously***

Multi-choice meals onboard allow sailors to choose between different components. Meals can be combined to include your own preferences regarding taste, appetite and individual needs, i.e. physical training programme. There is no healthy, unhealthy or forbidden food. Just take care to include a balanced choice, amount and combination. The circle of nutrition is shown at Figure 1. If weight loss is desired, smaller portions will help and remember you don't have to eat everything on the plate.

***2.) Grains and Cereals Several Times a Day***

Bread products (preferably wholemeal), noodles, natural rice and potatoes all contain vitamins, minerals, trace elements, fibre and secondary plant agents and very little fat. These ingredients provide protection from physical and climatic stress.

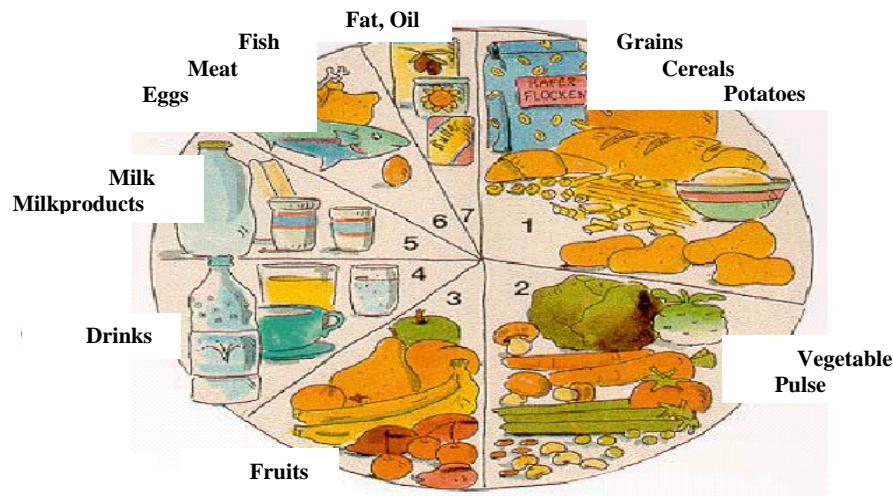


Figure 1: Circle of Nutrition; combination and relation of nutriments

### **3.) Vegetable, Fruits and Salads – Take 5 a Day**

5 portions of vegetables, fruits and salads, preferably fresh, either raw ,cooked or preserved in juices. Fresh food retains many more vitamins and minerals. These foods can be eaten with and between meals and also provides vitamins, fibre and plant agents which help your body defend against stress and protect from cancer. It is recommended that large portions of vegetables are taken with comparatively small portions of meat.

### **4.) Milk and Products of Milk daily; Fish once a Week; Eggs, Hot and Cold Meat Moderately**

These products contain important nutritive substances: calcium in milk, iodine and selenium and  $\omega$ -3-fatty acids in fish. Meat has a lot of iron and vitamins. You need this for your skeleton, muscles blood production and immune system. 3 to 4 portions of meat a week and 30g of cold meat a day in total is enough. Beware the fat content.

**5.) Less Fat and Fatty Food**

Often fatty food tastes very good. But too much fat causes obesity and leads to coronary heart diseases and cancer. Keep the volume down at around 30% of the daily total food intake, and where possible free range. Beware the hidden fats in sweets, meat, milk and cakes. If you think there is excessive fatty food in your ship, consult your medical officer or get into contact with the Catering Officer.

**6.) Sugar and Salt Moderately, Spices as much as You Want**

Enjoy sugar and food or drinks prepared with sugar occasionally, as a treat.. In the first place use fresh fruits naturally, as a desert or in yoghurt. If you use salt on food, use salt with iodine and be careful of the quantity. Salt causes high blood pressure. As an alternative to salt you can flavour and be creative with your meals with as many herbs and spices as you want. This will make your food more interesting.

**7.) Drink a lot**

Water is one of the most important substances in human life. Your physical and mental fitness will decrease if your fluid intake is inadequate, sweating or working in hot climate. Drink 40ml per kg of your bodyweight including coffee and tea as well as water needed for cooking. Mineral water alone is very palatable and has no calories, but minerals and trace elements, or mix with juices (which have vitamins), fruit or herb teas which also contain no calories or light drinks.

**8.) Cooking Palatably and Gently**

If you are cooking by yourself try to use less fat, a shorter time, with less water and as little fat as possible. You will preserve the natural taste, retain the nutrients and vitamins and prevent the build-up of harmful and noxious substances.

**9.) Take Time for Your Meal and Enjoy Your Food**

Ingestion is more than a duty for staying alive. Eat consciously and take your time. Eating has to be a special kind of fun. If you eat hastily you do not recognize the point of satiation and you may not even recognize what you have eaten. For some, occasionally it is enjoyable to close the eyes to perceive the original taste of foods. For overweight or obese people eating and all the things involved with it are very important for their quality of life. Any restriction of eating means a loss of quality of life for them. That is why they have to abandon themselves to the meal and become distracted while walking or passing anything edible or when working.

**10.) Have a Look on Your Weight and Keep on Moving**

Sailors are endangered by the effects of overweight and obesity as much any other human. But being sailor and working in the navy means a you must be capable of a state of permanent readiness to ensure operational fitness. You will feel better, stronger and healthier when you are of the correct weight and adequate fitness. Balanced nutrition and physical fitness are of equal importance in this respect.

**Annex 7-2**

**Exercise Recommendations for Obese Crew Members**

Stamina only is one part to enhance your fitness. Do not forget to train your muscular strength and agility (for example in the fitness area on board), mobility (by gymnastics) and coordination (by games). You have to find out your own individual limit.

