YOUR ULTIMATE GUIDE TO SURVIVAL IN THE ED!

OXFORD HANDBOOK OF EMERGENCY MEDICINE

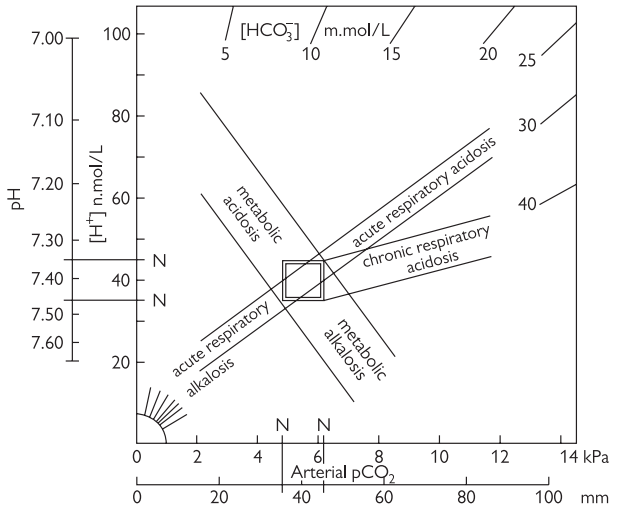
Jonathan P. Wyatt | Robert G. Taylor
Kerstin de Wit | Emily J. Hotton

The must-have handbook for all those involved in emergency medicine

Covers all the conditions that commonly present to the Emergency Department

Updated with the latest treatment guidelines

Packed with a host of new X-rays to aid identification and treatment



Acid-base nomogram in the interpretation of arterial blood gases

Golden rules of Emergency Medicine

There are exceptions to every rule, but think very carefully before breaking the following:

General Rules

- Turn up on time for every shift
- ED staff work as a team—thank members appropriately
- Always listen to nagging doubts
- Do not work beyond your expertise: when in doubt, seek senior advice
- If someone gives you advice, record what it was and who gave it
- Referral means referral and is usually a one-way process
- When making notes, write legibly, record times and print your name
- Always record what explanation and advice you give
- Avoid giving an opinion outside your expertise
- Always re-check drug doses (especially in children)

Rules and your patient

- Allow patients to 'tell their story' or at least a summary of it
- Beware patients who are 'handed over' to you
- Treat patients as you would want to be treated
- Treat the patient (not just the investigation result)
- Do not bring patients back for a second opinion—get a first opinion
- Discuss with a senior if contemplating breaking patient confidentiality
- If a patient has ↓ GCS, check BMG
- Glass + skin wound = X-ray
- Beware using tourniquets on digits and limbs
- Check visual acuity for all eye problems
- X-ray high velocity eye injuries (eg hammering)
- Always check/document anatomical snuffbox tenderness in wrist injuries
- 'Worst headache ever' mandates exclusion of subarachnoid haemorrhage
- Call an anaesthetist early in possible airway burns
- Never assume ↓ GCS is due to alcohol alone (especially with head injury)
- Admit patients with even minor head injury and no one at home
- CT scan patients with head injury if they take anticoagulants
- Bleeding disorder + injury = discuss with a haematologist
- Do not place chest tubes through stab or bullet wounds
- Take it seriously if a parent says their baby (or child) is simply 'not right'
- Consider meningococcal disease with unexplained skin rashes
- Consider NAI in atypical paediatric presentations
- If NAI is a possibility, inform a senior and/or specialist at once
- Do not try to age bruises
- Ask about allergies before giving drugs

Rules and you

- Ensure each shift contains regular refreshment breaks
- Do not try to 'work through' illness
- If you feel yourself becoming angry, take a deep breath and a short break
- If a fellow professional is rude, it may reflect stress on their part
- Each time you see a new condition, read up about it

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OXFORD HANDBOOK OF

Emergency Medicine

FIFTH EDITION

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Abbreviations and symbols

°C	degrees Centigrade
+ve	positive
–ve	negative
±	plus or minus
>	greater than
<	less than
≥	equal to or greater than
≤	equal to or less than
♂	male
♀	female
®	registered
™	trademark
~	approximately
↑	increase(d), increasing
↓	decrease(d), decreasing
▶▶	don't dawdle
▶	important
➲	cross-reference
🖱	online reference
α	alpha
β	beta
5HT	5-hydroxytryptamine
ABC	airway, breathing, circulation
ABG	arterial blood gas
AC	acromio-clavicular
ACE	angiotensin-converting enzyme
ACS	acute coronary syndrome
ACTH	adrenocorticotrophic hormone
ADH	antidiuretic hormone
AF	atrial fibrillation
AIDS	acquired immune deficiency syndrome
AIO	Ambulance Incident Officer
AIS	Abbreviated Injury Scale
AKI	acute kidney injury
ALS	Advanced Life Support
ALT	alanine aminotransferase
ALTE	apparent life-threatening event
ANDO	Allow Natural Death Order
AP	antero-posterior
APLS	Advanced Paediatric Life Support
APTT	activated partial thromboplastin time
ARDS	adult respiratory distress syndrome
ARF	acute renal failure
ASA	American Society of Anesthesiologists
AST	aspartate aminotransferase
ATLS	Advanced Trauma Life Support
ATP	adenosine triphosphate
AV	atrioventricular
BCG	bacille Calmette–Guérin
bd	twice daily
BE	base excess
BiPAP	bilevel positive airway pressure
BKPOP	below-knee plaster of Paris
BKWPOP	below-knee walking plaster of Paris
BLS	Basic Life Support
BMG	bedside strip measurement of venous/capillary blood glucose
BMI	body mass index
BNF	*British National Formulary*
BNFC	*British National Formulary for Children*
BNP	B-type natriuretic peptide
BP	blood pressure
BTS	British Thoracic Society
BURP	Backwards, Upwards, Rightwards Pressure
BZP	benzylpiperazine
Ca^{2+}	calcium
CAMHS	child and adolescent mental health services
CBRN	chemical, biological, radiological, nuclear
CCU	coronary care unit
CDC	Centers for Disease Control

CIWA-Ar	revised Clinical Institute Withdrawal Assessment for Alcohol
CK	creatine kinase
CKD	chronic kidney disease
Cl^-	chloride
cm	centimetre(s)
cmH_2O	centimetre(s) of water (pressure)
CMV	cytomegalovirus
CN	chloroacetophenone
CNS	central nervous system
CO	carbon monoxide
CO_2	carbon dioxide
COHb	carboxyhaemoglobin
COPD	chronic obstructive pulmonary disease
CPAP	continuous positive airway pressure
CPK	creatine phosphokinase
CPR	cardiopulmonary resuscitation
CRF	chronic renal failure
CRP	C-reactive protein
CRT	capillary refill time
CS	orthochlorobenzylidene malononitrile
CSF	cerebrospinal fluid
CT	computed tomography
cTnI	cardiac troponin I
cTnT	cardiac troponin T
CTPA	computed tomography pulmonary angiography
CVP	central venous pressure
CVS	cardiovascular system
CXR	chest X-ray
DC	direct current
Defra	Department for Environment, Food, and Rural Affairs
DIC	disseminated intravascular coagulation
DIPJ	distal interphalangeal joint
DKA	diabetic ketoacidosis
dL	decilitre(s)
DNA	deoxyribonucleic acid
DNACPR	Do Not Attempt CPR
DPG	diphosphoglycerate
DPL	diagnostic peritoneal lavage
DPT	diphtheria, pertussis, and tetanus
DVLA	Driver and Vehicle Licensing Agency
DVT	deep vein thrombosis
EBV	Epstein–Barr virus
ECG	electrocardiogram
ECT	electroconvulsive therapy
ED	emergency department
EDTA	ethylenediamine tetra-acetic acid
EEG	electroencephalogram
eGFR	estimated glomerular filtration rate
EMLA	eutectic mixture of local anaesthetics
ENT	ear, nose, and throat
EPAP	expiratory positive airway pressure
ERCP	endoscopic retrograde cholangiopancreatography
ESR	erythrocyte sedimentation rate
ET	endotracheal
$ETCO_2$	end-tidal carbon dioxide
FAST	focussed assessment with sonography for trauma
FB	foreign body
FBC	full blood count
FFP	fresh frozen plasma
FG	French Gauge
FGM	female genital mutilation
FiO_2	inspired oxygen concentration
FOB	faecal occult blood
ft	foot/feet
FTOCC	Fever, Travel, Occupation, Cluster and Contact
γ	gamma
G6-PD	glucose-6-phosphate dehydrogenase
g	gram(s)
G	gauge
GA	general anaesthesia/ anaesthetic
GCS	Glasgow Coma Score
GFR	glomerular filtration rate
GHB	gammahydroxybutyrate
GI	gastrointestinal
GMC	General Medical Council

GP	general practitioner
GTN	glyceryl trinitrate
GU	genitourinary
HAS	human albumin solution
Hb	haemoglobin
HCG	human chorionic gonadotrophin
HCM	hypertrophic cardiomyopathy
HCO_3^-	bicarbonate
Hct	haematocrit
HDU	high dependency unit
HHS	hyperosmolar hyperglycaemic state
HIV	human immunodeficiency virus
H_2O	water
HPV	human papillomavirus
hr	hour(s)
HTLV	human T-cell lymphotropic virus
Hz	hertz(s)
ICP	intracranial pressure
ICU	intensive care unit
IgA	immunoglobulin A
IgE	immunoglobulin E
IgG	immunoglobulin G
IHD	ischaemic heart disease
IM	intramuscular
INR	international normalized ratio (of prothrombin time)
IO	intra-osseous
IPAP	inspiratory positive airway pressure
IPJ	interphalangeal joint
IPPV	intermittent positive pressure ventilation
ISS	Injury Severity Score
IUD	intrauterine contraceptive device
IUS	intrauterine system
IV	intravenous
IVF	*in vitro* fertilization
IVI	intravenous infusion
IVRA	intravenous regional anaesthesia
IVU	intravenous urography
J	joule(s)
JVP	jugular venous pressure
K^+	potassium
KCl	potassium chloride
KE	kinetic energy
kg	kilogram(s)
kPa	kilopascal(s) pressure
L	litre(s)
LA	local anaesthesia/ anaesthetic
LAD	left axis deviation
LBBB	left bundle branch block
LDH	lactate dehydrogenase
LET	lidocaine, epinephrine, tetracaine
LFTs	liver function tests
LMA	laryngeal mask airway
LMP	last menstrual period
LMWH	low-molecular weight heparin
LP	lumbar puncture
LSD	lysergic acid diethylamide
LV	left ventricle/ventricular
LVAD	left ventricular assist device
LVF	left ventricular failure
LVH	left ventricular hypertrophy
m	metre(s)
MAC	mid-arm circumference
MAOI	monoamine oxidase inhibitor
MAP	mean arterial pressure
max	maximum
MC	metacarpal
MCA	Mental Capacity Act
mcg	microgram(s)
MCPJ	metacarpophalangeal joint
MCV	mean corpuscular volume
MDDUS	Medical and Dental Defence Union of Scotland
MDMA	3,4-methylene-dioxymetamphetamine
MDU	Medical Defence Union
MERS	Middle East respiratory syndrome
MERS-CoV	Middle East respiratory syndrome
mg	milligram(s)
Mg^{2+}	magnesium
MI	myocardial infarction
min	minute(s)

MIO	Medical Incident Officer
mL	millilitre(s)
mm	millimetre(s)
mmHg	millimetre(s) of mercury pressure
mmol	millimole(s)
MMR	measles, mumps, and rubella
mOsm	milliosmole(s)
MRA	magnetic resonance angiography
MRI	magnetic resonance imaging
MRSA	meticillin-resistant *Staphylococcus aureus*
ms	millisecond(s)
MS	multiple sclerosis
MSU	mid-stream specimen of urine
MT	metatarsal
MTPJ	metatarsophalangeal joint
MUA	manipulation under anaesthesia
mV	millivolt(s)
Na^+	sodium
NAI	non-accidental injury
NAIR	National Arrangements for Incidents involving Radioactivity
NAPQI	*N*-acetyl-*p*-benzoquinone imine
ND	notifiable disease
NEWS2	National Early Warning Score (revised 2017)
NG	nasogastric
NHS	National Health Service
NICE	National Institute for Health and Care Excellence
NIHSS	National Institutes of Health Stroke Scale
NIV	non-invasive ventilation
N_2O	nitrous oxide
NPIS	National Poisons Information Service
NPS	novel psychoactive substance
NSAID	non-steroidal anti-inflammatory drug
NSPCC	National Society for the Prevention of Cruelty to Children
NSTEMI	non-ST segment elevation myocardial infarction
O_2	oxygen
OA	osteoarthritis; occiput anterior
OCP	oral contraceptive pill
od	once daily
OPG	orthopantomogram
ORIF	open reduction and internal fixation
PA	postero-anterior
PACS	picture archiving and communication system
PAN	polyarteritis nodosa
PCI	percutaneous coronary intervention
pCO_2	arterial partial pressure of carbon dioxide
PCR	polymerase chain reaction
PE	pulmonary embolus/embolism
PEA	pulseless electrical activity
PEEP	positive end-expiratory pressure
PEFR	peak expiratory flow rate
PEG	percutaneous endoscopic gastrostomy (tube)
PERT	Paediatric Emergency Response Team
PGL	persistent generalized lymphadenopathy
PICU	paediatric intensive care unit
PID	pelvic inflammatory disease
PIPJ	proximal interphalangeal joint
PO	*per os* (orally/by mouth)
pO_2	arterial partial pressure of oxygen
PO_4^{2-}	phosphate
POP	plaster of Paris
PPE	personal protective equipment
PPI	proton pump inhibitor
PR	per rectum
PrEP	pre-exposure prophylaxis
PRF	patient report form
PRICE	Protection/Rest/Ice/Compression/Elevation
PRN	*pro re nata* (as required)

Ps	probability of survival
PSP	primary spontaneous pneumothorax
PV	per vaginam
qds	four times daily
qSOFA	quick SOFA
RA	rheumatoid arthritis
RAD	right axis deviation
RBBB	right bundle branch block
RBC	red blood cell
RCEM	Royal College of Emergency Medicine
Rh	rhesus
RIMA	reversible inhibitor of monoamine oxidase A
RNA	ribonucleic acid
RMO	responsible medical officer
ROSC	restoration of spontaneous circulation
ROTEM	rotational thromboelastometry
RR	respiratory rate
RSI	rapid sequence induction/ intubation
RSV	respiratory syncytial virus
rtPA	recombinant tissue plasminogen activator
RTS	Revised Trauma Score
RV	right ventricle/ventricular
s	second(s)
SA	sino-atrial
SARS	severe acute respiratory syndrome
SC	subcutaneous
SCIWORA	spinal cord injury without radiographic abnormality
SCRA	synthetic cannabinoid receptor agonist
SIDS	sudden infant death syndrome
SIGN	Scottish Intercollegiate Guidelines Network
SL	sublingual
SLE	systemic lupus erythematosus
SOFA	Sequential Organ Failure Assessment
SPECT	single-photon emission computed tomography
SpO_2	arterial oxygen saturation
SSP	secondary spontaneous pneumothorax
SSRI	selective serotonin reuptake inhibitor
STEMI	ST segment elevation myocardial infarction
STI	sexually transmitted infection
SUDI	sudden unexplained death in infancy
SUDIC	sudden unexpected death in infancy and childhood
SVT	supraventricular tachycardia
T°	temperature
T_3	tri-iodothyronine
T_4	thyroxine
TAC	tetracaine, adrenaline, and cocaine
TACO	transfusion-associated circulatory overload
TB	tuberculosis
tds	three times daily
TEG	thromboelastography
TEP	Treatment Escalation Plans
TFCC	triangular fibrocartilage complex
TFTs	thyroid function tests
TIA	transient ischaemic attack
TIG	tetanus immune globulin
TIMI	thrombolysis in myocardial infarction
TORCH	*Toxoplasma*, rubella, CMV, herpes
tPA	tissue plasminogen activator
TSH	thyroid-stimulating hormone
TWOC	Trial WithOut Catheter
U	unit(s)
U&E	urea and electrolytes
UK	United Kingdom
URTI	upper respiratory tract infection
USS	ultrasound scan
UTI	urinary tract infection
V	volt(s)
VA	visual acuity
VBG	venous blood gas
VF	ventricular fibrillation

VHF	viral haemorrhagic fever
V/Q	ventilation–perfusion (scan)
VT	ventricular tachycardia
VTE	venous thromboembolism
vW	von Willebrand
WBC	white blood cell
WCC	white cell count
WPW	Wolff–Parkinson–White (syndrome)
y	year(s)

Normal values

Note that 'normal' values in adults may vary slightly between labs. Normal values in pregnancy are shown in ➔ Prescribing in pregnancy, p. 594.