Every overweight soldier starting with physical exercise should conceptualise the following:

- You never can start too slow!
- Less very often is more (but nothing is not everything)!
- Be able to talk, sing or whistle during moving!
- Moving without panting!
- Moving as much as possible, straining as less as possible!
- Be able to enhance your moving at end of exercise (without being exhausted totally)!
- Be able to keep on training at the end of exercise!

In order to implement these recommendations it is necessary to detect the limit between aerobic and anaerobic energy-consumption.

In the anaerobic field of special and high fitness training you do not burn fat, only carbohydrates in an inefficient way. The aerobic burning of preventive health and general fitness training needs carbohydrates and fat to produce energy. That is why you have to be able to talk, sing or whistle during sports, because only then you (and your muscles) get enough oxygen for energy-production. By knowing the limit you now can diminish your exposure round about 15 % to exercise in the field of preventive health and fat burning training. Exercise for as long as possible with low strain and without being exhausted.

Especially in the beginning you have to start slowly, because may be your body is not used to it.

The translation of these rules will reduce adipose tissue and build up muscles. Development and preservation of muscular tissue is a central facet to avoid and to combat metabolic disorders like hypertonus, hyperlipidemia, diabetes mellitus and especially obesity.

## Annex 8-1

### Illicit Drug Detection Limits in Urine and Blood

	<b>Urine</b>		<b>Blood</b>
<b>Cannabis</b>	1-3 days 5 days 20 days and longer	one joint moderate smoker heavy smoker	days to 2-3 weeks
<b>XTC/Speed</b>	1-3 days		6 hours
<b>Cocaine</b>	1-4 days		6 hours
<b>Opiates</b>	2-3 days		hours to days, dose-dependent
<b>Barbiturates</b>	24 hours 2-3 weeks	short-acting B. long-acting B.	hours to days
<b>Benzodiazepines</b>	3 days to 6 weeks		hours to days

## Annex 9-1

### Noise Category Assignments

#### Category A:

- CIC
- Chart room
- All offices pilothouse
- Damage control central Training spaces Briefing rooms
- Squadron ready rooms Maneuvering room
- TV station (internal) Control room
- Missile compartment
- Missile control center Radio room
- Propulsion plant enclosed operating stations <sup>(1)</sup>

#### Category B:

- All berthing and living spaces
- Recreation areas
- Lounges
- Wardrooms <sup>(2)</sup>
- Messrooms <sup>(2)</sup>
- Barber shops

#### Category C:

- Sonar control rooms
- Medical spaces
- Chapel and chaplain offices
- Libraries

#### Category D:

- Machinery rooms
- Engine rooms
- Fire rooms
- Laundry
- Auxiliary machinery rooms
- Steering gear room
- All workshops (with repair equipment secured)

Category E:

Bridge wings  
Open bridge  
Torpedo room  
Propulsion plant maneuvering areas

The words used to describe these areas and the examples used are slightly different to what is contained in STANAG 1186 - Guidelines Governing Noise Levels in Ships.

Notes:

- (1) Propulsion plant enclosed operating stations will be either category A or E depending upon the function of the space and the feasibility of installing acoustic treatments.
- (2) For ships and submarines without training spaces, briefing rooms, or chapels, Category A shall apply.

## Annex 9-2

### Acceptable Airborne Noise Levels <sup>(1)</sup>

Noise Category	Sound Pressure Level in dB(A)
A-3	70
A-12	60
B	70
C	65
D	84 <sup>(2)</sup>
E	80

#### Notes:

- (3) For design, engineering, and procurement purposes, other more detailed or specific criteria, such as octave band, may be used to supplement these A-weighted criteria.
- (4) Hearing conservation program requirements in high noise level environments may be applicable.

## Annex 10-1

### Definitions in Lighting

#### **Adaptation**

The process which takes place as the visual system adjusts itself to the brightness or the colour of the visual field. The term is also used, usually qualified, to denote the final state of this process. For example “dark adaptation” denotes the state of the visual system when it has become adapted to a very low luminance (below some hundredths of a candela per square meter). “Light adaptation” refers to luminances of at least several candelas per square meter.

#### **Colour, Apparent Colour**

Of a light source; the degree of warmth associated with the source colour. Lamps of low colour temperatures are usually described as having a warm apparent colour, and lamps of high colour temperature as having a cold apparent colour.

#### **Colour rendering**

A general expression for the appearance of surface colours when illuminated by light from a given source. “Good colour rendering” implies similarity of appearance to that under an acceptable light source, such as daylight.

#### **Colour rendering index ( Ra )**

A measure of the degree to which the colours of surfaces illuminated by a given light source are rendered accurately. This index is based on the accuracy with which a set of test colours are reproduced by the light source of interest relative to how they are reproduced by an appropriate standard light source. Perfect agreement is given a value of 100.

#### **Colour temperature ( CT ) (unit: K)**

A measure of the apparent colour of a light source.

CT ≤ 3300 K	warm
3300 K < CT ≤ 5300 K	neutral
5300 K < CT	cold

#### **Contrast ( C )**

A term that is used subjectively and objectively. Subjectively, it describes the difference in appearance of two parts of a visual field seen simultaneously or successively. The difference may be one of brightness or colour or both. Objectively, the term expresses the luminance difference between the two parts of the field. The relationships used are:

$$\text{contrast} = \frac{L - L_1}{L_1} \quad (1)$$

Quantitatively, the sign of the contrast is ignored.  $L_1$  is the dominate of background luminance.  $L$  is the task luminance.

$$\text{contrast} = \begin{cases} \frac{L}{L_1} & \text{if } L > L_1 \\ \frac{L_1}{L} & \text{if } L < L_1 \end{cases}$$

Relationship (2), better known as luminance ratio, is used in this chapter.

**Contrast rendering factor ( CRF )**

The ratio of the contrast of a task under a given lighting installation to its contrast under reference lighting conditions, that is perfectly diffuse and un-polarised lighting.

### **Darkened ship**

The ship's material conditions established to ensure light security. These conditions are operated by providing light traps, door operated switches, darkened ship control circuits, and material classifications assigned to certain doors and hatches.

### **Glare**

The discomfort or impairment of vision experienced when parts of the visual field are excessively bright in relation to the general surroundings.

#### **Glare, Discomfort Glare**

Glare which causes visual discomfort.

**Illuminance (at a point of a surface) ( E ) (unit: lm/m<sup>2</sup>, Lux)**

Quotient of the luminous flux incident on an element of the surface containing that point, and the area of that element.

**Illuminance, Mean Illuminance (  $\bar{E}$  )**

The quotient of the luminous flux received by a surface and the area of that surface. The mean illuminance can be approximated by the arithmetic mean of the illuminances in a number of points on the surface.

**Illuminance, Service illuminance ( E )**

The illuminance used in the lighting specifications of this chapter. The service illuminance is the mean illuminance throughout the maintenance cycle of the installation and averaged over the reference surface. The mean illuminance may never, not even at the end of the maintenance cycle, be less than 0.8 multiplied by the service illuminance.

### **Lighting, Back-up Lighting**

(emergency lighting, substitute lighting, auxiliary lighting). Lighting provided for use when the main lighting installation fails in areas in which illumination is

needed. The electrical power for back-up lighting may be provided through a secondary power supply system or by batteries. Provisions for immediate activation on failure of the main system have to be made.

**Lighting, General Lighting**

Lighting designed to illuminate the whole of the reference surface without provision for special local requirements.

**Lighting, General Surround Lighting**

Lighting designed to illuminate the non-working parts of a working interior.

**Lighting, Local lighting**

Lighting designed to illuminate a particular small area of the reference surface which usually does not extend far beyond the visual task, e.g. a desk light.

**Lighting, Orientation lighting**

Lighting provided to ensure that one can find his way and perceive other persons in the almost dark.

**Lighting, Red lighting**

Lighting designed to minimise interference with vision in dark-adapted conditions. Wavelengths between 625 - 635 nm dominate while wavelengths smaller than 600 nm must be excluded from the light emitted by the source. Applicable with darkened ship operation in berthing areas for safety and sleeping comfort.

**Lighting, White lighting**

In some cases locally white lighting at low intensity from fluorescent (filtered: blue excluded) or incandescent (dimmed) lamps may be applied if colour perception is important and interference with dark adaptation must be minimized.

**Luminaire**

An apparatus which controls the distribution and if necessary the spectral properties of light given by a lamp or lamps and which includes all the components necessary for fixing and protecting the lamps and for connecting them to the supply circuit.

**Luminous flux (  $\Phi$  ), (unit: lm)**

The light emitted by a source, or received by a surface. The quantity is derived from radiant flux by evaluating the radiation in accordance with the spectral sensitivity of the standard human eye as described by the CIE Standard Photometric Observer.

**Luminance ( L ), (unit: cd/m<sup>2</sup>)**

The physical measure of the stimulus which produces the sensation of brightness measured by the luminous intensity of the light emitted or reflected in a given direction from a surface element, divided by the area of the element in the same direction. The SI unit of luminance is the candela per square metre, the relationship between luminance is given by the equation

$$\text{Luminance} = \frac{\text{Illuminance} \times \text{reflectance}}{\pi}$$

This equation applies to a matt surface

**Maintenance factor ( MF ) / Light loss factor ( LLF )**

The ratio of illuminance provided by an installation in the average condition of dirtiness expected in service, to the illuminance from the same installation when new. The maintenance factor is always less than unity.

**Reference Surface (plane of interest)**

The reference surface will usually be the working plane, in most of the cases 0.85 m above the deck. However, the reference surface can be limited to the area(s) of the working zone(s) or to the task area(s) when the task locations are known and clearly specified. When the task is not in a horizontal plane or in a different height, the reference surface has to be determined accordingly, at a specific angle or height, e.g. vertical front panels in machinery control rooms. On the deck, the reference surface usually is 0.20 m above the ground.

**Reflectance ( R )**

The ratio of the luminous flux reflected from a surface to the luminous flux incident on it. Except for matt surfaces, reflectance depends on how the surface is illuminated but especially on the direction of the incident light and its spectral distribution. The value is always less than unity and is expressed as either a decimal or as a percentage.

**Reflection, Diffuse Reflection**

Reflection in which the reflected light is diffused and there is no significant specular reflection, as from a matt paint.

**Reflection, Specular Reflection**

Reflection without diffusion in accordance with the laws of optical reflection as in a mirror.

**Uniformity ratio ( UR )**

In working and living areas: the ratio of the minimum illuminance to the average illuminance. The ratio applies to values on the reference surface.

$$UR_1 = E_{\min} / \bar{E}$$

In passageways: the ratio of the minimum illuminance to the maximum illuminance. The ratio applies to values on the plane 0.2m above the deck.

$$UR_2 = E_{\min} / E_{\max}$$

**Visual task**

The visual element of the work being done.

Working plane

The plane at which work is usually done. In general, it is assumed to be a horizontal plane limited by the bulkheads of the interior at a height above the deck of 0.90m for standing workers and of 0.75m for those who are seated.

## Annex 10-2

### Recommended Illumination Requirement for Different Visual Tasks

Recommended illumination requirements ( E ) for different visual task characteristics

Application of Lighting	Class	Characteristics of the visual task	E ( lx )
Lighting for Orientation	1.	Visual tasks confined to movement and casual seeing calling for only limited perception of big objects	10 – 100
Lighting for Orientation	2.	Visual tasks especially confined to movement, requiring some perception of (very large) detail and recognition of persons.	100 – 200
Normal Lighting	3.	Reading and writing and visual tasks with comparable details and contrasts.	200 – 400
Normal Lighting	4.	Perception of smaller details and lower contrasts as with 3.	400 – 800
Special Lighting	5.	Perception of low contrast on dark background; also accurate colour judgement.	800 – 1600
Special Lighting	6.	Perception at the limit of vision.	1600 - 3000

The lower values of the ranges represent the minimum requirements, the higher values the optimum requirements. The latter should always be the target values.