Arterial blood gas analysis

H^+	35–45nanomol/L
pH	7.35–7.45
pO_2 (in air)	>10.6kPa, 75–100mmHg
pCO_2	4.5–6.0kPa, 35–45mmHg
Bicarbonate	24–28mmol/L
Base excess	± 2mmol/L

Biochemistry

Alanine aminotransferase (ALT)	5–35 IU/L
Albumin	35–50g/L
Alkaline phosphatase	30–300 IU/L
Amylase	0–180 Somogyi U/dL
Aspartate transaminase (AST)	5–35 IU/L
Bicarbonate	24–30mmol/L
Bilirubin	3–17 micromoles/L
Calcium (total)	2.12–2.65mmol/L
Calcium (ionized)	1–1.25mmol/L
Chloride	95–105mmol/L
Creatine kinase (CK)	25–195 IU/L
Creatinine	70–150 micromoles/L
C-reactive protein (CRP)	<10mg/L
Glucose (fasting)	3.5–5.5mmol/L
α-glutamyl transpeptidase (♀)	7–33 IU/L
(♂)	11–51 IU/L
Magnesium	0.75–1.05mmol/L
Osmolality	278–305mOsm/kg
Potassium	3.5–5.0mmol/L
Sodium	135–145mmol/L
Urea	2.5–6.7mmol/L
Urate (♀)	150–390 micromoles/L
(♂)	210–480 micromoles/L

Haematology

RBC (♀)	3.9–5.6 × 10^{12}/L
(♂)	4.5–6.5 × 10^{12}/L
Hb (♀)	115–160g/L
(♂)	135–180g/L
Hct (♀)	0.37–0.47
(♂)	0.40–0.54
MCV	76–96fL
WCC	4.0–11.0 × 10^{9}/L
Neutrophils	2.0–7.5 × 10^{9}/L (40–75% of WCC)
Lymphocytes	1.5–4.0 × 10^{9}/L (20–40% of WCC)
Monocytes	0.2–0.8 × 10^{9}/L (2–10% of WCC)
Eosinophils	0.04–0.40 × 10^{9}/L (1–6% of WCC)
Basophils	<0.1 × 10^{9}/L (<1% of WCC)
Platelets	150–400 × 10^{9}/L
Prothrombin time (factors I, II, VII, X)	12–15s
APTT (factors VII, IX, XI, XII)	23–42s

International normalized ratio (INR) therapeutic targets

2.0–3.0	(for treating DVT and PE)
2.5–3.5	(embolism prophylaxis for AF)
3.0–4.5	(recurrent thromboembolic disease, arterial grafts, and prosthetic valves)

ESR	(women)	< $^{(\text{age in years}+10)}/_{2}$ mm/hr
	(men)	< $^{(\text{age in years})}/_{2}$ mm/hr

Metric conversion

Length

1m = 3 feet 3.4 inches	1 foot = 0.3048m
1cm = 0.394 inch	1 inch = 25.4mm

Weight

1kg = 2.20 pounds	1 stone = 6.35kg
1g = 15.4 grains	1 pound = 0.454kg
	1 ounce = 28.4g

Volume

1L = 1.76 UK pints = 2.11 US liquid pints
1 UK pint = 20 fluid ounces = 0.568L
1 US liquid pint = 16 fluid ounces = 0.473L
1 teaspoon = ~ 5mL
1 tablespoon = ~ 15mL

Temperature

T° in °C = (T° in Fahrenheit – 32) × 5/9

Pressure

1kPa = 7.5mmHg

Chapter 1

General approach

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The emergency department

Role of the emergency department

The emergency department (ED) occupies a key position in terms of the interface between primary and secondary care. It has a high public profile. Many patients attend without referral, but some are referred by minor injury units, general practitioners (GPs), other medical practitioners, and National Health Service (NHS) 111/NHS 24/NHS Direct Wales.

The ED manages patients with a huge variety of medical problems. Many of the patients who attend have painful and/or distressing disorders of recent origin.

ED priorities

- To make life-saving interventions.
- To provide analgesia.
- To identify relevant issues, investigations, and commence treatment.
- To decide upon need for admission or discharge.

ED staff

A key feature of the ED is the way that the staff work together as a team. Traditional roles are often blurred, with the important issue being what clinical skills a member of staff is capable of. Staff include:

- Nurses (including nurse practitioners, nurse consultants, health care assistants) and Advanced Care Practitioners.
- Doctors (permanent and fixed-term).
- Reception and administrative staff (receptionists, secretaries, managers).
- Radiographers, including reporting radiographers.
- Other specialist staff (eg psychiatric liaison nurses, plaster technicians, physiotherapists, paramedic practitioners, physician assistants, occupational therapists, clinic/ED ward staff).
- Supporting staff (security, porters, cleaners, police).

The facilities of an ED

Most departments have the following areas:

- Resuscitation area—including a paediatric area (often separate).
- Majors area (sometimes called 'trolley area').
- Minors area—including theatre, plaster room, eye room.
- Paediatric area—with a separate waiting room.
- Adjacent or embedded imaging (X-ray department and CT scanner).
- Reception and waiting room.
- Relatives room (for seriously ill patients).
- Staff room.
- Teaching/resource room.
- Offices.

Depending upon the nature and configuration of the service which is being delivered, many EDs have other areas within or adjacent which are designated for a specific purpose (eg clinic area, short stay ward/clinical decision unit).

Emergency medicine beyond the ED

Additional roles of ED staff

In addition to their roles in providing direct clinical care in their departments, many ED staff provide related clinical care in other settings and ways, including in short stay wards, in outpatient follow-up clinics (eg for burns, soft tissue injuries), and through planned theatre lists (eg for wrist fracture manipulation) and telemedicine advice (for satellite and minor injury units).

Short stay wards/clinical decision units

The intention is for admissions to these units to be short—most of the patients admitted are observed for relatively short periods (<24hr) and undergo assessments at an early stage to decide about the need for discharge or longer-term admission. The range of conditions which may be appropriately managed varies between units but may include the following:

- Head and neck injuries.
- Poisoning, self-harm, and some psychiatric presentations.
- Alcohol and/or drug intoxication.
- Falls (especially in the elderly), with no injuries requiring surgery.
- Anaphylaxis.
- Drowning and electrocution injuries.
- Low-risk chest pain.
- Soft tissue infection.
- Asthma.
- Low back pain (including suspected cauda equina syndrome).
- 'Social problems'.

The clinical staff required to provide support to a short stay ward depends upon the exact service being delivered, but typically includes occupational therapists, physiotherapists, psychiatric liaison staff, social workers, and alcohol and drug specialists.

Emergency medicine in other settings

As the delivery of emergency care continues to develop and evolve, patients with emergency problems are now being assessed and treated in a variety of settings. In the overstretched, overcrowded world of acute/emergency medicine, different ways of working are being implemented, which enables ED clinicians, GPs, acute physicians, and other specialists to work in adjacent areas with a variety of different names (eg urgent care centre, primary care unit, walk-in centre, same-day emergency care, clinical decision unit, medical assessment areas).

Traditional distinctions between emergency medicine, acute medicine, and primary care have become blurred.

Patient flow

Discharge from the ED

To work efficiently, the overall hospital system needs to enable easy flow of patients out of the ED. Options available for continuing care of patients who leave the ED include:

- Discharge home with no follow-up.
- Discharge home with GP and/or other community support/follow-up.
- Discharge with hospital clinic follow-up arranged.
- Admission to hospital for further investigation and treatment.
- Transfer to another hospital with more specialist facilities.

Aim to make an early decision about the likely 'disposal' of each patient—this is very helpful for senior staff and managers who are focussed on patient flow.

Patient flow

The flow of patients through the ED depends upon a number of factors, most particularly:

- The rate of patients arriving.
- The waiting time to be seen.
- The time to 'process' (examine/assess/investigate/decide a plan).
- The time to discharge/admit.

A problem with any of these factors can result in overcrowding in the ED, which, in turn, adds further delays to the process. Most EDs are designed and staffed to cope with an average rate of patients arriving, and so it is natural that, at some times, there will be fluctuations in the waits to be seen, which will occasionally rise. However, a bigger problem in the United Kingdom has become 'exit block' from the ED, whereby there are no beds available in the hospital for patients to be admitted to. Sometimes the block can be specific to certain areas or specialties (eg surgery or ICU).

At times of high demand and/or extreme pressure, some EDs have systems in place whereby additional support (eg medical and nursing staff) can be obtained from other parts of the hospital or where some elements of the usual procedures for processing patients (eg documentation in the ED) can be reduced.

Government targets

Long waiting times to be seen in the UK EDs prompted the introduction of quality indicators, most notably the '4-hour target', which was adopted variably throughout the UK. Often misquoted in the press as '4hrs to be seen', it was actually set out as a percentage (eg 95%) to be seen, treated, and discharged/admitted within 4hrs. Lack of hospital beds, resulting in poor flow for patients admitted into the hospital, has impacted dramatically on the ability of hospitals to deliver on these targets. Irrespective of the politics, long stays in the ED impact very negatively on patient outcomes.

Patient safety: overcrowding

Overcrowding and queuing

Overcrowding disrupts the usually smooth processes which are in place, risking the safety of patients. Although the timely and efficient processing of patients can help to keep patients safe, experience suggests that when (especially junior) staff try to work too quickly or cut corners, mistakes are made. Do not compromise the quality of care by a less rigorous assessment of a patient simply because the department is busy.

Privacy and dignity

Overcrowding inevitably adversely affects privacy and dignity, especially for patients arriving on stretchers. As capacity becomes saturated, patients end up waiting on trolleys in corridors. Many EDs have recognized that it is safer for selected patients to queue out waiting for a bed than for unselected patients to queue to get in. Whilst it may be necessary to undertake a limited assessment in a corridor, do not undress patients to examine them in a corridor.

Patient safety checklist for an overcrowded department

The following is an example of the way that one ED has attempted to combat some of the risks posed by overcrowding:

- Provide reassurance to patients who arrive to a crowded ED.
- Explain to patients that although the environment is not ideal, they can expect to be looked after with the same quality of care from the ED team.
- Focus on minimizing any compromise of patient privacy and dignity.
- Provide a simple verbal explanation and an apology for the ED crowding situation (and document this in the notes).
- Hand out the written ED crowding information sheet to patients and their relatives.
- Ask patients for permission before taking a history, undertaking a non-intimate examination, or taking observations/bloods outside of an ED cubicle space. Explain the benefits of early diagnosis and treatment and apologize for the lack of privacy.
- Use a private area if requested by the patient.
- Use a private area for any examination or investigation where the patient needs to get undressed (eg chest/abdominal examination, recording an ECG).
- Document clearly in the notes any examinations which are suboptimal due to the inability to adequately assess patients in the corridor. Complete the examination fully at the earliest opportunity.
- Ensure routine nursing and clinical care (including analgesia, medication, regular observations, toileting, food and drink) continue wherever the patient is located. Keep patients informed about the progress of their care.

Note keeping

General aspects

The importance of making accurate notes cannot be over-emphasized. The principal role of ED patient notes is to record (and communicate with future carers) the history, investigations, possible diagnoses, and treatment plan. Rather than making comprehensive notes on every aspect of the patient's care, aim to focus notes in the ED on those important issues that need to be addressed within the first few hours—leave the 'comprehensive clerking' to doctors on the ward.

Medicolegal considerations

Clinicians each treat hundreds of patients every month. With the passage of time, it is impossible to remember all aspects relating to these cases, yet it may be necessary to give evidence in court about them years after the event. The only reference will be the notes made much earlier. Medicolegally, the ED record is also the prime source of evidence in negligence cases. If the notes are deficient, it may not be feasible to defend a claim, even if negligence has not occurred.

The *Data Protection* and *Access to Medical Records Acts* give patients right of access to their medical notes. Remember, whenever writing notes, that the patient may in the future read exactly what has been written. Follow the following basic general rules.

Layout

Presenting complaint

Indicate from whom the history has been obtained (eg the patient, a relative, or the paramedic). Avoid attributing events to certain individuals (eg the patient was struck by 'Joe Bloggs').

Previous relevant history

Note recent ED attendances, together with other information which may be available within the hospital electronic record system—in particular, check recent letters and investigation results. Previous ECGs can be very useful to compare against. Take a relevant social history (which needs to be detailed when there are potential concerns about the safety of later discharging the patient).

Current medications

Many patients bring their medication (and/or list) to hospital. It is also often possible to cross-check against online/GP records. Remember to ask about non-prescribed drugs. Enquire about allergies and document the nature of any reaction.

Examination findings

As well as +ve features, document relevant –ve findings (eg the absence of neck stiffness in a patient with headache and pyrexia). Always document the side of the patient which has been injured. For upper limb injuries, note whether the patient is left- or right-handed. Use 'left' and 'right', not 'L' and 'R'. Document if a patient is abusive or aggressive, but avoid non-medical judgemental terms (eg 'drunk').

Investigation findings

Record these clearly, plus what is still outstanding.

Working diagnosis

For patients being admitted, this may be a differential diagnostic list. Sometimes a problem list can help.

Treatment given

Document drugs, including the dose, time, and route of administration. Include medications given in the ED, as well as therapy to be continued (eg course of antibiotics). For patients who are being referred for admission, whilst it is not necessary to prescribe all regular medications in the ED, ensure that important medications are prescribed—these include drugs for epilepsy, Parkinson's disease, and diabetes, together with antibiotics.

Record other treatments in detail such as the number and type of sutures or staples used for wound closure (eg '5 × 6/0 nylon sutures').

Advice and follow-up arrangements

Document if the patient and/or relative is given a preprinted advice sheet (eg 'head injury advice'). Indicate when/if the patient needs to be reviewed (eg 'see GP in 5 days for suture removal').

Basic rules

- Write legibly, ideally in black ink which photocopies well.
- Always date and time the notes.
- Sign the notes, and print your name and status below.
- Make your notes concise and to the point.
- Use simple line drawings or preprinted sheets for wounds/injuries.
- Avoid idiosyncratic abbreviations.
- Never make rude or judgemental comments.
- Always document the name, grade, and specialty of any doctor from whom you have received advice.
- When referring or handing a patient over, *always* document the time of referral/handover, together with the name, grade, and specialty of the receiving doctor.
- Inform the GP by letter/email (see ➲ Liaising with GPs, p. 12), even if the patient is admitted. Most EDs have computerized systems that generate letters. In complex cases, send also a copy of ED notes, with the results of investigations, and consider giving the patient a copy as well.

Pro formas

Increasing emphasis on evidence-based guidelines and protocols has been associated with the introduction of pro formas for many patient presentations and conditions. Whilst they have some advantages, bear in mind the fact that, for some patients, satisfactory completion of a pro forma may not adequately capture all of the information required.

Electronic records

Some departments (and hospitals) are now completely paperless, which has obvious advantages in terms of legibility, storage, and later access. When completing electronic records, follow the same principles as those outlined for written records.

Radiological requests

General aspects

The *Royal College of Radiologists'* booklet *iRefer: Making the Best Use of Clinical Radiology* (eighth edition, London, Royal College of Radiologists, 2017) contains useful information and is recommended.

- An X-ray is no substitute for a careful, thorough clinical examination. It is usually unnecessary to request X-rays to confirm the clinical diagnosis of uncomplicated fractures of the nose, the coccyx, a single rib, or toes (other than the big toe).
- If in doubt about the need for X-rays/CT or the specific test required, consider relevant guidelines (eg Ottawa rules for ankle injuries—see ➲ Approach to ankle injuries, p. 498; the National Institute for Health and Care Excellence (NICE) guidelines for CT scanning in head injuries—see ➲ Head injury: imaging, p. 370) and/or discuss with senior ED staff or the radiologist. The dose of radiation involved may need to be weighed up against the risk of missing or delaying making the diagnosis, in the context of the availability of the tests.
- When requesting imaging, describe the indication/mechanism of injury, clinical findings, including the side involved (right or left—spelt out in full, not abbreviated), and the suspected clinical diagnosis. This is important for the radiologist reporting the films without the advantage of being able to examine the patient.
- Do not worry about specifying exactly which X-ray views are required. The radiographer will know the standard views that are needed, based on the information provided (eg antero-posterior (AP) + simplified apical oblique views for a patient with suspected anterior shoulder dislocation). In unusual cases, discuss with senior ED staff, the radiographer, or the radiologist.
- Always consider the possibility of pregnancy in women of child-bearing age before requesting an X-ray (or CT scan) of the abdomen, pelvis, lumbar spine, hips, or thighs. If the clinical indication for X-ray/CT scanning is overriding, tell the radiographer, who will attempt to shield the fetus/gonads. If the risks/benefits of X-ray/CT scanning in pregnant or possibly pregnant women are not obvious, consult senior ED or radiology staff.
- Magnetic resonance imaging (MRI) can be dangerous in patients who have metalwork *in situ*. Its effects in pregnancy have not been established, but it is usually regarded as being safe in pregnancies after 3 months.
- Ultrasound scanning (USS) is particularly useful at identifying radiolucent foreign bodies (FBs) (see ➲ Approach to foreign bodies, p. 413).

X-ray reporting system

Most hospitals have systems whereby all ED X-rays are reported by a specialist within 24hr. Reports of any missed abnormalities are returned to the ED for the attention of senior staff, so that appropriate action can be taken.

System for identifying abnormalities

In addition to the formal reporting system described above, a system is commonly used whereby the radiographer taking the films applies a label to the image if they identify an abnormality. This alerts other clinical staff to the possibility of abnormal findings.

Triage

The nature of ED work means that a sorting system is required to ensure that patients with the most immediately life-threatening conditions are seen first. A triage process aims to categorize patients based on their medical needs and the available departmental resources. One process used in the UK is the National Triage Scale (see Table 1.1).

Table 1.1 National Triage Scale (UK)

National Triage Scale	Colour	Time to be seen by doctor
1 Immediate	Red	Immediately
2 Very urgent	Orange	Within 5–10min
3 Urgent	Yellow	Within 1hr
4 Standard	Green	Within 2hr
5 Non-urgent	Blue	Within 4hr

On arrival in the ED, a patient is assessed by a dedicated triage nurse (a senior, experienced individual with considerable common sense). This nurse provides any immediate interventions that are needed (eg elevating injured limbs, applying ice packs or splints, and giving analgesia) and initiates investigations to speed the patient's journey through the department (eg ordering appropriate X-rays). The Royal College of Emergency Medicine (RCEM) guidelines are that patients should not have to wait >15min to be triaged. It is a brief assessment which should take no more than a few minutes.

Three points require emphasis:

- Triage is a dynamic process. The urgency (and hence triage category) with which a patient requires to be seen may change with time. For example, a middle-aged man who hobbles in with an inversion ankle injury is likely to be placed in triage category 4 (green). If in the waiting room, he becomes pale and sweaty and collapses with chest pain, he would require prompt re-triage into category 1 (red).
- Placement in a triage category does not imply a diagnosis, or even the lethality of a condition.
- Triage has its own problems. In particular, patients in non-urgent categories may wait inordinately long periods of time, whilst patients who have presented later, but with conditions perceived to be more urgent, are seen before them. Patients need to be aware of this and be informed of likely waiting times. Uncomplaining elderly patients can sometimes be poorly served by the process.