## Annex 10-3

### Compartment Illumination Requirements

General Lighting Recommendations		Local Lighting Recommendations	
Functional Group	Class	Equipment or Furniture	Class
hangar and air control and associated spaces, except:	2		
flight deck crew shelter	1		
flight crew ready room	1	status board	2
living and recreation spaces, except:	2		
staterooms	1	berths (reading)	3
berthing areas	1	mirror, toilet cases	2
recreation areas	2	reading and writing areas	3
library without local lighting	3	secretary-bureau	3
library with local lighting	2		
commissary and messing spaces	2	food preparation counter range tops serving lines	3 2 2
damage control spaces, except:	2		
repair stations	1	diagram board	3
unit patrol stations	1	diagram with lamps	2
foam injection station	1		
electronic spaces	1	desk, radio receiver	2
machinery spaces	1	gage and control boards switchboards (except weapons control) log desk switchboards, weapons control enclosed operation station machine tools (rough task)	2 2 2 2 2
ordnance spaces (enclosed) and weapons control spaces	1	control rooms	2
gunnery spaces, ammunition handling spaces, and magazines	1	panels and instruments (bulkhead mounted) computers (requiring illumination) range keepers stable elements	2 2 2
flag spaces (except galley)	1		
medical and dental spaces, except:	2	dental bracket table	3
laboratories	3	dental operating chair (dental vision)	5
medical treatment room	2	dental prosthetic laboratory unit	5
surgical dressing room	4	dental instrument cabinet	3
pharmacy		medical training room and technical professional library	
X-ray viewing and examining room (dental)	2	(reading position)	3
battle dressing stations	2	operating table	6
offices	2	desks tables	3 3

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		desk, typewriter teletypewriters	3 3
for in-port use only: other ship control and weapons control spaces except CIC (for example: enclosed lookout stations, secondary conning station, pilot house)	1	chart table	3
workshops	2	workbench, general workbench, fine work, such as instrument and typewriter repair, etc. machine tools	3 4 3
store rooms dental store rooms issue rooms	1 1 1	issue counters bins and drawer areas	1 2
utility spaces	1	sewing machines barber shop chair iron board and press	3 2 2
sanitary spaces, except: shower areas	1 1	mirror areas	1
moving stairways, passageways, companionways, ladders and vestibules scuttles, hoists, unattended equipment spaces, unassigned spaces, reserved spaces, and cargo spaces passageways (used as medical waiting rooms) photographic spaces	1 1 2 2	bulletin boards elevator controls  sink (photographic)	1 1  1

## Annex 11-1

### Overview of Available Antidotes

Poison	Antidote	Dose
Organophosphates	Atropine	2-5 mg iv (repeat till heart-rate > 90/min)
	Obidoxime or Pralidoxime (Methansulfonate)	250 mg im 500 mg im
Pulmonary toxicants	Dexamethasone-21-Isonikotinate	Initially 5 metric doses (d.), followed by 2 d. every 5-10 min
	Budesonide	Initially 10 d., followed by 5 d. every 10 min (1. hour), 5 d. every 30 min (2-4. h), 5 d. every 1 h till aerosol is empty
	Prednisone (or equivalent) in severe cases	1000 mg iv
Carbon Monoxide	Oxygen	100%, preferably hyperbaric oxygenation (2.8 bar)
Cyanides	DMPA	250 mg iv (3mg/kg)
	Sodiumthiosulfate	100 mg/kg
Methemoglobin-inducing agents	Toluidinblue	2-4 mg/kg iv
	Methyl Blue	1-2 mg/kg iv
	Ascorbic acid (2. choice)	1000 mg iv
Ethylenglycol Methanol	Ethanol	Initially 0.6 g/kg, followed by 0.1 g/kg/hr (target conc.: 1 o/oo)
Antidepressants Antihistamines Atropine	Physostigmine	2 mg iv
Benzodiazepines	Flumazenil	0.2 – 2 mg iv
Opiates	Naloxon	0.4 – 2 mg iv
Paracetamol	N-Acetylcystein	150 mg/kg in 5% G iv over 15 min, followed by 50 mg/kg over 4h, 100 mg/kg over 16h, 300 mg/kg over 20h

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Digitalis	Digitalis-antibodies	160-240 mg/20 min iv (80 mg binds 1 mg digitalis)
Mercury (organic & inorganic), Arsenic, Lead, Antimony, Chrome, Cobalt	Dimercaptopropanesulphonate (DMPS)	250 mg iv every 3-4 h
Thallium, Caesium	Iron(III)hexacyanoferrate (II)	3 g orally, followed by 250 mg/kg/d in 2-4 single doses

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## Annex 14-1

### Chemistry, Use and Duraration of Local Aneasthetics

#### A. Classification of Local Anaesthetics:

	Type	Clinical Uses	Usual Concentration (%)	Usual Duration (hour)	Max. Dose (mg) **
<b>Procaine</b>	Ester	Infiltration PNB	1 2	0.5-1.0	1000, 500with EPI
<b>Tetracaine</b>	Ester	Topical	2	0.5-1.0	100, 20 with EPI
<b>Lidocaine</b>	Amide	Topical Infiltration, PNB	4 0.5-1.0 1.0-1.5	0.5-1.0 1.0-2.0 1.0-2.0	300, 500 with EPI
<b>Mepivacaine</b>	Amide	PNB	1.0-1.5	2.0-3.0	300, 500 with EPI
<b>Prilocaine</b>	Amide	PNB i.v.-Reg.	1,5 – 2 0.25-0.5	1.5 - 3	4000 600 with EPI
<b>Bupivacaine</b>	Amide	PNB	0.25-0.5	4.0-12	150 200 with EPI
<b>Ropivacaine</b>	Amide	PNB	0.25-0.75	4.0-12	250

\*\* Dose for 70 kg male. Use only as a general guide. PNB = Peripheral Nerve Block, EPI = Epinephrine/Adrenalin

Note: The toxicity of Bupivacaine compared to Lidocaine is 4 – 5 times higher. Especially the cardiotoxic side effects have to be mentioned. Bupivacaine in concentrations equal or higher than 0,75 % should not be used in pregnancy or during delivery.

A new, long acting local anaesthetic is Ropivacaine. The toxic potential compared to Bupivacaine seems to be less severe. There are less observed

Ventricular Arrhythmias, AV-blockages, Bradycardias and less Central Nervous System (CNS) toxicity.

- B. Alternatively the following method for the calculation of the maximum safe volume of local anaesthetics might be used:

**I. Calculating the maximum safe volume of a local anaesthetic:**

1. Find out weight of patient in kg
2. Calculate the mg/ml-concentration (**A**) of the local anaesthetic from a solution given in percentage:

$$\boxed{A} = \text{Percentage of solution} \times 10$$

3. Calculate the maximum safe dose (**B**) from the body weight and the specific factor (**F**) of the local anaesthetic:

$$= (\text{Weight of the patient} \times \boxed{F}) = \boxed{B}$$

4. Maximum safe volume (in ml) of local anaesthetic:

$$= \boxed{B} \div \boxed{A}$$

**II. Example:**

Using 1% Lidocaine for local anaesthesia in a 70 kg patient:

1. Weight of patient = 70

2. Concentration of Lidocaine:

$$\boxed{A} = 1\% \times 10$$

$$\boxed{A} = 10$$

3. Maximum safe dose

$$\boxed{B} = 70 \times \boxed{3} \quad (\boxed{F} \text{ for Lidocaine} = 3)$$

$$\boxed{B} = 210$$

4. Maximum safe volume for local anaesthesia

$$= \boxed{B \div A}$$

$$= 210 \div 10$$

$$= 21 \text{ ml}$$

III. Specific Factor **F** for different local anaesthetics:

- 3 for Lidocaine
- 7 for Lidocaine with Adrenaline
- 4 for Mepivacaine
- 3 for Ropivacaine
- 2 for Bupivacaine
- 5 for Prilocaine
- 8 for Prilocaine with Adrenaline

## Annex 14-2

### Muscle Relaxants: Pharmakinetics of Muscle Relaxants

	Pancuronium	Vecuronium	Atracurium	Cisatracurium	Mivacurium	Rocuronium	Rapacuronium	Pipecuronium
Absorption	Only given parenterally							
Distribution	Positive charged ammonium ion limits molecules to the extracellular fluid, all have a small volume of distribution ~0.2 l/kg							
Metabolism	Deacetylation	Deacetylation	Hoffman degradation	Hoffman degradation	Plasma cholinesterase	Minimal	Hydroxylation	Minimal
		3 deacetyl vecuronium	Laudanosine (eliptogenic) 10 isomers	R cis-R 'cis isomer	3 isomers		ORG-9488 active metabolite	
Excretion	Renal / Bile	Renal / Bile	Renal	Renal	Renal / Bile	Renal / Bile	Renal / Bile	Renal / Bile
Chemistry	Bi quaternary Amino steroid	Mono quaternary Amino steroid	Bi quaternary benzyl iso quinolone	Bi quaternary benzyl iso quinolone	Bi quaternary benzyl iso quinolone	Bi quaternary Amino steroid	Mono quaternary Amino steroid	Bi quaternary Amino steroid
Dose	E <sub>D</sub> 95 = dose to suppress the twitch by 95% of its original height. Normal intubation dose is 2 x E <sub>D</sub> 95 and the dose used for a rapid sequence induction is normally 3-4 x E <sub>D</sub> 95							
E <sub>D</sub> 95	0.06 mg/kg	0.05 mg/kg	0.25 mg/kg	0.05 mg/kg	0.08 mg/kg	0.4 mg/kg	1.0 mg/kg	0.05 mg/kg
Intubation	0.1 mg/kg	0.1 mg/kg	0.5 mg/kg	0.1 mg/kg	0.15 mg/kg	0.4 mg/kg	1.5 mg/kg	0.07 mg/kg
Maximum block (min)	4-5	3-4	3-4	4.5-5.5	2-3	2-3	1.5	4-5
Clinical duration (T <sub>1</sub> 0-25%)	90	45	40	30-40	15-20	30	10-15	95
Recovery index min (T <sub>1</sub> 25-75%)		60	50	15-20	25	30	10-15	130
Rapid sequence intubation	n/a	0.2 mg/kg	0.75 mg/kg	0.2 mg/kg	0.25 mg/kg	0.6 mg/kg	2.5 mg/kg	Succinyl choline
Maximum block (min)		2-2.5	2-2.5	2.5-3	1.8-2.5	1.8-2.2	0.9-1.2	1 mg/kg 0.8-1.2
Clinical duration min (T <sub>1</sub> 0-25%)		60	60	60	30-40	40-45	18-25	5-8 5
Recovery index min (T <sub>1</sub> 25-75%)		80	80	15-20	30-35	40-45	15-25	NO!
Reversal by neostigmine		only >25% recovery					even @ <25% CD to 5 min RI to 10 min	2-15 mg/kg/hr
Infusion				1.2-1.5 mg/kg/min	4-10 mg/kg/min		accumulation of ORG-9488	
Formulation	Pavulon 2mg/ml	Norcuron 4mg powder	Tracrium 10mg/ml	Nimbex 2mg/ml	Mivacron 2mg/ml	Esmeron 10mg/ml	powder	Duramax 2mg/ml