The triage process has evolved to include an initial assessment of the physiological status (NEWS2—see ➔ National Early Warning Score ('NEWS 2'), p. 61), which can assist in the identification of sick patients and also of deterioration of patients after arrival. Other systems aim to tackle the issues of patients waiting to be seen, including 'see and treat' which aims to enable patients to be assessed and treated immediately by a senior practitioner.

Discharge, referral, and handover

Most patients seen in the ED are examined, investigated, treated, and discharged home, either with no follow-up or with advice to see their GP (for suture removal, wound checks, etc.). Give these patients (and/or attending relative/friend) clear instructions on when to attend the GP's surgery and an indication of the likely course of events, as well as any features that they should look out for to prompt them to seek medical help prior to this.

Formal written instructions are useful for patients with a range of conditions (eg minor head injury—see ➲ Discharging patients, p. 375; those with limbs in plaster of Paris (POP) or other forms of cast immobilization—see ➲ Casts and their problems, pp. 430–1; low back pain—see ➲ Atraumatic low back pain, pp. 508–9; spontaneous pneumothorax—see ➲ Spontaneous pneumothorax, pp. 118–20).

The referral of patients to an inpatient team can cause considerable anxiety, misunderstanding, and potential conflict between ED staff and other disciplines. Before making the referral, consider the following.

Is it appropriate to refer this patient to the inpatient team?

Usually, this will be obvious. For example, a middle-aged man with a history of crushing chest pain and an ECG showing an acute myocardial infarction (MI) clearly requires urgent management in the ED and rapid admission for further investigation and treatment. Similarly, an elderly lady who has fallen, is unable to weight-bear, and has a fractured neck of femur will require analgesia, inpatient care, and surgery.

However, difficult situations occur where the clinical situation is less clear, eg a man who experienced 4–5min of atypical chest pain, has a normal ECG and chest X-ray (CXR), and is anxious to go home, or a patient who has no apparent fracture on X-ray but is struggling to weight-bear.

Is there appropriate information to make this decision?

This requires a balance between availability, time, and appropriateness. In general, simple investigations which rapidly give the diagnosis, or clues to it, are all that are needed. These include ECGs, arterial blood gas (ABG)/venous blood gas (VBG), and plain X-rays. It is relatively unusual to have to wait for the results of investigations such as full blood count (FBC), urea and electrolytes (U&E), and liver function tests (LFTs) before referring a patient, since these rarely alter the immediate management. Simple trolleyside investigations are often of great value, eg Stix estimations of blood glucose (BMG) and urinalysis. If complicated investigations are needed, then referral for inpatient or outpatient specialist care is often required.

Has the patient had appropriate treatment pending admission?

Do not forget, or delay, in providing analgesia. Treat every patient in pain appropriately as soon as possible. A patient does not have to 'earn' analgesia. Never delay analgesia to allow further examination or investigation. Concern regarding masking of signs or symptoms (eg in a patient with an acute abdomen) is inhumane and incorrect.

Note: clinical responsibility for a patient in the ED usually passes over to the admitting team once the patient has been seen by that team.

How to refer patients

Referral is often by telephone, which can create problems. Adopt the following approach:

- Introduce yourself and ask for the name and grade of the specialist.
- Give a clear, concise summary of the history, investigations, and treatment that you have already undertaken.
- Early in the discussion, say clearly whether you are making a referral for admission or requesting a specialist opinion (it is usually better to obtain a senior ED opinion before a specialist one). With ever increasing pressure on hospital beds, inpatient teams can be reluctant to come and see patients, and may appear to be happier to give advice over the phone to avoid admission. If, however, the patient needs to be admitted, then clearly indicate this. If, for whatever reason, this is declined, do not get cross, rude, or aggressive, but contact senior ED medical staff to speak to the specialist team.
- When the specialist team comes to see the patient, or the patient is admitted directly to a ward, ensure the ED notes are complete and legible. Make sure that there is a list of the investigations already performed, together with the available results and, crucially, a list of investigations whose results remain outstanding. Similarly, summarize the treatment already given and the response.
- Encourage inpatient specialists who see patients in ED to write their findings and management plan in the notes.

Referring to a specialist at another hospital

An increasing number of patients require discussion with a specialist at a remote hospital (eg regional neurosurgeon, plastic surgeon).
The two questions to ask the specialist are:

- Does the patient require transfer and if so, when?
- What treatment is required (whether transferred or not)?

Follow established protocols for referral/discussion. Increasingly, telephone discussions are being replaced by referral online, with systems in place to enable images (eg of skin burns) to be transferred securely.

Handing over patients

Dangers of handing over

Handing over a patient to a colleague (usually because it is the end of the shift) is fraught with danger. It is easy for patients to be neglected or to receive suboptimal or delayed treatment. Hand over the patient carefully to the doctor who is taking over, update the electronic system/register as appropriate, and inform the nursing staff.

How to hand over

Include in the handover relevant aspects of the history and examination, investigation results, and treatment undertaken. Complete records on the patient as soon as possible. Note the time of handover and the name of the doctor or nurse handed over to. When accepting a 'handed-over patient' at the start of a shift, spend time establishing exactly what has happened so far. Finally, it is courteous (and will prevent problems) to tell the patient that their further care will be performed by another doctor or nurse.

Liaising with GPs

Despite changes in the way that care (particularly out of hours) is delivered, GPs still have a pivotal role in co-ordinating medical care. Often the GP knows more than anyone about the past history, the social and family situation, and recent events of their patient's management. Therefore, consider contacting the GP when these aspects are relevant to the patient's ED attendance or where considerations of admission or discharge cannot be resolved during the consultation and by reviewing old online records.

Every attendance is followed routinely by a letter/email to the GP, detailing the reason(s) for presentation, clinical findings and relevant investigations, treatment given, and follow-up arrangements.

If a patient dies, contact the GP without delay—to provide a medical contact and assistance to the bereaved family, to prevent embarrassing experiences (eg letters requesting clinic attendances), and out of courtesy, because the GP is the patient's primary medical attendant. Finally, the GP may be asked to issue a death certificate by the Coroner (in Scotland, the Procurator Fiscal), following further enquiries.

Aim to contact the GP prior to the discharge of a patient where early follow-up (ie within the next 24–72hr) is required. This may occur with elderly patients where there is uncertainty about the home situation and their ability to manage. A typical example is an elderly woman with a Colles' fracture of her dominant wrist who lives alone. The ED management of this patient is relatively simple (see ➲ Colles' fracture, pp. 454–5). However, manipulating a Colles' fracture into a good position, supporting it in an adequate cast, and providing analgesia are only one facet of care. The GP may know that the patient has supportive relatives or neighbours who will help with shopping and cooking and who will help her to bathe and dress. The GP and the primary care team may be able to supplement existing support and check that the patient is coping. Equally, the GP may indicate that with additional home support (eg home helps, meals, district nurses), the patient could manage. Alternatively, the GP may indicate that the Colles' fracture merely represents the final event in an increasingly fragile home situation and that the patient will require hospital admission, at least in the short term.

For the same reasons, a GP who refers a patient to the ED and indicates that the patient requires admission does so in the full knowledge of that patient's circumstances. Always contact the GP if it is contemplated that such a patient is to be discharged—preferably after senior medical consultation.

Finally, remember that GPs are also under considerable pressure. Some situations may appear to reflect the fact that a patient has been referred inappropriately or the patient may report that they have tried to contact their GP unsuccessfully. Rather than irately ringing the practice and antagonizing them, inform the ED consultant who can consider this constructively and appropriately in a suitable environment.

Telephone advice

Advice for the public

Members of the public often try to call their local ED in an attempt to request medical advice. Most departments have a system in place whereby such requests are automatically redirected to telephone and/or Internet sources of help, including NHS 111 in England, NHS 24 in Scotland, or NHS Direct in Wales.

Not infrequently, patients who have been recently discharged (or their relatives) will call the department for advice on how to manage further symptoms, medication, or other treatment. Most EDs will consider these as their responsibility and will try to help the caller. Approach these calls in exactly the same way as a face-to-face consultation. Before giving any information over the phone, first establish who is calling and that the patient has given consent to discuss his/her medical details.

There is usually a book to record this information in. Formally document details of the call, including:

- The date and time of the call.
- The caller's telephone number.
- The caller's relationship to the patient.
- The patient's name, age, and sex.
- The nature of the problem.
- The advice given.

Telephone advice calls from other health professionals

Other health professionals (eg paramedics and GPs) often telephone requesting advice regarding the management of patients in their care. Ensure that this advice is given by experienced ED staff and that the details are recorded in the appropriate book.

Telemedicine

Increasingly, emergency health care is provided by integrated networks, which include EDs, minor injuries units, radiology departments, and GP surgeries connected by telemedicine links. This has advantages in remote or rural settings, enabling a wide range of injuries and other emergencies to be diagnosed and treated locally.

The combination of video and teleradiology may allow a decision to be made and explained directly to the patient. A typical example is whether a patient with an isolated Colles' fracture needs to have a manipulation of the fracture. Expertise is required to undertake telemedicine consultations safely. Ensure that this specialist advice is given by senior/experienced ED staff and that it is carefully documented.

Liaising with the ambulance crew

Paramedics and ED staff have a close professional relationship. Paramedics and ambulance staff are professionals who work in conditions that are often difficult and sometimes dangerous. It is worth taking an off-duty day to accompany a crew during their shift to see the problems they face.

In the UK, a patient brought to the ED by ambulance will routinely have a patient report form (PRF) (see Fig. 1.1). This is usually completed by the crew at the scene and in transit, and printed on arrival at hospital. The information on these forms can be invaluable. In particular, the time intervals between the receipt of the 999 call and arrival at the scene and at hospital provide a time framework within which changes in the patient's clinical condition can be placed and interpreted.

The initial at-scene assessment will include details of the use of seat belts, airbags, crash helmets, etc., and is particularly valuable when amplified by specifically asking the crew about their interpretation of the event, likely speeds involved, types of vehicle, etc.

The clinical features of the Glasgow Coma Score (GCS), pulse rate, blood pressure (BP), and respiratory rate (RR) form baseline values from which trends and response to treatment can be judged. Useful aspects in the history/comments section include previous complaints, current medications, etc., which the crew may have obtained from the patient, relatives, or friends. The PRF will also contain important information about oxygen (O_2), drugs, and/or intravenous (IV) fluids administered, and the response to these interventions. Before the crew leave the department, confirm that they have provided all relevant information.

Do not be judgemental about the crew's performance. Remember the constraints under which they operate. Without the benefits of a warm environment, good lighting, and sophisticated equipment, it can be exceedingly difficult to make accurate assessments of illness or injury severity, or to perform otherwise simple tasks (eg airway management and IV cannulation).

Do not dismiss the overall assessment of a patient made by an experienced crew. Whilst the ultimate diagnosis may not be clear, their evaluation of the potential for life-threatening events is often extremely perceptive. Equally, take heed of their description (and photographs) of crash scenes. They will have seen far more than most ED staff, so accept their greater experience.

Most ambulance staff are keen to obtain feedback, both about specific cases and general aspects of medical care. Like everyone, they are interested in their patients. A few words as to what happened to 'Mrs Smith who was brought in last week' and her subsequent clinical course are a friendly and easy way of providing informal feedback and help to cement the professional relationship between the ambulance service and the ED.

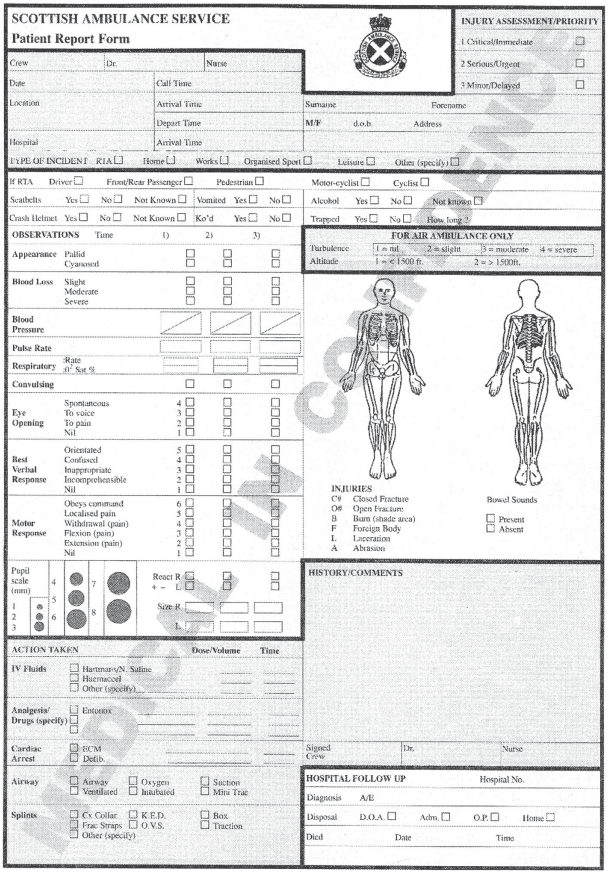

SCOTTISH AMBULANCE SERVICE
Patient Report Form
INJURY ASSESSMENT/PRIORITY
1 Critical/Immediate
2 Serious/Urgent
3 Minor/Delayed
Crew
Dr.
Nurse
Date
Call Time
Location
Arrival Time
Depart Time
Hospital
Arrival Time
Surname
Forename
M/F
d.o.b.
Address
TYPE OF INCIDENT RTA Home Works Organised Sport Leisure Other (specify)
If RTA Driver Front/Rear Passenger Pedestrian
Motor-cyclist Cyclist
Seatbelts Yes No Not Known
Vomited Yes No
Alcohol Yes No Not known
Crash Helmet Yes No Not Known
Ko'd Yes No
Trapped Yes No How long ?
OBSERVATIONS Time 1) 2) 3)
FOR AIR AMBULANCE ONLY
Turbulence 1 = nil 2 = slight 3 = moderate 4 = severe
Altitude 1 = < 1500 ft. 2 = > 1500ft.
Appearance Pallid Cyanosed
Blood Loss Slight Moderate Severe
Blood Pressure
Pulse Rate
Respiratory Rate O^2 Sat %
Convulsing
Eye Opening Spontaneous 4 To voice 3 To pain 2 Nil 1
Best Verbal Response Orientated 5 Confused 4 Inappropriate 3 Incomprehensible 2 Nil 1
Motor Response Obeys command 6 Localised pain 5 Withdrawal (pain) 4 Flexion (pain) 3 Extension (pain) 2 Nil 1
INJURIES
C# Closed Fracture
O# Open Fracture
B Burn (shade area)
F Foreign Body
L Laceration
A Abrasion
Bowel Sounds
Present
Absent
Pupil scale (mm) 1 2 3 4 5 6 7 8
React R + − L
Size R
L
HISTORY/COMMENTS
ACTION TAKEN
Dose/Volume
Time
IV Fluids Hartmann's/N. Saline Haemaccel Other (specify)
Analgesia/ Drugs (specify) Entonox
Cardiac Arrest ECM Defib.
Airway Airway Ventilated Oxygen Intubated Suction Mini Trac
Splints Cx. Collar K.E.D. Box Frac Straps O.V.S. Traction Other (specify)
Signed Crew
Dr.
Nurse
HOSPITAL FOLLOW UP
Hospital No.
Diagnosis A/E
Disposal D.O.A. Adm. O.P. Home
Died Date Time

Fig. 1.1 An example of a patient reporting form.
Reproduced with kind permission from the Scottish Ambulance Service.

Coping as a junior doctor in the ED

Although many junior doctors coming to the ED have completed >12 months of work since qualification, the prospect of working at the 'sharp end' can be accompanied by trepidation. As with many potentially worrying situations in life, the reality is not as terrifying as its anticipation. The number of hours worked may not appear long in comparison with other posts, but do not assume that this makes an ED job 'easy'. Being on duty inevitably involves much time standing, walking, working, thinking, and making decisions. It is unusual to come off-shift without feeling physically tired.

Active young doctors can usually cope with these physical demands, but a demanding professional life and a demanding social life are rarely compatible. Make the most of time off and try to relax from the pressures of the job. However, do not think it is possible to stay out all night and then work unimpaired the next day. Tired doctors make mistakes. They also tend to have less patience and, as a consequence, interpersonal conflicts are more likely.

A greater problem is the mental aspect of the job. Doctors often find that the ED is the first time in their careers when they have to make unequivocal decisions based on their own assessment and investigations. This is one of the great challenges and excitements of emergency medicine. It is also a worry. Decision-making is central to ED practice and, with experience, the process becomes easier. Developing a structured approach can pre-empt many problems and simplify your life. After taking an appropriate history and completing the relevant clinical examination of a patient, consider the following:

- What is likely to be wrong with this patient?
- What investigations are required to confirm the diagnosis?
- What treatment is needed and is the expertise available?
- Does this patient require referral to an inpatient team (see ➔ Discharge, referral, and handover, pp. 10–11)?
- If not, do they need to be reviewed in the ED or in another specialist clinic?

The wide spectrum of problems with which ED patients can present means that no individual can be expert in every possible condition. Recognize and accept when you are out of your depth. Seek help appropriately and do not just try to muddle through. Help may be readily available from senior ED staff, but in some departments, direct contact with a specialist team may be required.

One of the most difficult situations is where a specialist either refuses to come to see the patient or gives telephone advice that is clearly inappropriate. Always act as the patient's advocate. If, having referred a patient with a fractured neck of femur, the telephone message from the inpatient team is 'bring him back to the fracture clinic in 1 week', it is clearly wrong to carry this out. First, check that the doctor has understood the details of the patient's condition and the diagnosis. More conflict and aggravation are caused by communication errors (usually involving second-hand telephone messages) than by anything else. If the situation remains unresolved, consult senior ED staff. Whatever happens, remain cool in public and always put the patient's interests first.

Learning in the ED

Try to learn something new every day. Keep a note of patients with interesting or unusual problems, and later check what happened to them. Ask senior staff for advice. Use ED reference books. Try to note all new conditions seen during a shift and read about them later.