Atracurium or vecuronium in small titrated doses is preferred by patients with known cholinesterases sickness

**Muscle Relaxants: Effects of muscle relaxants**

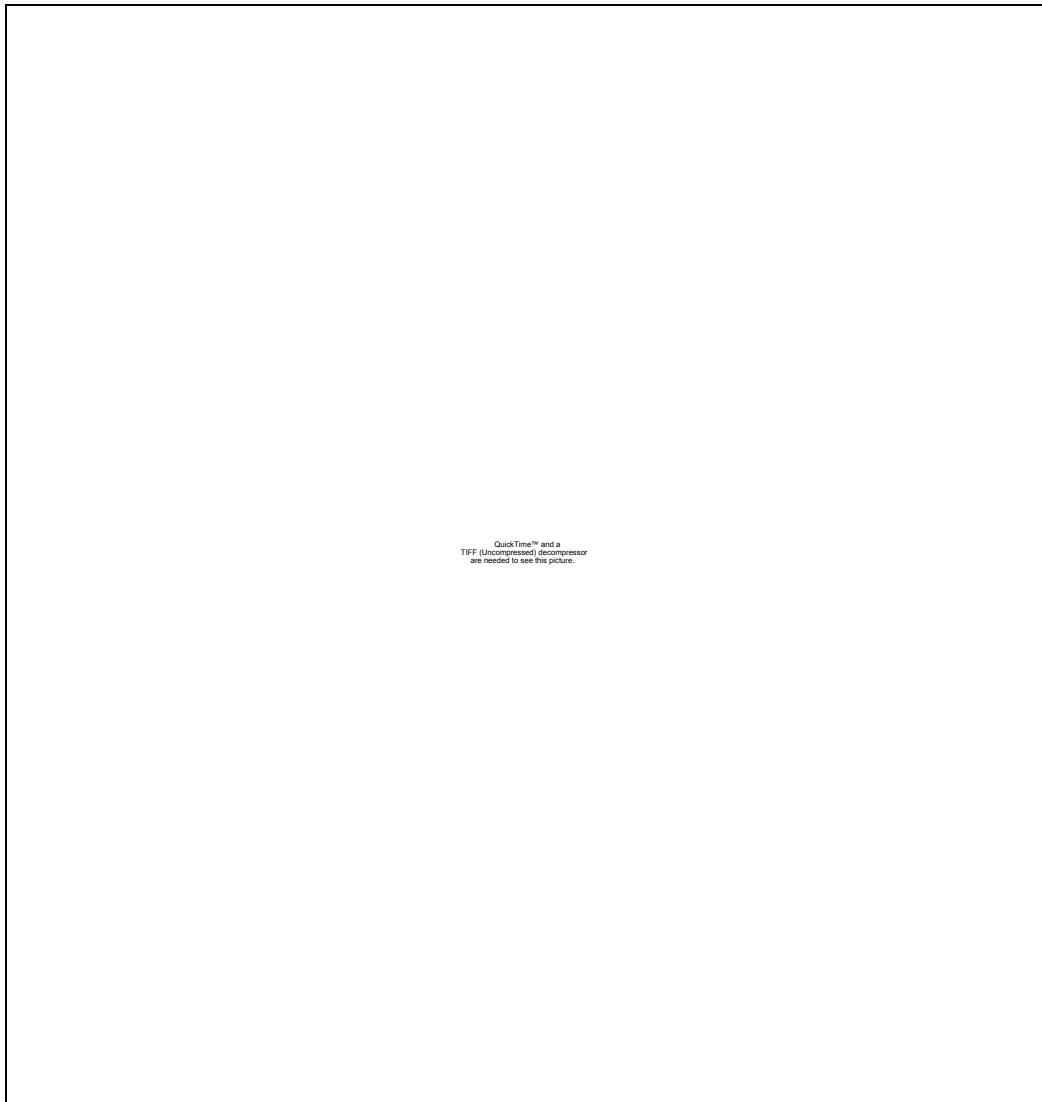
	Pancuronium	Vecuronium	Atracurium	Cisatracurium	Mivacurium	Rocuronium	Rapacuronium	Pipecuronium
Effects								
Histamine release	no	no	+++	no	++	no	+	no
Ganglionic blockade	+	no	no	no	no	no	+	no
Vagolytic	++	no	no	no	no	+	+	no
sympatho - mimetic	++	no	no	no	no	no	+	no
Cardio vascular								
Heart rate	Increase +++	Stable	Reflex increase ++	minor increase	Reflex increase +	Increase +	Increase +	Stable
SVR	Stable	Stable	Decrease ++	Minor Decrease	Decrease +	Stable	Decrease	Stable
CO	Increase	Stable	Stable	Stable	Stable	Stable	Decrease	Stable
MAP	Increase	Stable	Decrease	Stable	Decrease	Stable	Decrease	Stable
Respiratory	Apnoea, don't give these drugs unless you have everything available to ensure intubation of the airway							
broncho spasm	No	No	Possibility	Possibility	Possibility	No	Possibility	No
secretions	Increased	Increased	Increased	Increased	Increased	Increased	Increased	Increased
Central nervous system								
Intra ocular pressure		Increased						
Intra cranial pressure		Increased						
Porphyria	<b>Not safe</b>	<b>Not safe</b>	Safe	Safe	Safe	<b>Not safe</b>	<b>Not safe</b>	<b>Not safe</b>

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## Annex 16-1

### Burn Injury – Lund and Browder Chart



QuickTime™ and a  
TIFF (Uncompressed) decompressor  
are needed to see this picture.

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## **Annex 16-2**

### **Burn Injury – Escharotomy Incisions**

(dotted lines, avoid crossing joints if possible)

QuickTime™ and a  
TIFF (Uncompressed) decompressor  
are needed to see this picture.

## **Annex 17-1**

### **Specific Antivenin for Marine Bites and Stings**

- Box Jellyfish antivenin**
- Stonefish antivenin**
- Enhydrina schistosa antivenin (Sea Snake)**

Manufacturer, provider and information line:

These are the Commonwealth Serum Laboratory CSL, Parkville, VIC, Australia.

Tel.: +61-3-9389 1911

Fax: +61-3-9389 1434

## Annex 22-1

### National Authorities Responsible for Initiating Treatment of Diving Casualties and Emergency Contact Numbers

**BE:** COMOPSNAV  
Graaf Jansdijk 1  
B 8380 Zeebrugge  
Belgium  
Tel: 050/55.87.13  
+32/50.55.87.13  
Signal Message Address: COMOPSNAV

**CA :** Director Diving Safety  
National Defence Headquarters  
MGEN George R Pearkes Bldg.  
101 Colonel By Drive  
Ottawa,  
Canada K1A 0K2

Tel: Working Hours (613) 995 6193  
Emergencies (613) 996 7811  
Signal Message Address: NDHQ OTTAWA// DDIVES//  
Emergencies 24 Hrs NDOC OTTAWA// DUTY DDIVES STAFF//

Other CA Emergency Signal Addressees:

East: FDU SHEARWATER  
West: FDU ESQUIMALT  
Central: DCIEM TORONTO//OC EDU//  
Medical: DCIEM TORONTO//CDM

Emergency Medical Contact: DCIEM Consultant in Diving Medicine  
Tel: (416) 635-2079  
24 hour Pager (416) 246-3155

**DA:** Admiral Danish Fleet  
PO Box 483  
DK 8100 Aarhus C  
Tel: (+45) 89 43 30 99 (The Duty Officer)  
Signal Message Address: ADMIRALDANFLEET  
e-mail: sok@sok.dk

**FR:** COMISMER

B.P. 84  
83800 Toulon-Naval  
Tel: Code + 33 - 494020622 or 494020341  
Fax: 33-494021795  
Signal Message Address: COMISMER

**GE:** SAR - Leitstelle  
24960 Gluecksburg  
Uferstrasse  
Germany  
Tel: + 49 - (0) 4631, Ext 6013  
Fax: + 49 - (0) 4631 666 3259  
Telex No: 022560  
Call-sign for wireless communications: Morse - DHM 42  
Voice call-sign: Glueckburg Rescue  
Call-sign for wireless communication: Morse - DHM 42  
Voice - Gluecksburg Rescue

**GR:** Hellenic Navy General Staff  
Medical Directorate (DYG)  
Section I  
Stratopedon Papagou - Holargos  
Athens, Greece  
Tel: 6520468  
Signal Message Address: COMMEDEAST

**IT:** MOD ITALY - Navy General Staff  
00100 - ROMA  
Attn: Chief of Staff/COMSUBIN  
Tel: (06) 3601600  
Signal Message Address: MARISTAT – ROMA

**NL:** Commandant Mijnendienst  
Diving Medical Centre  
Postbus 10.000  
1700 CA Den Helder  
The Netherlands  
Tel: (0) 223-653076 or + 31-223-653076/658220  
E-Mail: dmc.post@dpkm.navy.disp.mindef.nl  
Signal Message Address: DNLDMD

**NO:** Norwegian Naval Diving School  
PO Box 26 Haakonsvern  
N-5886 Bergen, Norway

Message Address: COMTRAINSUB  
Tel: +47-55 50 33 42 / Fax: +47-55 50 22 22.

Civilian emergency communication centre: +47-55 32 30 03  
Diving Medical Office  
P.O. Box 26 Haakonsvern  
5886 Bergen, Norway  
Message Address: NAVDISVEST  
Tel: +47-55 50 21 60. Fax: +47 55 50 37 92

Out of working hours: 47 55 50 22 22  
Civilian emergency communication centre +47 55 32 30 03

**PO:** POL - Estado-Maior da Armada  
1188 Lisboa Codex  
Portugal  
Signal Message Address: MOD PORTUGAL NAVY  
Servico De Medicina  
Hyperbarica DO  
Campo De Santa Clara  
1200 Lisboa  
PORTUGAL  
Tel: Hospital Da Marinha

In working hours: 01-8863141, 01-8879971  
Out of working hours: 01-8863145  
Telex: 01-12587  
Fax: 01-8881531  
Signal Message Address: To: HOSPITALMAR  
Info: ESQLAMERGMAR  
Esqla De Mergulhadores  
Base Naval De Lisboa  
Alfeite  
2800 Almada  
PORTUGAL  
Tel: Esqla De Mergulhadores 01-27682(33)/28  
Fax: 01-2766822  
Signal Message Address: To: ESQLAMERGMAR  
Info: HOSPITALMAR

**SP:** AJEMA  
Seccion de Operaciones  
Calle MONTALBAN numero 2  
Madrid 28014  
Espana

Tel: 91/379 5960/5118/5120/5367 +34-91-3795960  
E-Mail: opemon@teleline.es  
Signal Address: AJEMA// SIC: LAA  
SW: Naval Centre  
Naval Medicine  
S-130 61 Harsfjarden