Staff interaction

The nature of the job, the patients, and the diversity of staff involved means that a considerable degree of camaraderie exists. For an outsider, this can initially be daunting. Junior medical staff are likely to work for 4–12 months in the department. Other staff may have spent a lifetime there, with long-established friendships (or sometimes animosities). Respect their position and experience, and learn from them.

The role of one individual and that of other individuals in the department are inextricably linked. Anyone who feels they are the most important individual in their working environment will have an extremely uncomfortable professional existence. In the ED, every member of staff has an important role to play.

Never consider any job 'beneath you' or someone else's responsibility. Patients come before pride. So if portering staff are rushed off their feet and you are unoccupied, wheel a patient to X-ray yourself—it will improve your standing with your colleagues and help the patient.

Shifts

Rule 1

Never be late for your shift.

Rule 2

If, for whatever reason, you are unable to work a shift, let the senior staff in the ED know as soon as possible.

Ensure that you take a break. Two or three short breaks in an 8-hr shift are better than one long one. Remember to eat and maintain your fluid intake. Shift working may mean that you will work sometimes with familiar faces and perhaps occasionally with individuals with whom you find social contact uncomfortable. Put these considerations aside whilst you are at work, for the sake of the patients and your peace of mind.

If you can't cope

Finally, if you feel that you are unable to manage or that the pressure of the job is too great—*tell someone*. Do not bottle it up, try to ignore it, or assume that it reflects inadequacy. It does not. Everyone, at some time, has feelings of inability to cope. Trying to disguise or deny the situation is unfair to yourself, your colleagues, and your patients. You need to tell someone and discuss things. Do it now. Talk to your consultant. If you cannot face him or her, talk to your GP or another senior member of staff—but talk to someone who can help you.

The *BMA Counselling Service for Doctors* (tel: 0330 123 1245) provides a confidential counselling service 24hr a day, 365 days of the year, to discuss personal, emotional, and work-related problems. The Doctors' Support Network (℔ http://www.dsn.org.uk) is a useful resource providing peer support for doctors and medical students with mental health concerns.

Inappropriate attenders

This is an emotive and ill-defined term. Depending upon the department, such patients could comprise 4–20% of attendances.

The perception as to whether it is appropriate to go to an ED or attend a GP will vary between the patient, GP, and ED staff. Appropriateness is not simply related to the symptoms, diagnosis, or the time interval involved. It may not necessarily be related to the need for investigation. For example, not all patients who require an X-ray necessarily have to attend an ED.

Further blurring of 'appropriate' and 'inappropriate' groups relates to the geographical location of the ED. In some rural areas, GPs sometimes perform procedures such as suturing. In urban areas, these arrangements are less common. For ill-defined reasons, patients often perceive that they should only contact their GP during 'office' hours, and outside these times they may attend an ED with primary care complaints.

It is clearly inappropriate to come to an ED simply because of real or perceived difficulty in accessing primary care. Nevertheless, the term 'inappropriate attendance' is a pejorative one—it is better to use the phrase 'primary care patients'. It must be recognized that primary care problems are best dealt with by GPs. In the past, many departments have tried to prevent this primary care workload presenting to the ED. Most departments now tackle the problem by having GPs working alongside ED staff, either within the department or in an adjacent unit.

Managing inappropriate attenders

Only through a continual process of patient education will these problems be resolved. Initiatives include nurse practitioner minor injuries units and hospital-based primary care services. Evaluations are under way, but to function effectively, such services require adequate funding and staffing.

It can sometimes be difficult to deal with primary care problems in the ED. After an appropriate history and examination, it may be necessary to explain to patients that they will have to attend their own GP. This may need direct contact between the ED and the practice to facilitate this.

Inappropriate referrals

Sometimes, it may appear that another health professional (eg GP, emergency nurse practitioner, member of staff at NHS 111) has referred a patient to the ED inappropriately. Avoid making such judgements. Treat patients on their merits, but mention the issue to your consultant. Remember that the information available to the referring clinician at the time of the prehospital consultation is likely to have been different to that available at the time of ED attendance.

The patient with a label

Some patients are referred by a medical practitioner with an accompanying letter which includes a presumptive diagnosis. The details in the letter are often extremely helpful, but do not assume the diagnosis is correct! Take particular care with patients who re-attend following an earlier attendance. The situation may have changed. Clinical signs may have developed or regressed. The patient may have not given the referring doctor and ED staff the same history. Do not pre-judge the problem—start with an open mind.

Self-labelled patients

Take care with patients who label themselves. Those with chronic or unusual diseases often know significantly more about their conditions than ED staff! In such situations, take special notice of comments and advice from the patient and/or their relatives. Do not resent this or see it as a professional affront—rapport with the patient will increase markedly and management will usually be easier.

Regular attenders

Every ED has a group of 'regular' patients who, with time, become physically, and sometimes emotionally, attached to the department. Some have underlying psychiatric illnesses, often with personality disorders. Some are homeless. Regular attenders frequently use the ED as a source of primary care. As outlined previously, make attempts to direct them to appropriate facilities, because the ED is unsuited to the management of chronic illness and is unable to provide the continuing medical and nursing support that these patients require.

Repeated presentations with apparently trivial complaints or with the same complaint often tax the patience of ED staff. This is heightened if the presentations are provoked or aggravated by alcohol intake. Remember, however, that these patients can and do suffer from the same acute events as everyone else. Keep an open mind, diagnostically and in attitude to the patient. Just because he/she has returned for the third time in as many days, complaining of chest pain, does not mean that, on this occasion, he does not have an acute MI! Maintain adequate documentation for each attendance. Sometimes, with intractable re-attenders, a multidisciplinary meeting can provide a plan of action for both the patient and the medical services, which can help to shape care in the ED (and, importantly, identify those investigations and treatments that are unlikely to help).

Medically unexplained symptoms

A significant proportion of regular attenders present with ongoing problems relating to medically unexplained symptoms which have often been extensively investigated. These patients can be very difficult to manage, made more tricky by the fact that a small proportion will have an underlying treatable condition. Information from previous attendances can be extremely helpful in preventing unnecessary investigations. Acknowledge to the patient that the symptoms are real, and involve a senior ED clinician. Very often, the best approach is to focus on managing the symptoms, rather than making a new diagnosis.

The difficult patient

General approach

Accept the patient as he or she is, regardless of behaviour, class, religion, social lifestyle, or ethnicity. Given human nature, there will inevitably be some patients whom you immediately dislike or find difficult. The feeling is often mutual. Many factors that cause patients to present to the ED may aggravate the situation. These include their current medical condition, their past experiences in hospitals, their social situation, and any concurrent use of alcohol and/or other drugs. Your approach and state of mind during the consultation play a major role. This will be influenced by whether the department is busy, how much sleep you have had recently, and when you last had a break for coffee or food.

Given the nature of ED workload and turnover, conflict slows down the process and makes it more likely that you will make clinical errors. Many potential conflicts can be avoided by an open, pleasant approach. Introduce yourself politely to the patient. Use body language to reduce a potentially aggressive response.

Put yourself in the patient's position. Any patient marched up to by a doctor who has their hands on their hips, a glaring expression, and the demand 'Well, what's wrong with you now?' will retort aggressively.

Defusing a volatile situation

Most complaints and acts of aggression occur when the department is busy and waiting times are long. Patients understand the pressures under which medical and nursing staff have to work, and a simple 'I am sorry you have had to wait so long, but we have had a number of emergencies elsewhere in the department' does much to diffuse potential conflict, and will often mean that the patient starts to sympathize with you as a young, overworked practitioner!

There is never any excuse for rude, abusive, or aggressive behaviour to a patient. If you are rude, complaints will invariably follow and, more importantly, the patient will not have received the appropriate treatment for their condition. It may be necessary to hand care of a patient to a colleague if an unresolvable conflict has arisen.

Management of the violent patient is considered in detail in ➲ Managing aggression, p. 626.

Patients in police custody

Patients who are brought to the ED whilst in police custody can be very challenging to manage. Follow the 2016 RCEM guideline (*Emergency Department Patients in Police Custody*)—the key points of which are:

- Patients in custody are entitled to the same care as other patients.
- Treat patients in custody as a priority within their triage category.
- Liaise with the health care practitioner (nurse/doctor) at the police station if discharging the patient from the ED to a police station. Provide clear instructions and advice about continuing care to the health care practitioner and/or police personnel responsible for the patient.
- ED staff have a purely therapeutic role and should not act as surrogate forensic medical examiners (who also have a forensic role).

Special patient groups

Attending the ED is difficult enough but can be even more so for certain patient groups. It is important that ED staff are sensitive to the needs of these groups and that there are systems in place to help them in what may be regarded as an intimidating atmosphere. The following list is far from exhaustive but includes some important groups who require particular consideration:

- *Children*: they are such an 'obvious' and large 'minority' group that they receive special attention to suit their particular needs (see ➔ Chapter 15).
- *Pregnant women* (see ➔ Chapter 13).
- *Those with mental health problems* (see ➔ Chapter 14).
- *The elderly*: who often have multiple medical problems and live in socially precarious circumstances.
- Patients with Alzheimer's disease and other states associated with chronic confusion.
- *Those with learning difficulties* (see ➔ The patient with learning difficulties, p. 24).
- Patients with hearing problems.
- The visually impaired.
- *Those who do not speak or understand English*: arrangements should be in place to enable the use of interpreters.
- *Patients with certain cultural or religious beliefs (particularly amongst 'minority groups')*: these can impact significantly upon a variety of situations (eg after unsuccessful resuscitation for cardiac arrest—see ➔ Breaking bad news, pp. 26–7).
- Those who are homeless or away from home, friends, and family (eg holiday makers).
- Those who have drug/alcohol dependency.

Isn't everyone special?

Taken at face value, the concept that certain groups of patients are 'special', and so require special attention, does not meet with universal approval. There is a good argument that every patient deserves the best possible care. Whilst this is true, it is also obvious that certain patients do have additional needs that need to be considered. Many of these additional needs relate to effective communication. There are some tremendous resources available that can help practitioners to overcome communication difficulties (eg 🔗 http://www.communicationpeople.co.uk).

Assessing the elderly patient

Frailty

Although a large proportion of elderly patients attending the ED with serious illness are very frail, most elderly people in the general population are actually not frail. The degree of frailty of an elderly individual is a good predictor of their life expectancy. Early assessment of frailty can assist with the planning of patient management in ED and beyond. There are a number of different scoring systems in current use—an example is shown in Table 1.2.

Table 1.2 Rockwood Clinical Frailty Scale

Score	Label	Descriptor
1	Very fit	Robust, fit, and very active
2	Well	No active illness, exercises occasionally
3	Managing well	Medical problems well controlled
4	Vulnerable	Symptoms limit activities
5	Mildly frail	Requires help for activities of daily living
6	Moderately frail	Needs help in the home and with bathing
7	Severely frail	Completely dependent for personal care
8	Very severely frail	Could not recover from minor illness
9	Terminally ill	Life expectancy <6 months

Frailty syndromes

Elderly frail patients may present in a number of ways, some of which are relatively non-specific but warrant careful assessment: falls, immobility, delirium, incontinence, and medication issues.

Risk indicators

Multiple pathologies and atypical symptoms render the elderly more vulnerable to the physical, functional, and social effects of acute illness. Past medical history and pre-admission status are especially important determinants for patients with dementia or psychiatric illness. Check for recently changed circumstances, recent bereavement, a change in medical or physical condition, ↑ confusion, or unusual behaviour. The patient may not be able to afford adequate food or heating. Community services may not be aware that support is needed, or help may have been offered but refused.

Other important indicators are: living alone, absence of close family support or community services, unsuitable home circumstances (eg external or internal stairs), and difficulty with mobility.

Cognitive impairment

Perform an Abbreviated Mini-Mental Test or a Mini-Mental State Examination on every patient aged >75y.

Discharging the elderly patient

There are no set predisposing factors that determine which patients are most at risk following discharge. Those that affect the chance of difficulties at home include the current medical problem and the underlying functional and social factors.

Determining those unable to cope

Look for evidence of self-neglect that suggests that the elderly person is having difficulty coping at home (eg poor personal hygiene, unclean or unsuitable clothing). Evidence of recent weight loss may suggest difficulties with food preparation or eating or unavailability of food, or it may be due to serious pathology such as malignancy or tuberculosis. Signs of old bruising or other minor injuries may be consistent with frequent falls. Shortness of breath and any condition producing impaired mobility are important factors.

Falls

These are a very common problem of old age—analyse what happened carefully. Avoid using the term 'mechanical fall', which does not really provide an explanation of what happened. Correctable factors include damaged walking aids, loose rugs, poor lighting, unsuitable footwear or glasses. Common medical causes include cerebrovascular disease, arthritis, and side effects of drugs.

Many elderly people claim that they can cope at home when they are unable to do so. If in doubt, ask relatives, the GP, and community support agencies. They may give helpful insight into the patient's mental state, which can be assessed further, whether it be a cognitive or a reactive condition.

Admission to a specialist unit

If hospital admission is required, consider where the patient's overall needs would be best met. Specialty older persons or frailty units may be best placed to perform a full assessment.

The decision to discharge

Hospital admission for an elderly person is a frightening experience and can lead to confusion and disorientation. If circumstances allow, aim to discharge the patient home. If there are concerns regarding the patient's functional ability and/or mobility, ask for an *occupational therapy* and/or *physiotherapy* assessment. On some occasions, it may be necessary to admit the patient for a short time (eg to a clinical decision unit) to complete this assessment. On other occasions, it may be possible to arrange a home assessment.

The elderly person is best seen in their home environment with familiar surroundings, especially if there is evidence of cognitive deficit. The provision of equipment and recommendations for adaptations can be made at this point, if required. A wide range of community services, including district nurse, health visitor, home help, crisis care, social work, hospital discharge, and rapid response therapy teams, can be contacted to provide immediate follow-up and support. These play a crucial role in preventing later breakdowns in home circumstances and unnecessary admissions for social reasons.

The patient with learning difficulties

Patients with learning difficulties use the health care system more than the general population. Unfortunately, many health care professionals have little experience with these patients. However, understanding common illness patterns and using different techniques in communication can result in a successful consultation. Patients with learning difficulties often have complex health needs. There are many barriers to assessing health care, which may lead to later presentations of illness. Patients may have a high tolerance of pain—take this into consideration when examining them.

Associated health problems

Patients with learning difficulties have a higher incidence of certain problems:

- Visual and hearing impairment.
- Poor dental health.
- Swallowing problems.
- Gastro-oesophageal reflux disease.
- Constipation.
- Urinary tract and other infections.
- Epilepsy.
- Mental health problems (↑ incidence of depression, anxiety disorders, schizophrenia, delirium, and dementia), with specific syndromes having their own particular associations (eg Down's syndrome is associated with depression and dementia; Prader–Willi with affective psychosis).
- Behavioural problems (eg Prader–Willi, Angelman syndrome).

Leading causes of death

These include pneumonia (relating to reflux, aspiration, swallowing, and feeding problems) and congenital heart disease.

The patient's perspective

Past experiences of hospital are likely to have a significant impact on the patient's reaction to his/her current situation. Most patients have problems with expression, comprehension, and social communication. They may find it difficult to describe symptoms—behavioural change may be the best indication that something is wrong.

Tips for communication

- Explain the consultation process before starting.
- Speak first to the patient, then to the carer.
- Use open questions, then re-phrase to check again.
- Aim to use language that the patient understands, modifying this according to comprehension.
- Patients may have difficulties with time, so try to relate symptoms to real-life temporal events (eg 'did the pain start before lunch?').
- They may not make a connection between something that they have done and feeling ill (eg several questions may be required in order to establish that they have ingested something).
- Take particular note of what the carer has to say—information from someone who knows the patient well is invaluable.

End of life care

Background

It was once unusual for patients to present to the ED requiring end of life care, but it is now relatively common, perhaps a reflection of the way that the work has evolved in recent years. Consider possible end of life care issues in any sick or frail patient who presents to the ED. Involve the patient and their family when making any decisions about end of life care.

Many patients have plans in place which cover their wishes regarding their end of life care—try to establish the nature of these plans through discussion with the patient, their family, carers, and paramedics and by checking electronic medical records. Frustratingly, sometimes patients who have clearly documented wishes of not to be brought to hospital in the event of a deterioration are still brought to the ED. On occasions, it can be appropriate to discharge a patient in the expectation that they will die in the community, rather than in hospital.

Decisions about CPR

A key decision which needs to be made about sick patients who are brought to the ED is whether or not to start resuscitation in the event of a cardiac arrest. On some occasions, there is insufficient information available to make a considered decision—in an emergency, start CPR as the default position.

Try to make a considered decision about whether or not to start CPR, including discussion with a senior doctor, the patient, and their family, whenever possible, and document this on an appropriate form. In many hospitals, previously used 'Do Not Attempt CPR' (DNACPR) and 'Allow Natural Death Order' (ANDO) have been replaced with 'Treatment Escalation Plans' (TEPs) or the equivalent.

Treatment Escalation Plans

DNACPR orders have been criticized as focussing simply on one aspect of end of life care and have sometimes been misinterpreted by patients and their families. TEPs are personalized to the patient and include considerations about whether or not it is appropriate to start CPR, but also include a number of wider issues (eg whether to treat in ICU/high dependency unit (HDU) and/or use non-invasive ventilation (NIV)). Such plans may reassure patients that, irrespective of a decision about CPR, they will still be treated actively (eg IV fluids, antibiotics, and analgesia) and may enable staff to set an agreed 'ceiling of care'. See the ReSPECT website (🔗 http://www.respectprocess.org.uk) which outlines the process for making a Recommended Summary Plan for Emergency Care and Treatment and has some useful resources.

Other considerations

See RCEM recommendations (2015) for adult patients receiving end of life care in the ED. Focus upon symptom control and, in particular, provide analgesia, hydration, and personal care, as required. Consider opportunities for organ and tissue donation, as appropriate.