**Sweden**

Tele: 08-502 630 00 +46-8-502 630 00  
Fax: +46-8-502 638 40. Naval Medicine 46-8-502 636 87  
Emergency non working hours:  
Armed Forces HQ  
S-107 85 Stockholm, Sweden  
Tele: 08-788 81 14. +46-8-788 81 14  
Fax: +46-8-664 28 17  
E-Mail: vbhkv@hkv.mil.se

**TU:** Deniz Kuvvetleri Komutanligi  
Harekat Baskanligi  
Bakanliklar - Ankara  
Turkey  
Signal Message Address: CINCTURNAV/ANKARA  
Tele: ++90-(312)-417-3065  
Fax: ++90-(312)-417-6250

**UK:** RN Superintendent of Diving  
Reclaim Building  
Horsea Island  
Cosham  
Hampshire  
PO6 4TT  
Tel: +44 2392 224143 or 224145  
Fax: +44 2392 224150  
Signal Message Address: RNSUPDIV PORTSMOUTH

Emergency Numbers for Diving Accidents or Incidents:  
Office hours: +44 2392 768026  
Fax: + 44 2392 504823  
24hrs:+ 44 07831 151 523  
Signal Message Address: INM ALVERSTOKE

**US:** US Navy Supervisor of Diving (Administrative Only)  
COMNAVSEASYSCOM (NAVSEA OOC-3)  
Navy Department  
Washington DC 20362  
Tel: +01-703-607-2766

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Signal Message Address: COMNAVSEASYSCOM, Washington DC

Other US Emergency Signal Addressees:

NORTH EAST: SUBASE, NEW LONDON, CT  
MID ATLANTIC: COMNAVBASE, NORFOLK, VA  
SOUTH: COMNAVBASE, CHARLESTON, SC  
GULF COAST: NAVXIDIVINGU, PANAMA CITY, FL  
CARRIBEAN: COMNAVACTSCARIB, ROOSEVELT ROADS, PR  
EUROPE : CINCUS NAVEUR, LONDON, UK  
SOUTH WEST: COMNAVBASE, SAN DIEGO, CA  
NORTH WEST: COMNAVBASE, SEATTLE, WA  
HAWAII: COMNAVBASE, PEARL HARBOR, HI

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## Annex 22-2

### Investigation of Diving Accidents

Diving accident investigations have the aim to evaluate the cause or causes of an accident. As a result of the investigation it is important to identify general system malfunctions or necessary changes of the diving safety rules. The three common causes for an accident are:

- (1) Equipment failures.
- (2) Faulty procedures.
- (3) Diver's error.

**The Diver:** It is important to achieve as much information as possible from the diver himself, other divers or any other eye witnesses. Important points are:

- (1) Diving Medical Examination. Must be carried out as soon as possible after the incident to document the initial status of the patient
- (2) Experience of the diver
- (3) Recent Medical History
- (4) Personal History
- (5) Pre-Dive Activities
- (6) Post-Mortem: In fatal diving accidents it is most important to document any type of lesion, if possible with photo documentation. A post-mortem examination and inquest must be carried out in accordance with the appropriate laws and regulations. Specialised autopsy techniques may be necessary for a valid post-mortem examination after underwater accidents, however, it should be understood that the discovery and location of gas bubbles are of doubtful significance and are of no significance at all if the diver died while under pressure.
- (7) In all cases of diving accidents a full toxicological and drug analysis of blood and urine is strongly recommended

**The Dive:** This part of the investigation has to cover the dive itself and the ambient conditions before, during and after the dive:

- (1) The diver's narrative.
- (2) Witnesses narratives.
- (3) Objective of the dive
- (4) Depth and duration of the dive.
- (5) Earlier dives of the last days.
- (6) Tides and sea state.
- (7) Water temperature.
- (8) Secure dive computer (if used)

**The Equipment.** The general condition of the used apparatus should be noted. The gas valves should be shut off and the number of turns needed must be noted. Any relief valve must be sealed. Once the set has been sealed it should be stored safely and sent to a unit which is specialized in the investigation of diving equipment and gas analysis.

**Records.** It is vital that all diving accidents are reported to the central national military authority.

## Annex 24-1

### Wind Chill Index

Beaufort scale	Wind speed knots (mph)	Actual ambient temperatures measured °C (°F)							
		5(41)	0(32)	-5 (23)	-10 (14)	-15 (5)	-20 (-4)	-25 (-13)	-30 (-22)
Calm, light air	<3.5 (<4)	5 (41)	0 (32)	-5 (23)	-10 (14)	-15 (5)	-20 (-4)	-25 (-13)	-30 (-22)
Light breeze	5 (4-7)	3 (37)	0.5 (23)	-7 (19)	-12 (10)	-17 (1)	-23 (-9)	-29 (-20)	-33 (-28)
Gentle breeze	10 (8-12)	-2 (28)	-9 (16)	-14 (7)	-20 (-4)	-26 (-15)	-32 (-25)	-38 (-37)	-45 (-49)
Moderate breeze	15 (13-18)	-5 (23)	-11 (12)	-18 (0)	-23 (-10)	-32 (-25)	-39 (-38)	-45 (-49)	-51 (-60)
Fresh breeze	20 (19-24)	-8 (17)	-16 (3)	-23 (-9)	-28 (-19)	-37 (-34)	-44 (-48)	-49 (-57)	-57 (-70)
Strong breeze	28 (25-31)	-10 (14)	-18 (-0.5)	-26 (-16)	-31 (-24)	-40 (-40)	-47 (-53)	-56 (-68)	-62 (-80)
Half gale	35 (32-38)	-12 (11)	-20 (-4)	-27 (-17)	-34 (-29)	-42 (-43)	-49 (-57)	-57 (-70)	-64 (-83)
Gale	43 (39-46)	-13 (9)	-21 (-6)	-30 (-22)	-35 (-30)	-43 (-45)	-50 (-58)	-58 (-72)	-65 (-85)

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