Breaking bad news

A proportion of patients presenting to the ED have life-threatening conditions and some will die in the department. Often, the event will be sudden and unexpected by family and friends. It may already involve other family members (eg in the context of a road traffic collision). In contrast to hospital inpatients or those in general practice, an opportunity to forewarn relatives as to what has happened or the eventual outcome is unlikely. The relatives may already be distressed after witnessing the incident or collapse and may have been directly involved in providing first aid.

It is inappropriate for junior hospital staff without suitable experience to speak with distressed or bereaved relatives. The task must be undertaken by someone with sufficient seniority and authority, who also has the skills of communication and empathy. The most important component is time.

Reception

Relatives usually arrive separately and after the patient. Anticipate this by designating a member of staff to meet them and show them to a relatives' room, which should afford privacy, comfortable seating, an outside telephone line, tea, coffee, and toilet facilities. Paper tissues, some magazines, and toys for small children are useful.

Whilst the relatives are waiting, a designated nurse should stay with them to act as a link with the department and the team caring for the patient. This nurse can pre-warn relatives of the life-threatening nature of the patient's condition and assist in building (an albeit short) relationship between staff and relatives. The link nurse should also check that important details have been recorded correctly, eg the patient's name, address, date of birth, religion (in case last rites are required), next of kin (name, relationship to patient, address, and phone number), and the patient's GP. This information should be collected as soon as possible, since later the relatives may be too upset to remember all these details or it may be difficult to ask for them.

Breaking the news

Irrespective of who performs this task, remember a number of points. If you are the person who informs the relatives, ensure the link nurse is with you. After leaving the resuscitation room or clinical area, allow a minute or two of preparation to make yourself presentable, checking clothing for bloodstains, etc. Confirm that you know the patient's name. Enter the room, introduce yourself, and sit or kneel by the relatives so that you are at their physical level. Ensure that you speak with the correct relatives and identify who is who. Speak slowly and keep your sentences short and non-technical. Do not hedge around the subject. In their emotional turmoil, relatives very often misconstrue information. Therefore, you may need to re-emphasize the important aspects.

For many critically ill patients, their ultimate prognosis cannot be determined in the ED. In these situations, do not raise unrealistic expectations or false hopes, but be honest and direct with the relatives and the patients.

If the patient has died, then use the words 'death' or 'dead'. Do not use euphemisms such as 'passed away' or 'gone to a better place'.

After giving the news, allow the relatives a few minutes to collect their thoughts and ask questions. In some cases, these may be unanswerable. It is better to say 'We don't yet know', rather than confuse or give platitudinous answers.

Common responses to bad news or bereavement include emotional distress, denial, guilt, and aggression. The feelings of guilt and anger can be particularly difficult to come to terms with, and relatives may torture themselves with the idea that if only their actions had been different, the situation would never have arisen or the clinical outcome would have been different.

Relatives seeing patients

Many relatives wish to see or touch their loved ones, however briefly. Television and cinema have prepared much of the population for the sights and sounds in the ED. In some departments, relatives are encouraged to be present in the resuscitation room. In selected situations, this stratagem has benefits. If the relatives are present during resuscitation, ensure that the link nurse is present with the relatives to provide support, explain what is happening, and accompany them if they wish to leave.

More frequently, the relatives can see the patient in the resuscitation room briefly or whilst they are leaving the ED (eg to go to the CT scan room or theatre). Even a few seconds, a few words, and a cuddle can be immensely rewarding for both the relative and the patient. The link nurse can give guidance beforehand as to the presence of injuries (especially those involving the face), monitors, drips, and equipment to diminish any threatening impact that these may have.

When death occurs

Even before death has occurred, involvement of religious leaders can be valuable. As early as possible, inform the hospital chaplain, who can provide help to relatives and staff.

When a patient has died, offer the relatives the opportunity to see the body. This contact, which should be in a private quiet room, can greatly assist in the grieving process. With careful preparation, most patients who have died from multiple injuries can be seen by relatives in this fashion.

Remember that followers of some faiths, such as Muslims and Hindus, have important procedures and rituals to be followed after death, although these may not always be feasible after a sudden death, especially from trauma. In such situations, discuss the matter with the Coroner's or Procurator Fiscal's officer, and obtain help from an appropriate religious leader to look after the bereaved relatives.

What to do after a death

Who to contact

Any suspicious death must be immediately reported to the police who will liaise directly with the Coroner or Procurator Fiscal (in Scotland).

Following all deaths in the ED, a number of important contacts must be made as soon as possible:

- *Informing the next of kin*: if the relatives are not already present in the ED, it may be necessary to ask the police for assistance.
- Notifying the Coroner (Procurator Fiscal in Scotland).
- Informing the patient's GP.
- Cancelling hospital outpatient appointments.
- Informing social work and health visitor teams, as appropriate.

Ensure relatives of the deceased are given information about the process for death certification and registration, and how to organize funeral arrangements. Most EDs have useful leaflets that cover these matters and can answer many questions. Some departments have formal arrangements for counselling after bereavement. Often the GP is the best individual to coordinate bereavement care, but in any event, give the relatives a telephone number for the ED, so they can speak to a senior nurse or doctor if they need further information or help.

Information for the Coroner or Procurator Fiscal

Report sudden deaths as soon as possible to the Coroner (in Scotland, the Procurator Fiscal). It is helpful to give the following information if it is available:

- Patient's name, address, and date of birth.
- Next of kin (name, relationship, address, phone number).
- Patient's GP.
- Date and time of patient's arrival in the ED.
- Date and time of patient's death.
- Name and job title of doctor who pronounced death.
- Details of the incident, injuries, or illness.
- Relevant past medical history.
- When the patient last saw a doctor (the Coroner may be happy for a GP or a hospital doctor to write the death certificate if they saw the patient recently for the condition that caused the death, eg a patient with known terminal cancer).
- *The patient's religion*: some faiths may wish to arrange burial before the next sunset, but this may not be feasible after a sudden death.
- Anything else that is important, eg difficulties in communication with the next of kin due to language or deafness.

Looking after the staff

The death of a patient or the management of patients with critical illness inevitably affects ED staff. This is particularly so when some aspect of the event reminds staff of their own situation or relatives. These episodes often occur at the busiest times and when everyone in the ED is working under pressure.

One of the most difficult situations is to have to inform parents of the death of their child and help them in the initial grieving process, and then return to the busy department where many people are waiting with increasingly strident demands. It would be easy to respond that such individuals, with injuries or illnesses that are minor or have been present for days or weeks, are time-wasting. However, this approach will lead to conflict and is unfair to all concerned. Take 5–10min for a break in the staff room before returning to the fray. Remember that, in these circumstances, you too are a patient. Even senior and experienced staff may be distressed after difficult resuscitation situations and may require support—an informal or formal debrief can be very helpful.

Organ donation

There is considerable potential to assist with the process of organ/tissue donation in the ED. However, the possibility of organ donation is sadly often overlooked in the ED. Many patients who die after an unexpected cardiac arrest are potential donors of corneal tissue and heart valves. Kidneys may also be retrieved from some patients who have died in the ED, if a protocol for this has been arranged with the transplant team and the local Coroner or Procurator Fiscal. Many other patients who are moribund, intubated, and ventilated (eg following massive subarachnoid haemorrhage) may be identified as potential donors of other tissues also. Consider the possibility of organ donation in patients who die in the ED or who are moribund with no hope of survival.

Most hospitals have specialist organ donation nurses (previously known as 'donor transplant co-ordinators') who will educate, advise, and assist with the process of organ donation. Useful information about organ/tissue transplantation is available on the website of the British Transplantation Society (http://www.bts.org.uk).

Patient transfer

The need to transfer

When patients have problems that exceed the capabilities of a hospital and/or its personnel, transfer to another hospital may be needed.

Timing the transfer

Do not commence any transfer until life-threatening problems have been identified and managed and a secondary survey has been completed. Once the decision to transfer has been made, do not waste time performing non-essential diagnostic procedures that do not change the immediate plan of care. First, secure the airway (with tracheal intubation, if necessary). Ensure that patients with pneumothoraces have intercostal drains inserted prior to transfer where necessary. This is particularly important before sending a patient by helicopter or fixed wing transfer. Consider the need to insert a urinary catheter and a gastric tube.

Arranging the transfer

Speak directly to the doctor at the receiving hospital. Provide the following details by telephone or electronic link:

- Details of the patient (full name, age, and date of birth).
- A brief history of the onset of symptoms/injury.
- The prehospital findings and treatment.
- The initial findings, diagnosis, and treatment in the ED and the response to treatment.

Write down the name of the doctor responsible for the initial reception of the patient after transfer. Establish precisely where, within the receiving hospital, the patient is to be taken. Where possible, prepare the receiving unit by sending details ahead by email. Preprinted forms can help in structuring the relevant details and avoiding omissions.

Preparing for transfer

Transfer team

If the patient to be transferred may require advanced airway care, ensure they are accompanied by a doctor who can provide this. Accompanying staff should be trained in resuscitation, with a good knowledge of the equipment used during transfer. Note that, in some instances, the transfer team is a retrieval team based in the regional centre.

Equipment

'Transfer cases' containing a standardized list of equipment must be immediately available and regularly checked. Take all the emergency equipment and drugs that might prove necessary to maintain the 'Airway, Breathing, and Circulation' (ABC) during transfer. In particular, take at least twice the amount of O_2 estimated to be necessary (a standard 'F' cylinder contains 1360L of O_2 and will therefore last <3hr running at 10L/min). Before leaving, ensure that the patient and stretcher are well secured within the ambulance. Send all cross-matched blood (in a suitably insulated container) with the patient.

Monitoring during transfer

Minimum monitoring during transfer includes ECG monitoring, pulse oximetry, and non-invasive BP measurement. If the patient is intubated and ventilated, end-tidal carbon dioxide (CO_2) monitoring is mandatory. An intra-arterial line may be recommended to monitor BP during the journey. Make allowances for limited battery life on long transfers—spare batteries may be needed. Plug monitors and other equipment into the mains supply, whenever possible.

Accompanying documentation

Include the following:

- *Patient details*: name, date of birth, address, next of kin, telephone numbers, hospital number, and GP.
- History, examination findings, and results of investigations (including imaging).
- Type and volume of all fluids infused (including prehospital).
- Management, including drugs given (type, route, and time of administration) and practical procedures performed.
- Response to treatment, including serial measurements of vital signs.
- Names of referring and receiving doctors, and their hospitals and telephone numbers.

Some departments use standard forms to ensure that important information is complete.

The relatives

Keep the patient's relatives informed throughout. Explain where and why the patient is going. Document what they have been told. Arrange transport for relatives to the receiving hospital.

Before leaving

Prior to transfer, re-examine the patient. Check that the airway is protected, ventilation is satisfactory, chest drains are working, IV cannulae are patent and well secured, and the spine is appropriately immobilized, with pressure areas protected. Ensure that the patient is well covered to prevent heat loss. Inform the receiving hospital when the patient has left, and give an estimated time of arrival.

After leaving

Communicate to the receiving hospital the results of any investigations that become available after the patient has left. Contact the receiving doctor afterwards to confirm that the transfer was completed satisfactorily and to obtain feedback.

Intra-hospital transfers

In many respects, the only difference between intra- and inter-hospital transfers is the distance. The principles involved in organizing a transfer are the same, whether the patient is to be conveyed to the CT scanner down the corridor or to the regional neurosurgical unit miles away.

Medicolegal aspects: avoiding trouble

Medicolegal problems are relatively common in the ED. Many of these problems may be avoided by adopting the correct approach.

Attitude

Be polite and open with patients. Try to establish a good rapport. Be as honest as possible in explaining delays/errors.

Consent

(See General Medical Council guidance, available at: https://www.gmc-uk.org)

Use the consent form liberally for anything that is complex or risky or involves sedation or general anaesthesia (GA). Ensure that the patient understands what is involved in the procedure, together with the potential benefits and risks. Whenever possible, attempt to obtain consent from the parent/guardian in minors, but do not delay life-saving treatment in order to obtain consent.

Documentation

(See ➲ Note keeping, pp. 6–7.)

Good notes imply good practice. Keep careful notes, using simple, clear, unambiguous language. Write your name legibly, and document the time that you saw the patient. Remember that successful defence of a medical negligence claim may depend upon accurate, legible, comprehensive, contemporaneous notes. Try to avoid abbreviations, particularly where there is room for confusion. In particular, name the digits of the hand (thumb, index, middle, ring, and little fingers), and specify right or left by writing it in full.

Be meticulous in documenting the nature, size, and position of any wounds (see ➲ The approach to wounds, p. 410). Write down a diagnosis, together with a full interpretation of any investigations. Ensure that all attached documents (nursing observations, blood results, ECG) are labelled. Document all instructions and advice given to the patient, together with any follow-up arrangements made.

Referral

(See ➲ Discharge, referral, and handover, pp. 10–1.)

Always seek senior help or refer those patients with problems beyond your knowledge or expertise. Record any referral made, together with the name and grade of the doctor referred to, the time it was made, and a summary of the facts communicated. After referral, be cautious about accepting telephone advice alone—an expert cannot usually provide an accurate opinion without seeing the patient.

Return visits

Take special care with any patient who returns to the ED with the same presenting complaint, because it is no better or has deteriorated or the patient is simply dissatisfied. Do not automatically rely upon previous diagnosis and X-ray interpretations as being correct—treat the patient as if they were attending for the first time. Aim to involve a senior doctor in these cases.

Discharge against advice

Always attempt to persuade the patient to accept the treatment offered, but if this is refused or the patient leaves before being seen, ask the patient to sign an appropriate form. Patients not deemed competent (see ➲ Mental Capacity Act, p. 645) to make this decision may need to be held against their wishes—seek senior help with this. Write full notes explaining what happened.

Mental Capacity Act

(See ➲ Mental Capacity Act, p. 645.)

The Mental Capacity Act 2005 outlines how a person is unable to make a decision for himself/herself if he/she is unable to:

- Understand the information relevant to the decision.
- Retain the information.
- Use or weigh that information as part of the process of making the decision.
- Communicate his/her decision.

A patient lacks capacity if at the time he/she is unable to make a decision for himself/herself in relation to the matter because of an impairment or a disturbance in the functioning of the mind or brain.

Access to records

All ED staff should bear in mind that patients may gain access to their medical records and read what has been written about them. Patients in the UK have a statutory right of access to information about themselves (set out in the Data Protection Act 1998) and this includes medical records. Competent patients may apply for access to, and copies of, their own records. Applications are usually made in writing via the hospital's legal department.

Medical defence organization

Join a medical defence organization. The Medical Defence Union (MDU), Medical and Dental Defence Union of Scotland (MDDUS), and Medical Protection Society provide professional indemnity cover for emergencies outside hospital and advice and support for all sorts of medicolegal matters that are not necessarily covered by NHS trusts, eg statements to the Coroner or Procurator Fiscal, support at inquests or fatal accident inquiries, allegations of negligence, legal actions, and problems with the General Medical Council (GMC). They also provide members with useful information and booklets about consent, confidentiality, and other issues.

Further information

http://www.themdu.com
http://www.mddus.com
http://www.medicalprotection.org

Medicolegal aspects: the law

Confidentiality

Medical information about every patient is confidential and should not be disclosed without the patient's consent. In the UK, the police do not have routine access to clinical information, but some information may be divulged in certain specific circumstances:

- The Road Traffic Act (1972) places a duty on any person to provide the police, if requested, with information that might lead to the identification of a vehicle driver who is suspected of an offence under the Act. The doctor is obliged to supply the person's name and address, but not clinical information.
- Suspicion of terrorist activity.
- Gunshot and knife wounds (see https://www.gmc-uk.org).
- Disclosure in the public interest. The GMC advises that this might include situations where someone may be exposed to death or serious injury (eg murder, rape, armed robbery, child abuse). Although this may provide ethical permission for the doctor to reveal details without consent, it does not place him/her under any legal duty to do so. Discuss these cases with your consultant and/or your medical defence organization. See GMC advice (https://www.gmc-uk.org).

Ability to drive

A patient's ability to drive may be impaired by injury (especially limb or eye), by drugs (eg after GA, opiates, alcohol), or due to medical conditions (eg transient ischaemic attacks (TIAs), epilepsy, arrhythmias). In each case, warn the patient not to drive and ensure that this warning is documented in the notes. It may be prudent to provide this warning in the presence of a close relative.

For further information on medical aspects of fitness to drive, see https://www.gov.uk

Police requests for blood alcohol

In the UK, the police may request a blood or urine sample under Section 5 of the Road Traffic Act (1988) from a patient they suspect to have been in charge of a motor vehicle with an illegal blood alcohol level (>80mg/100mL). In such circumstances, specimens should only be taken if they do not prejudice the proper care and treatment of the patient. The relevant specimens should only be taken by a clinical forensic physician (forensic medical examiner/police surgeon) and with the patient's consent.

A change in the law (Police Reform Act 2002) also allows a forensic physician to take a blood sample from an unconscious patient who is suspected of having been the driver of a motor vehicle whilst under the influence of alcohol and/or drugs. The blood sample is retained and tested later, depending upon the patient later giving consent. Again, only permit the forensic physician access to the patient if this will not delay or prejudice proper care and treatment of the patient.

Reporting deaths to the Coroner (or Procurator Fiscal)

Many deaths that occur in (or in transit to) the ED are sudden and unexpected, and/or follow trauma. The exact cause of death is seldom immediately apparent. Accordingly, do not be tempted to sign death certificates. Instead, report all deaths to the Coroner (the Procurator Fiscal in Scotland). (See ➲ What to do after a death, p. 28 for details of the information required.)

Police statements

Do not provide information to the police until patient consent has been obtained. Writing a police statement requires thought and care. Write the statement yourself. Keep statements brief and try to avoid hearsay, conjecture, or opinion on the likely outcome. List injuries using both medical and non-medical language, explaining terminology in detail as necessary. State the investigations and treatment provided as accurately as possible (eg what sutures and how many were used). Having written the statement, ask your consultant to read it and comment on it. Get the statement typed (a friendly ED secretary may help if you cannot type yourself and will also know how you can claim the relevant fee). Having checked it, sign and date the statement and give it to the officer concerned. Always keep a copy of the statement and the ED notes, so that they are easily available if you are called to court.

Court appearances

In advance Discuss the case with your consultant, and review the notes, the questions that you might be asked, and the likely court procedures. Get a good copy of the notes and any investigations. Ask whether you should take the original records to court.

On the day Dress smartly, arrive early, and behave professionally. Be prepared for a long wait, so take a book to read. Turn off your mobile phone. Once in court, you have the option of taking an oath before God or affirming without religious connotation. You are equally bound to tell the truth, whichever you choose. Use the same form of address that others have already used (eg 'My Lord', 'Your Honour'). Answer directly and simply. Use comprehensible language, free of medical jargon. Remember that you are a professional witness, not an expert. Therefore, confine the expression of opinion to within the limits of your knowledge and experience—if asked something outside this, say so!

Inquest/fatal accident inquiry If you are called to give evidence at an inquest (in Scotland, a fatal accident inquiry), discuss the case with your consultant and also with your medical defence society.

Further information and advice about reports and appearing in court The medical defence organizations (see ➲ Medical defence organization, p. 33) have useful advice sheets for their members about writing reports and appearing in court.

Infection control and prevention

Organisms such as *Staphylococcus aureus*, including meticillin-resistant *S. aureus* (MRSA) (see ➲ Staphylococcal infections, p. 245), can readily be transmitted by contaminated hands or equipment, causing infection of wounds, fractures, and indwelling devices (eg catheters or chest drains). Infected blood can transmit many infections, including hepatitis B and C (see ➲ Hepatitis, p. 249) and human immunodeficiency virus (HIV) (see ➲ Human immunodeficiency virus, pp. 250–1). Viral gastroenteritis usually spreads by the faecal–oral route, but vomiting may cause widespread viral contamination of the surroundings and equipment, with a risk of transmission to other patients and staff.

Coughing and sneezing produce small droplets of infected secretions, which could involve viruses such as influenza (see ➲ Influenza pandemics, avian flu, and swine flu, p. 262), COVID-19/severe acute respiratory syndrome (SARS) (see ➲ Severe acute respiratory syndrome, p. 259), and respiratory syncitial virus (RSV) (see ➲ Acute bronchiolitis, pp. 698–9). A nebulizer used on an infected patient may spread respiratory viruses widely, as occurred in the outbreak of SARS in Hong Kong in 2003.

Standard precautions for preventing infection

Use standard precautions (also known as 'universal precautions') at all times and with all patients to ↓ risks of infection. Treat all blood and body fluids from patients as infected. Standard precautions include:

- Hand hygiene: essential, but often neglected. Decontaminate your hands before and after every patient contact, and after any activity that might contaminate hands, including removing gloves. Wash hands that are visibly dirty or possibly grossly contaminated with soap and water, then dry thoroughly. Use alcohol hand gel if hands look clean. Cover broken skin with a waterproof dressing.
- Personal protective equipment (PPE): wear suitable disposable *gloves* for any contact with blood, body fluids, mucous membranes, or non-intact skin. Latex gloves are widely used but cause allergic reactions in some patients and staff who need special nitrile gloves. Use a *disposable plastic apron* if there is a risk of blood or body fluids contaminating clothing. *Impervious gowns* are needed if there is a high risk of contamination. Use a *mask*, *face shield*, and *eye protection* if blood or body fluids might splash in your eyes or mouth. Protection against respiratory viruses, eg SARS or COVID-19, requires special *masks* or *respirators* (eg FFP3), which must be fitted and used properly. *Powered air-purifying respirators* should be used for high-risk procedures such as intubating patients with serious viral infections.
- Safe handling and disposal of sharps: avoid handling needles directly and never re-sheathe them. Place used needles immediately into a 'sharps bin'. If possible, use safety needles and cannulae, which ↓ the risk of needlestick injury. If, despite all precautions, a *needlestick injury* does occur, follow local approved procedures to ↓ the risk of infection and look after the people involved (see ➲ Needlestick injury, p. 425).
- Managing blood and bodily fluids: handle samples of blood or other body fluids safely, with care not to contaminate request forms or the outside of the container. Follow local approved procedures for dealing with spillages of blood or body fluids—wear suitable PPE (usually a disposable apron and gloves), and disinfect the spillage with an appropriate agent, such as diluted bleach.

Planning for outbreaks of infectious diseases

Planning to cope with an outbreak of a serious infectious disease such as COVID-19, SARS, or pandemic flu (see ➔ Influenza pandemics, avian flu, and swine flu, p. 262) is a considerable challenge for ED staff and for the whole community. The ED must be organized, so that patients can be assessed properly, with a minimum risk of infecting staff or other patients. If possible, patients with serious airborne diseases should be treated in negative-pressure isolation rooms by staff in appropriate PPE who are fully trained to minimize the risks of spreading and acquiring the infection. In high-risk situations, a 'buddy' system for staff may be helpful, with each doctor or nurse being watched closely by another person to check that full safety precautions are maintained.

Assessment of febrile patients

Hospitals in Hong Kong with experience of SARS use the *FTOCC* criteria when assessing febrile patients for potentially serious infectious diseases:

- F—fever (>38°C).
- T—travel history.
- O—occupational history.
- C—clustering of cases.
- C—contact history (eg someone with SARS or avian flu).

See also:

- *Pandemic influenza/avian flu* (see ➔ Influenza pandemics, avian flu, and swine flu, p. 262).
- *SARS* (see ➔ Severe acute respiratory syndrome, p. 259).
- COVID-19 (see ➔ COVID-19, p. 260).

At the roadside

►► *If you arrive first at the scene of a collision, the initial priority is to ensure your own safety and that of other rescuers.*

- Park safely so your car will not obstruct other vehicles (including emergency vehicles), preferably where its presence will alert other road users to the collision. Put your hazard warning lights on. If you have a warning beacon, put it on the roof of the car and switch it on.
- If you have a mobile phone, dial '999' and request ambulance, fire service, and police to attend. Remember to give the exact location, a brief description of the incident, and the number of casualties. Tell the emergency service operator who you are, as well as the number of your mobile phone.
- Switch off the engine of your car and of any other vehicles.
- Ensure that no one is smoking or displays a naked flame.
- Events involving electricity or chemicals have specific hazards. Involvement of overhead or underground electric cables poses risks, compounded if water is involved or sparks are produced. The risk from high-tension cables extends for several metres. Phone the power company to ensure that the source is turned off before approaching. Electrified rail lines may be short-circuited by a trained individual using a special bar carried in the guard's compartment.

Chemical incidents

Do not approach a chemical incident until declared safe by the fire service. Lorries carrying hazardous chemicals must display a 'Hazchem' board (see Fig. 1.2). This has:

- Information on whether the area should be evacuated, what protective equipment should be worn, aspects relating to firefighting, and if the chemical can be safely washed down storm drains (top left). A white plate means that the load is non-toxic.
- A 4-digit UN product identification number (middle left).
- A pictorial hazard diamond warning (top right).
- An emergency contact number (bottom).

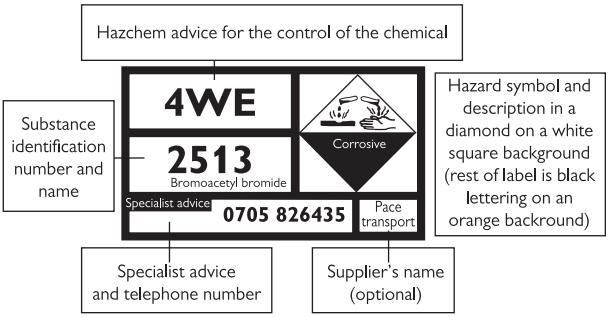
The European 'Kemler' plate Contains only the UN product number (bottom) and a numerical hazard code (top)—a repeated number means intensified hazard. Mixed loads of <500kg may only be identified by a plain orange square at the front and rear of the vehicle.

The transport emergency card (TREM card) Is carried in the driver's cab and gives information about the chemical for use at the scene of a crash. The fire tender may be equipped with CHEMDATA—a direct link with the National Chemical Information Centre at Harwell. Alternatively, contact a Poisons Information Centre or the transport company.

Helicopters

If helicopters are used for transport/evacuation, remember:

- Ensure any loose objects are secured to prevent them from being blown away.
- Never enter the landing space area during landing or take-off.
- Only enter/leave the rotor disc area with the pilot's permission. Duck down in the rotor disc area, and only approach in full view of the pilot.
- If the helicopter cannot land and the winch is used, do not touch the cable before it has touched the ground to earth any static electrical charge.



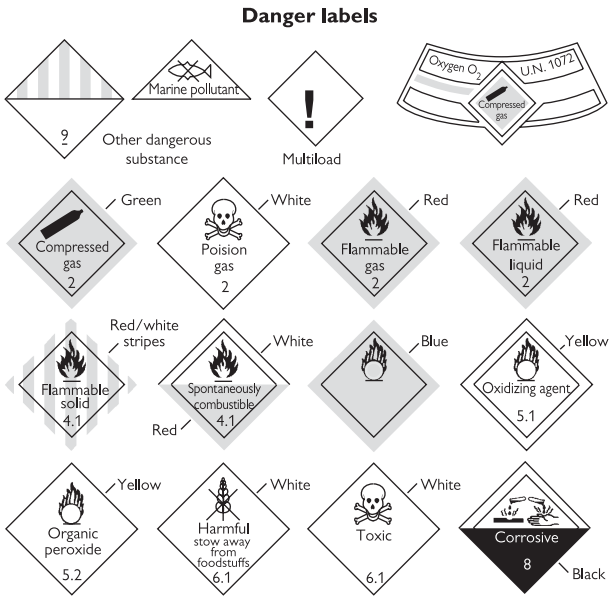


Fig. 1.2 Hazchem advice and danger labels.

Major incidents

A major incident involves a lot of people. Casualties may have multiple or minor injuries, burns, or other problems (eg food poisoning or chemical inhalation). Every hospital accepting emergencies has a Major Incident plan to use when normal resources are unable to cope and special arrangements are needed. Action cards for key staff detail their duties. All staff need to familiarize themselves with their roles in advance.

- *Call-in lists* must be up-to-date and available at all times.
- *Major incident practices* must be held regularly to check arrangements and contact details and to remind staff what they should do.

Alert

The ambulance service or the police should warn the hospital of a possible or definite major incident. Initial messages are often inaccurate because they are based on confused and incomplete information from the scene. Occasionally, patients arrive without warning from a major incident near the hospital.

Ensure that the *ED consultant* on duty is informed immediately of any suspected major incident, enabling them to participate in the decision to start the major incident procedure. Senior medical, nursing, and administrative staff will set up the hospital's *Control Centre* and prepare for action. If the major incident is confirmed, the full hospital response is initiated, following the procedures in the plan.

Communications are vital, but switchboards rapidly become overloaded. Staff should therefore be called in using non-switchboard phones, if possible. All staff should wear their identification badges.

Action in the ED

- Check that the ED consultant and hospital switchboard know about the incident and that the major incident procedure has been started.
- Inform all ED staff on duty (doctors, nurses, receptionists, porters).
- Call in other ED staff in accordance with the Major Incident plan.
- Clear the ED of any patients who are not seriously ill or injured. Prepare the department to receive patients from the incident.
- Doctors and nurses arriving to help should be given appropriate action cards. Staff should have labels or tabards, so that ED staff and other specialties (eg anaesthetists) can be identified easily.
- Prepare a triage point at the ambulance entrance. This should be staffed by a senior doctor and nurse who direct patients to the most appropriate area of the department. If possible, a nurse should stay with each patient until he/she is discharged or admitted to a ward.
- All patients should be labelled immediately with a unique Major Incident number, which is used on all notes, forms, blood samples, property bags, and lists of patients. Collect names, addresses, and other details as soon as possible, but this must not delay triage or emergency treatment. Keep lists of anyone leaving the ED.
- Ensure that the hospital *Control Centre* is regularly updated regarding the situation in the ED.

Wards and theatres

Beds must be cleared to receive patients, preferably on one or two wards, rather than on many different wards. A senior surgeon should triage patients needing operations and co-ordinate theatre work.

Relatives and friends

Relatives and friends of casualties should be looked after by social workers and chaplaincy staff in an area near to, but separate from, the ED, perhaps in the outpatient department. Keep relatives informed as soon and as much as possible. *Security staff* at each entrance to the ED should direct relatives and friends of casualties to the appropriate area and not allow them into the ED.

Press

Journalists and television crews will arrive rapidly after a major incident. Keep them out of the ED—direct them to a pre-arranged room to be briefed by a press officer and senior staff.

Arrangements at the site of a major incident

The police are in overall command. The fire service takes control of the immediate area if there is a fire or chemical risk. The police, fire, and ambulance services will each have a control vehicle, with an *Incident Officer* to co-ordinate their staff and the rescue work.

There may be a *Medical Incident Officer* (MIO) and also a *Mobile Medical Team* of doctors and nurses, who should, if possible, be sent from a supporting hospital, rather than the hospital receiving the first casualties. These staff must be properly clothed (yellow and green high-visibility jacket marked 'Doctor' or 'Nurse', overtrousers, green helmet with visor and chin strap, safety boots, gloves, knee pads, torch, ID badge) and must be trained and equipped with suitable medical supplies and action cards.

The mobile medical team must report to the MIO, who is in charge of all medical and nursing staff on site and works closely with the *Ambulance Incident Officer* (AIO). The MIO should record the names of the mobile medical team and brief them about their duties and the site hazards and safety arrangements. The MIO is responsible for supervising the team, arranging any necessary equipment and supplies, and making sure that the team are relieved when necessary. The MIO and AIO relay information to the hospitals and distribute casualties appropriately.

Debriefing staff

Debriefing is important after a major incident, so that staff can discuss what happened and express their feelings. Mutual support of the team is essential. Counselling may be required. Senior staff should prepare a report on the incident and review the Major Incident plan.

Further information

CBRN (chemical, biological, radiological, and nuclear) incidents (see ➲ Decontamination of the patient, p. 279)

NHS Emergency Planning guidance (see 🖱 https://www.gov.uk).

Chapter 2

Life-threatening emergencies

Anaphylaxis *44*
Treatment algorithm for adults with anaphylaxis *46*
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Cardiac arrest *48*
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Life-threatening emergencies in children are considered in Chapter 15, Paediatric emergencies p. 646

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➲ Choking from a foreign body p. 664
➲ Anaphylaxis in children p. 666
➲ Paediatric Advanced Life Support p. 668

Anaphylaxis

(*Anaphylaxis in children* is covered in ➲ Anaphylaxis in children, p. 666.)

Anaphylaxis is a generalized immunological condition of sudden onset, which develops after exposure to a foreign substance. The mechanism may:

- Involve an immunoglobulin E (IgE)-mediated reaction to a foreign protein (stings, foods, streptokinase) or to a protein–hapten conjugate (antibiotic) to which the patient has previously been exposed.
- Be complement-mediated (human proteins, eg G-globulin, blood products).
- Be unknown (aspirin, 'idiopathic').

Irrespective of the mechanism, mast cells and basophils release mediators (eg histamine, prostaglandins, thromboxanes, platelet-activating factors, leukotrienes), producing clinical manifestations. Angio-oedema caused by angiotensin-converting enzyme (ACE) inhibitors and hereditary angio-oedema may present in a similar way to anaphylaxis. Hereditary angio-oedema is not usually accompanied by urticaria and is treated with C1 esterase inhibitor.

Common causes

- Drugs and vaccines (eg antibiotics, streptokinase, suxamethonium, aspirin, non-steroidal anti-inflammatory drugs (NSAIDs), IV contrast agents).
- *Hymenoptera* (bee/wasp) stings.
- Foods (nuts, shellfish, strawberries, wheat).
- Latex.

Clinical features

The speed of onset and severity vary with the nature and amount of the stimulus, but the onset is usually in minutes/hours. A prodromal aura or a feeling of impending death may be present. Patients on β-blockers or with a history of ischaemic heart disease (IHD) or asthma may have especially severe features. Usually two or more systems are involved:

- ***Respiratory*** Swelling of the lips, tongue, pharynx, and epiglottis may lead to complete upper airway occlusion. Lower airway involvement is similar to acute severe asthma—dyspnoea, wheeze, chest tightness, hypoxia, and hypercapnia.
- ***Skin*** Pruritus, erythema, urticaria, and angio-oedema.
- ***Cardiovascular*** Peripheral vasodilatation and ↑ vascular permeability cause plasma leakage from the circulation, with ↓ intravascular volume, hypotension, and shock. Arrhythmias, ischaemic chest pain, and ECG changes may be present.
- ***Gastrointestinal (GI) tract*** Nausea, vomiting, diarrhoea, abdominal cramps.

Treatment

- Discontinue further administration of suspected factor (eg drug). Remove stings by scraping them carefully away from skin.
- Give 100% O_2 and IM adrenaline as indicated.
- Open and maintain airway. If upper airway oedema is present, get specialist senior help immediately. Emergency intubation or a surgical airway and ventilation may be required.
- In profound shock or *immediately life-threatening situations*, give CPR/Advanced Life Support (ALS) as necessary, and consider *slow* IV adrenaline 1:10,000 or 1:100,000 solution. This is recommended only for experienced clinicians who can also obtain immediate IV access. Note the different strength of adrenaline required for IV use. If there is no response to adrenaline, consider glucagon 1–2mg intramuscular (IM)/IV every 5min (especially in patients taking β-blockers).
- Give a β_2-agonist (eg salbutamol 5mg) nebulized with O_2 for bronchospasm, possibly with the addition of nebulized ipratropium bromide 500mcg.
- Give IV fluid if hypotension does not rapidly respond to adrenaline. Rapid infusion of 1–2L IV 0.9% saline may be required, with further infusion according to the clinical state.
- Antihistamine H_1 blockers (eg chlorphenamine 10–20mg slow IV) and H_2 blockers (eg ranitidine 50mg IV) are commonly given. They are second-line drugs that, with hydrocortisone 100–200mg slow IV, may reduce the severity/duration of symptoms.
- Admit/observe after initial treatment: prolonged reactions and biphasic responses may occur. Observe for at least 4–6hr after all symptoms have settled.

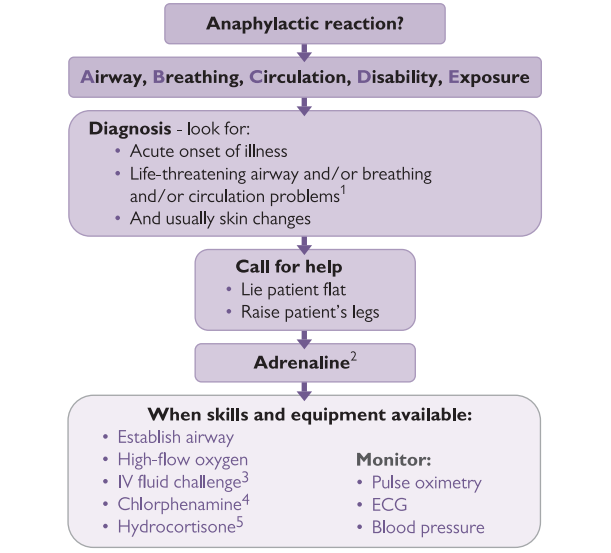
Report anaphylactic reactions related to drugs/vaccines to the Committee on Safety of Medicines. Further investigation of the cause (and possibly desensitization) may be indicated. Where identified, the patient and GP must be informed and the hospital records appropriately labelled. MedicAlert bracelets are useful.

Notes on treatment algorithm

(See Fig. 2.1.)

1 An inhaled β_2-agonist, such as salbutamol, may be used as an adjunctive measure if bronchospasm is severe and does not respond rapidly to other treatment.
2 If profound shock judged *immediately* life-threatening, give CPR/ALS if necessary. Consider slow IV adrenaline (epinephrine) 1:10,000 solution. This is *hazardous* and is recommended only for an experienced practitioner who can also obtain IV access without delay. Note the different strength of adrenaline (epinephrine) that may be required for IV use.
3 If adults are treated with an EpiPen®, the 300mcg dose will usually be sufficient. A second dose may be required. Half doses of adrenaline (epinephrine) may be safer for patients on amitriptyline, imipramine, or a β-blocker.
4 A crystalloid may be safer than a colloid.

Treatment algorithm for adults with anaphylaxis



1 Life-threatening problems:

Airway:	Swelling, hoarseness, stridor
Breathing:	Rapid breathing, wheeze, fatigue, cyanosis, SpO_2 <92%, confusion
Circulation:	Pale, clammy, low blood pressure, faintness, drowsy/coma

2 Adrenaline (*give IM unless experienced with IV adrenaline*)
IM doses of 1:1000 adrenaline (repeat after 5min if no better)

- Adult: 500 micrograms IM (0.5mL)
- Child more than 12 years: 500 micrograms IM (0.5mL)
- Child 6–12 years: 300 micrograms IM (0.3mL)
- Child less than 6 years: 150 micrograms IM (0.15mL)

Adrenaline IV to be given **only by experienced specialists**
Titrate: adults 50 micrograms; children 1 microgram/kg

3 IV fluid challenge:
Adult: 500–1000mL
Child: crystalloid 20mL/kg

Stop IV colloid if this might be the cause of anaphylaxis

	4 Chlorphenamine (IM or slow IV)	**5 Hydrocortisone** (IM or slow IV)
Adult or child more than 12 years:	10mg	200mg
Child 6–12 years:	5mg	100mg
Child 6 months to 6 years:	2.5mg	50mg
Child less than 6 months:	250 micrograms/kg	25mg

Fig. 2.1 Anaphylaxis algorithm.
Reproduced with the kind permission of the Resuscitation Council (UK), www.resus.org.uk

Choking

The management of choking is rightly taught as part of first aid. Recognition of the problem is the key to success. Clues include a person experiencing a sudden airway problem whilst eating, possibly combined with them clutching their neck.

Severity of airway obstruction

Victims with severe airway obstruction may be unable to speak or breathe and may become unconscious (see Fig. 2.2).

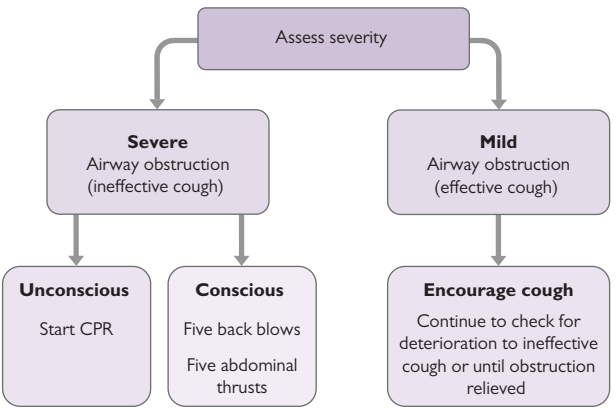


Fig. 2.2 Adult choking algorithm.

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Cardiac arrest

Clinical features and recognition

Follow the resuscitation algorithm (https://www.resus.org.uk) in Fig. 2.3. Cardiac arrest is a *clinical diagnosis*:

- Suspect cardiac arrest in any patient who is unconscious and who does not have signs of life. If you check a pulse, examine only for a major (carotid or femoral) one and take no longer than 10s. Other 'confirmatory' clinical features (eg colour, pupil size/response) waste time and do not help. Note that some respiratory efforts, such as gasping, may persist for several minutes after the onset of cardiac arrest. Occasionally, an arrest may present as a grand mal fit of short duration.
- Most patients have had a sudden and unexpected out-of-hospital event.

Prior warning to the department is usually relayed by radio or direct telephone link from the ambulance service. Whilst resuscitation is continued, ensure that accompanying relatives/friends are met and taken to an appropriate room, which has a telephone and facilities for making tea and coffee and where privacy is possible. Arrange for a member of staff to stay with the relatives to act as a link with the resuscitation team.

Information to obtain from ambulance crew/relatives

- *Patient details*, including age, past medical history, current medication, and chest pain before event.
- *Times of* collapse (often an approximation), 999 (or 112) call, arrival on scene, start of CPR, first defibrillating shock (if appropriate), other interventions (eg advanced airway management, drugs), restoration of spontaneous circulation (ROSC).
- *Was there any bystander CPR?*

Where a patient in cardiac arrest is brought to hospital by ambulance, the cardiac arrest team (ED staff, the hospital team, or a combination of both) should already be present in the resuscitation room, with all equipment ready, to receive the patient.

The team leader

The team leader controls, co-ordinates, and organizes the team and makes decisions. Four to six team members are optimal. Each should know their role. Perform resuscitation in a calm, quiet, confident manner with minimal interruption to the performance of Basic Life Support (BLS) or defibrillation.

Start the following procedures simultaneously

- Continue BLS.
- Remove/cut clothing from the upper body to allow defibrillation, ECG monitoring, chest compression, and IV access.
- Obtain the ECG trace (through defibrillator pads or monitor leads). If already attached to an ECG monitor, note (and print out, if possible) the rhythm. Beware movement artefact, disconnected leads, electrical interference, etc.
- Follow the ALS algorithm (see Advanced Life Support algorithm, p. 54).
- Do not interrupt CPR, except to perform defibrillation.

In-hospital resuscitation algorithm

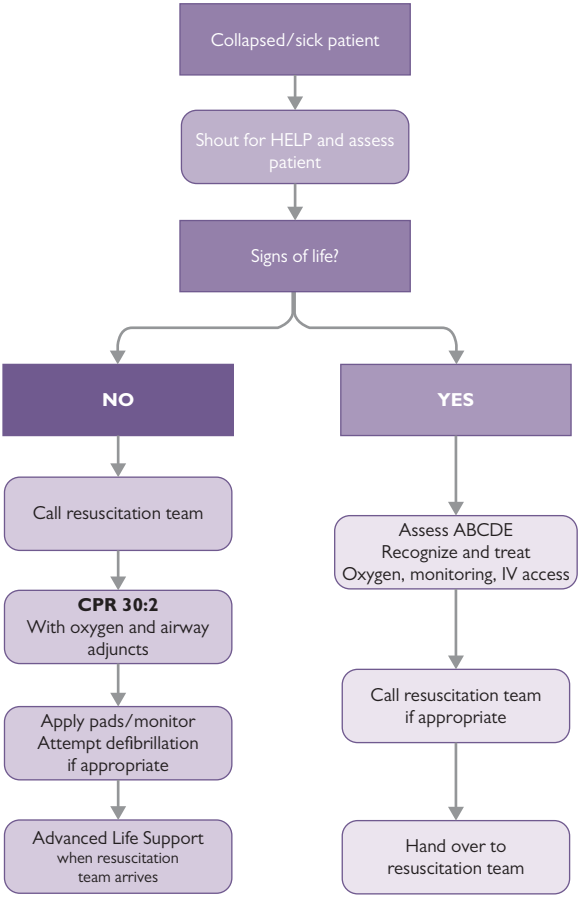

Fig. 2.3 In-hospital resuscitation algorithm.
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Adult Basic Life Support

Airway and ventilation

Usually in the ED, advanced airway techniques will be used from the outset. If basic techniques are used (see Fig. 2.4):

- With the patient on his/her back, open the airway by tilting the head and lifting the chin (use jaw thrust instead if neck trauma suspected).
- Remove any visible obstructions from the mouth, but leave well-fitting dentures in place.
- Aim for each breath to last ~1s, and make the chest rise. After each breath, maintain the head tilt/chin lift; take your mouth away from the patient's, and watch for the chest to fall as the air comes out.

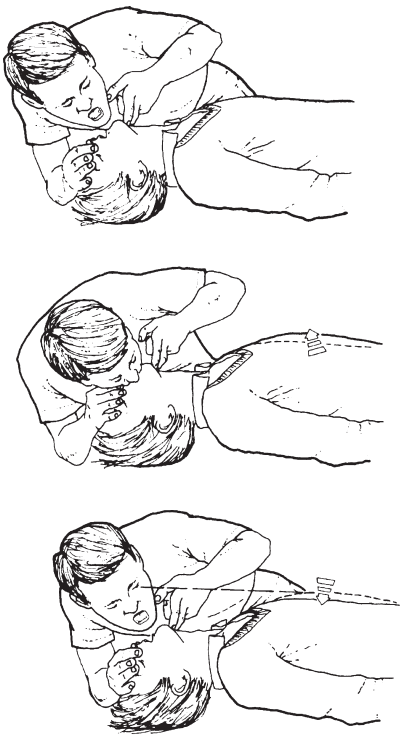

Fig. 2.4 Mouth-to-mouth ventilation.

Technique for chest compression

- Place the heel of one hand over the middle of the lower half of the patient's sternum, with the other hand on top. Extend or interlock the fingers of both hands, and lift them to avoid applying pressure to the patient's ribs (see Fig. 2.5.).
- Positioned above the patient's chest and with arms straight, press down to depress the sternum 5–6cm.
- Release all the pressure and repeat at a rate of 100–120/min.
- Compression and release phases should take the same time.
- Use a ratio of 30 chest compressions to two ventilations (30:2).
- Aim to change the person providing chest compressions every 2min, but ensure that this is achieved without causing significant pauses.

Fig. 2.5 Chest compressions.

Cardiac arrest management

Defibrillation

- Most survivors have an initial rhythm of ventricular fibrillation (VF)/ventricular tachycardia (VT). The treatment for this is defibrillation. With time, the chances of successful defibrillation and survival ↓ dramatically. Adhesive defibrillator pads have replaced manual paddles in most hospitals. Place one pad to the right of the upper sternum below the clavicle, the other at mid-axillary line level with the V_6 ECG electrode position. Avoid placement over the ♀ breast. To avoid problems with pacemakers, keep pads >15cm away from them.
- With biphasic defibrillators, use shock energy of 150J; for (mostly older) monophasic defibrillators, select 360J energy—check with each machine.
- Plan for chest compressions to be as continuous as possible, with minimal delays. Having paused briefly to assess the rhythm, recommence compressions until the defibrillator is charged. Pause briefly to deliver a shock (removing O_2 sources and GTN patches), then immediately restart CPR with 30:2 compressions:ventilation, and continue for 2min before reassessing the rhythm or feeling for a pulse.
- In monitored patients with pulseless VT/VF where defibrillation is not immediately available, give a single *precordial thump*. With a tightly clenched fist, deliver one direct blow from a height of ~20cm to the lower half of the sternum.

Airway management

Techniques for securing the airway, providing oxygenation, and ventilation are covered in ➲ Airway obstruction: basic measures, pp. 334–5. Although tracheal intubation has long been considered to be the gold standard definitive airway, only attempt this if suitably experienced. *Supraglottic airway* is a readily available, rapid alternative, which is easy to insert. Whatever method is used, aim to ventilate (preferably with 100% O_2) using an inspiratory time of 1s, a volume sufficient to produce a normal rise of the chest, at a rate of 10/min. For patients with tracheal tubes or laryngeal mask airways, ventilate without interrupting chest compressions, which should be continuous (except for defibrillation or pulse checks as appropriate).

End-tidal CO_2 monitoring is very useful to confirm correct tracheal tube placement and indirectly measure cardiac output during CPR.

Drugs

There is little evidence that *any* drug improves outcome. Central venous cannulation is difficult, has risks, and interrupts CPR. Peripheral access is easy and quick. Having given a peripheral IV drug, give a 20mL saline bolus and elevate the limb for 10–20s. If IV access is impossible, consider the intra-osseous route (➲ Intra-osseous infusion, pp. 656–7). It is no longer recommended for any drugs to be given by tracheal tube. Similarly, do not attempt intracardiac injections.

The first drug used in cardiac arrest (after O_2) is adrenaline. In the case of VF/VT, give adrenaline after three shocks, whereas in asystole/PEA, give it as soon as possible (see ➲ Advanced Life Support algorithm, p. 54).

Non-shockable rhythms: PEA and asystole

PEA (pulseless electrical activity) is the clinical situation of cardiac arrest with an ECG trace compatible with a cardiac output. PEA may be caused by:

- Failure of the normal cardiac pumping mechanism (eg massive MI, drugs such as β-blockers and calcium (Ca^{2+}) antagonists, or electrolyte disturbances, eg hypokalaemia, hyperkalaemia).
- Obstruction to cardiac filling or output [eg tension pneumothorax, pericardial tamponade, myocardial rupture, pulmonary embolism (PE), prosthetic heart valve occlusion, and hypovolaemia].

Prompt and appropriate correction of these can result in survival. Remember potentially reversible causes as the 4Hs and 4Ts (see Table 2.1).

Table 2.1 The 4Hs and 4Ts

4Hs	4Ts
Hypoxia	Tension pneumothorax
Hypovolaemia	Tamponade (cardiac)
Hyper-/hypokalaemia/metabolic disorders	Toxic substances (eg overdose)
Hypothermia	Thrombosis (PE/MI)

Asystole is the absence of cardiac (particularly ventricular) electrical activity. If unsure whether the rhythm is asystole or fine VF, continue chest compressions and ventilation in an attempt to increase the amplitude and frequency of VF and make it more susceptible to defibrillation.

Length of resuscitation

The duration of the resuscitation attempt depends upon the nature of the event, the time since the onset, and the estimated prospects for a successful outcome. In general, continue resuscitation whilst VF/pulseless VT persists, always provided that it was initially appropriate to commence resuscitation. If VF persists despite repeated defibrillation, try changing pad position or defibrillator.

Asystole unresponsive to treatment and arrests which last >1hr are rarely associated with survival. However, exceptions occur—particularly in younger patients, hypothermia, near drowning, and drug overdose.

Mechanical CPR

Several devices can provide mechanical CPR. These include the 'AutoPulse' circumferential load-distributing band chest compression device (comprising a pneumatically actuated constricting band and backboard) and the 'LUCAS' gas-driven sternal compression device (with an accompanying suction cup to provide active decompression). Mechanical CPR is potentially very useful in situations where the resuscitation attempt is prolonged (eg cardiac arrest associated with hypothermia or poisoning or following fibrinolytic treatment for PE), ensuring consistent CPR over a long period of time and freeing up an additional member of the team.

Advanced Life Support algorithm

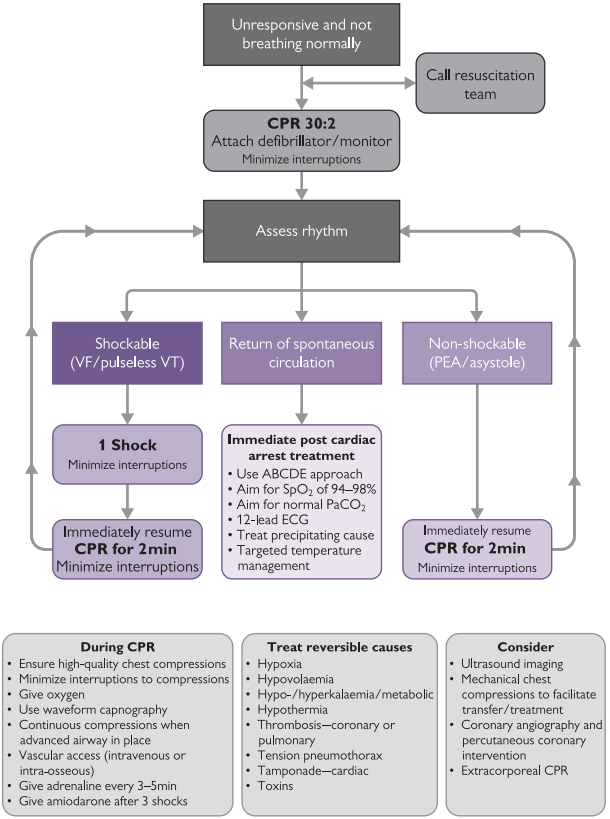

Fig. 2.6 Advanced Life Support algorithm.

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Notes on using the Advanced Life Support algorithm

- Establish the underlying cardiac rhythm as quickly as possible in order to determine which 'loop' to follow to provide appropriate treatment—for VF/pulseless VT, the initial focus is defibrillation and good CPR; for asystole/PEA, the initial focus is good CPR, IV adrenaline, and searching for potentially reversible causes (see Fig. 2.6).
- Do not interrupt CPR, except to perform defibrillation.
- Search for, and correct, potentially reversible causes of the arrest.
- Give IV adrenaline 1mg and amiodarone 300mg for VF/pulseless VT refractory to three shocks, followed by adrenaline 1mg every 3–5min. A further dose of IV amiodarone 150mg may be given for recurrent or refractory VF/VT. Lidocaine (1mg/kg) IV is an alternative to amiodarone, but do not give it if amiodarone has already been given.
- For torsades de pointes and refractory VF in patients with suspected digoxin toxicity or hypomagnesaemia (eg on potassium-losing diuretics), give IV magnesium sulfate 2g (= 8mmol = 4mL of 50% solution).
- In asystole and PEA, give IV adrenaline 1mg as soon as possible and thereafter every 3–5min.
- Exercise caution before using adrenaline in arrests associated with cocaine or other sympathomimetic drugs.
- Atropine is no longer routinely recommended in asystole or slow PEA.
- In PEA arrests associated with hyperkalaemia, hypocalcaemia, or Ca^{2+} channel-blocking drug or magnesium overdose, give 10mL of 10% IV calcium chloride (6.8mmol).
- With good-quality CPR, acidosis develops slowly. Do not 'routinely' give an alkali. Give 50mL of sodium bicarbonate 8.4% solution (50mmol) if the arrest is associated with tricyclic overdose (see ➲ Tricyclic antidepressant poisoning, pp. 202–3) or hyperkalaemia, and consider it in patients with severe acidosis (arterial pH <7.1, base excess less than –10). Allow further administration to be guided by repeated ABG results.
- Follow loops of the algorithm for as long as it is considered appropriate for the resuscitation to continue. Provided that the attempt was commenced appropriately, it should not normally be stopped if the rhythm is still VF.

Pacing and external cardiac percussion

Pacing may be of value in patients with extreme bradyarrhythmias, but its value in asystole is unproven (except for rare cases of asystole with P waves present). If there is a delay before pacing can be performed, external cardiac percussion can provide a cardiac output and 'buy time'. Perform external cardiac percussion using a clenched fist:

- Over the heart at a rate of 100/min.
- With a blow more gentle than a precordial thump.
- Each blow should generate a QRS complex. If this and a detectable output are not achieved, restart conventional CPR.

Post-resuscitation care

Features such as coma or pupil reflexes are unreliable prognostic indicators in the early post-resuscitation phase. Accurate prognostication in an individual patient is rarely possible before 24–72hr. Involve the ICU/CCU team early.

Pending this and following ROSC

- Ensure that the airway is protected (➲ Airway obstruction: basic measures, pp. 334–5).
- Maintain oxygenation and ventilation. Correct hypoxia and prevent hypercapnia under ABG guidance [may require intermittent positive pressure ventilation (IPPV)]. Use pulse oximetry to monitor arterial oxygen saturation (SpO_2) non-invasively, titrating the inspired O_2 concentration to achieve SpO_2 of 94–98%.
- In intubated patients, insert an oro- or nasogastric tube to decompress the stomach.
- Obtain a 12-lead ECG and a CXR (check the position of the tracheal tube, central lines, and presence of pneumothorax, etc.).
- Optimize cardiac output: inotropes, vasodilators, fluids, and/or diuretics may be needed under haemodynamic monitoring guidance. If the arrest is associated with an acute coronary syndrome (ACS), consider immediate thrombolysis and/or coronary revascularization (see Fig. 2.7).
- Cerebral blood flow autoregulation is deficient post-arrest. Maintaining arterial pressures 'normal' for the patient may prevent hypotensive hypoperfusion. ↑ BP above the normal for the patient may worsen cerebral oedema.
- Seizures aggravate brain injury by ↑ intracranial pressure (ICP) and cerebral metabolic requirements. Treat with appropriate anticonvulsants (as ➲ Treatment of status epilepticus, p. 157), and ensure adequate oxygenation and ventilation.
- Measure U&E, Ca^{2+}, magnesium (Mg^{2+}), and correct abnormalities appropriately.
- Obtain FBC to exclude anaemia contributing to myocardial ischaemia and to provide an admission baseline.
- Both hypo- and hyperglycaemia compromise neurological outcome. Monitor plasma glucose concentration regularly, and aim to avoid both hypo- and hyperglycaemia (keep the level ≤10mmol/L).
- No drug has been shown to improve cerebral outcome following a cardiac arrest. The routine use of steroids, mannitol, Ca^{2+} channel blockers, etc. is unwarranted.
- When any drug is used, remember that pharmacokinetic profiles are often impaired post-resuscitation. Dose adjustment and careful monitoring are needed.
- Avoid/treat hyperthermia with an antipyretic or active cooling.

- There are compelling data to support early induction of targeted temperature management (32–36°C) in patients who are comatose following an out-of-hospital VF arrest. Mild hypothermia is believed to be neuroprotective in this situation (and, pending more data, may be of benefit in other situations as well, eg other arrest rhythms, in-hospital arrests, paediatric patients). Cooling may be initiated by external techniques (cooling blankets, water- or air-circulating blankets) or internally by an infusion of 30mL/kg of 4°C 0.9% saline—liaise with ICU. Mild hypothermia is typically maintained for 12–24hr.

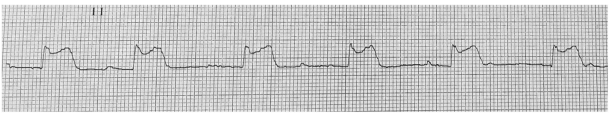

Fig. 2.7 Post-resuscitation ECG showing ST segment elevation MI (STEMI) with complete heart block.

Training

Theoretical knowledge is important, but many of the skills required during the management of a cardiac arrest need expert teaching and supervised practice. Attend an approved Resuscitation Council (UK) *Advanced Life Support* course (see https://www.resus.org.uk)—preferably before starting in the ED.

Central venous access

Indications

Central venous access may be required for:

- Administration of emergency drugs.
- Central venous pressure (CVP) measurement.
- Administration of IV fluids, especially when peripheral veins are collapsed or thrombosed. *Note*: other routes (eg femoral vein) are generally preferable for giving large volumes rapidly.
- Transvenous cardiac pacing.

Choice of vein

The external jugular vein is often readily visible and can be cannulated easily with a standard IV cannula.

The internal jugular and subclavian veins are generally used for central venous access in the ED. Subclavian vein cannulation has a relatively high risk of pneumothorax, so the internal jugular vein is usually preferable via a 'high' approach. Use USS guidance and the right side of the neck (↓ risk of thoracic duct damage). If, however, a chest drain is already *in situ*, use the same side for central venous cannulation.

The femoral vein is useful for temporary access in severe trauma and burns and in drug users with many thrombosed veins.

Seldinger technique for central venous access

This is the method of choice, because the relatively fine needle ↓ the risk of complications such as pneumothorax. The technique involves inserting a hollow metal needle into the vein. A flexible guidewire is threaded through the needle, which is then removed. A tapered dilator and plastic cannula are inserted over the guidewire and advanced into the vein. The guidewire and dilator are removed, and the cannula secured. Once the cannula is in place, check that venous blood can be freely aspirated and secure the cannula.

Precautions and problems

Central venous access is a specialized technique with potentially life-threatening complications, including pneumothorax, haemothorax, arterial puncture, thoracic duct damage, air embolism, and infection.

- Expert supervision is essential. Cannulation is particularly difficult and hazardous in hypovolaemic, shocked, or agitated patients. In such situations, consider whether it is possible to defer the procedure.
- Use USS to guide central line insertion. USS ↓ complications and failure rates by clarifying the relative positions of the needle, vein, and surrounding structures. Variant anatomy and vein patency can also be assessed by USS.
- Bleeding dyscrasias and anticoagulant treatment are contraindications to internal jugular and subclavian vein access.
- Severe pulmonary disease is a relative contraindication to central venous access, especially by the subclavian route, because a pneumothorax would be particularly dangerous.

Methods

Use an aseptic technique. If possible, tilt the trolley 10° head down to fill the internal jugular and subclavian veins and ↓ the risk of air embolus. After successful or attempted subclavian or internal jugular vein cannulation, take a CXR to check for pneumothorax and the position of the cannula.

External jugular vein

The vein can be seen and felt as it crosses superficially over the sternomastoid muscle and runs obliquely towards the clavicle. Gentle pressure on the lower end of the vein will distend it. A standard IV cannula can easily be inserted into the external jugular vein, but passing a catheter centrally may be difficult because of valves and the angle at which the vein joins the subclavian vein.

Internal jugular vein

The internal jugular vein runs antero-laterally in the carotid sheath, parallel to the carotid artery and deep to the sternocleidomastoid muscle. The high approach described has less risk of pneumothorax than lower approaches (see Fig. 2.8).

- Turn the patient's head away from the side to be cannulated.
- Identify the carotid artery and jugular vein on USS.
- Follow the needle tip with USS until the needle is seen to pierce the jugular vein and blood is freely aspirated.
- After inserting the guidewire, confirm positioning in the vein on transverse and longitudinal USS views.

Subclavian vein (infraclavicular approach)

(See Fig. 2.9.)

- Turn the patient's head away from the side of cannulation.
- Identify the subclavian artery and vein between the midpoint and the distal third of the clavicle with the USS probe.
- Align the needle with the midpoint of the USS probe which is centred over the subclavian vein. Follow the needle tip until it penetrates the vein and blood is aspirated freely. After inserting the guidewire, confirm the position on both transverse and longitudinal views.

Femoral vein

Insert the needle ~1cm medial to the femoral artery and just below the inguinal ligament, pointing slightly medially and with the needle at 20–30° to the skin. If time and expertise allow, use USS guidance.

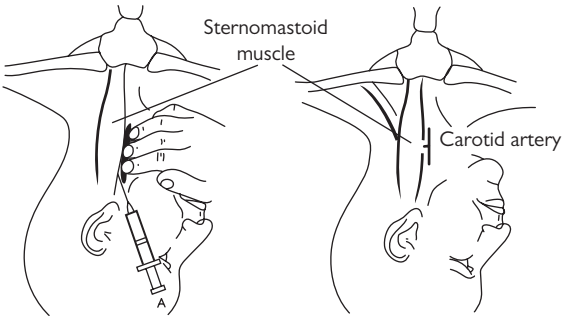

Fig. 2.8 Internal jugular cannulation.

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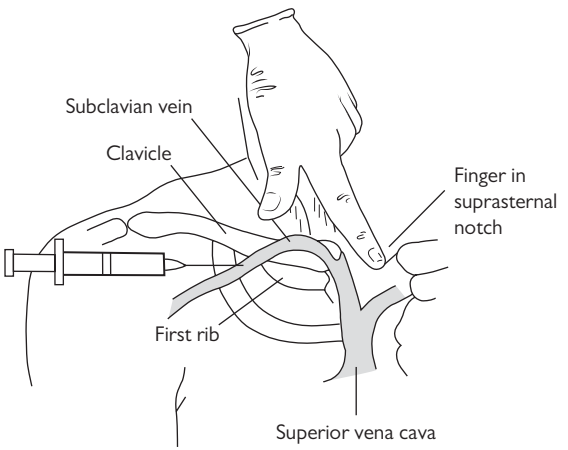

Fig. 2.9 Subclavian vein cannulation.

Recognition of the sick patient

Time-critical illness

There are a relatively large number of conditions where urgent intervention is required in order to secure the best outcome for the patient. Examples include sepsis, MI, major trauma, ruptured abdominal aortic aneurysm, and ruptured ectopic pregnancy. Clinical diagnosis of some of these conditions is not always straightforward, but a common theme is that many present with deranged physiology and vital signs. Implementation of an early warning score on arrival at hospital has helped to identify seriously ill patients.

National Early Warning Score ('NEWS2')

Following its introduction by the Royal College of Physicians in 2012, the National Early Warning Score was revised in 2017 to produce NEWS2. The original score has been adjusted to take into account the chronic hypoxia of patients with chronic obstructive pulmonary disease (COPD), which generated high baseline scores and led to some instances of excessive O_2 administration. Another hope associated with the updated system is that it would help with the early identification of sepsis. NEWS2 is based on six physiological simple, easily measured variables:

- RR.
- SpO_2.
- Systolic BP.
- Pulse rate.
- Level of consciousness or new confusion (delirium).
- Temperature.

In addition to NEWS2 being able to identify seriously unwell patients on presentation to hospital, it can also help in the early identification of patients who deteriorate after arrival at hospital and need urgent intervention.

Clinical acumen

It is not always easy to pinpoint exactly why, but experienced clinicians are often able to quickly identify the fact that a patient is very sick, when compared with less experienced staff. Sometimes, however, the clues are in the history. On other occasions, scrutiny of the prehospital notes can provide vital information. Take particular note of abnormal vital signs (and/or abnormal ECG) as recorded by the paramedics or the GP, even if these have returned to within the normal range by the time of arrival at hospital.

Sepsis

There is a high mortality rate associated with severe infection at all ages. Sepsis occurs when life-threatening organ dysfunction is associated with infection. It can be insidious in onset and challenging to identify in the ED.

Ask the question: 'does this patient have a suspected infection?'

The initial NEWS (see ➲ National Early Warning Score ('NEWS 2'), p. 61) can give an early indication of those patients with sepsis.

Suspected sepsis: qSOFA

The Sequential Organ Failure Assessment score has been simplified to the quick SOFA (qSOFA) score to provide one way to assess for sepsis.

Consider sepsis and commence treatment as appropriate if any one (or more) of the following is present (score 1 for each):

- RR ≥22 breaths/min.
- Systolic BP ≤100mmHg.
- Altered mental state (lower GCS than usual).

Patients scoring 2 or 3 have been shown to have ↑ mortality.

Note that an ↑ lactate level can also be helpful in the initial identification of sepsis in the ED (see ➲ Venous blood gases, p. 103).

Management: the sepsis bundle

Early treatment can improve outcome from sepsis—early IV antibiotics and IV fluids appear to be the most important. The following approach incorporates the 'sepsis 6' care bundle (to be delivered within 1hr of arrival in the ED): O_2, blood cultures, IV fluids, IV antibiotics, blood lactate measurement, and urine output monitoring.

- Obtain senior/ICU assistance immediately.
- Assess and manage airway, breathing, and circulation (ABC); in particular, provide high-flow O_2 as required—in most patients who require O_2, aim for SpO_2 of 90–96%. In patients with COPD, a target of 88–92% may be more appropriate (see ➲ Oxygen, p. 99).
- Secure good IV access and take blood samples, including FBC, C-reactive protein (CRP), U&E, LFTs, and a blood lactate level. If the blood lactate level is ≥2mmol/L, repeat the level in 2hr.
- Look for obvious sources of infection (consider a CXR).
- Take blood cultures before starting antibiotics if this does not delay the administration of antibiotics (the choice of antibiotics will depend upon the likely cause and is considered in ➲ Shock, p. 65), but broad-spectrum antibiotics are often appropriate.
- Begin administration of IV crystalloid according to response (eg 10–20mL/kg, although 30mL/kg may be required if hypotensive or if the blood lactate level is ≥4mmol/L). Be cautious with IV fluids in patients who have suspected COVID-19 as a large amount of IV fluid may worsen associated ARDS (see ➲ COVID-19, p. 260).
- Start vasopressors (such as a noradrenaline infusion) for persistent hypotension in order to maintain a mean arterial BP of ≥65mmHg.

See Surviving Sepsis Campaign at https://www.survivingsepsis.org

Neutropenic sepsis

Systemic chemotherapy (or sometimes radiotherapy) can cause bone marrow suppression and limit the ability of the body to respond to infection. Do not underestimate the extent to which patients with neutropenic sepsis can suddenly deteriorate without much warning—they may not exhibit the typical progressive clinical signs of shock over a number of hours but instead drop their BP precipitously. For this reason, triage ahead and ensure these patients receive immediate attention and resuscitation. Most patients who have received chemotherapy are well aware of the potential risks of neutropenic sepsis and the need to seek urgent medical attention on becoming unwell.

See NICE guidance at https://www.nice.org.uk

Suspect neutropenic sepsis if a patient presents pyrexial or unwell (with symptoms/signs of clinically significant sepsis), with a neutrophil count of $<0.5 \times 10^9$/L, then start treatment accordingly. Do not delay the administration of IV antibiotics whilst waiting for the neutrophil count to be processed by the lab—if in doubt, assume that a patient who has recently received chemotherapy is likely to be neutropenic. Provide the 'sepsis bundle', as outlined in Management: the sepsis bundle, p. 62, including giving broad-spectrum antibiotics according to local protocols—an example of one regime is:

- Piperacillin–tazobactam IV 4.5g every 8hr or
- If penicillin-allergic: ceftazidime IV 2g every 8hr.

It may not be easy to immediately identify an obvious source of infection. Apart from chest, urine, or skin infections, other causes include endocarditis, meningitis, GI perforation, osteomyelitis, sinusitis, and line sepsis.

Line sepsis

If the patient has a central line or another line *in situ*, consider infection of this and treat as appropriate (seek local advice from haematologist/microbiologist).

Shock

Shock is a clinical condition characterized by failure to adequately perfuse and oxygenate vital organs. Clinically, shock is recognized by:

- *Hypotension*: generally considered to be systolic BP <90mmHg (in adults), but values may be higher in young, fit, or previously hypertensive patients. Associated *tachycardia* (>100/min) is common but may not be present in patients with cardiac or neurological causes or in those taking β-blockers. A few patients with haemorrhagic shock have paradoxical bradycardia.
- *Altered consciousness* and/or fainting (especially on standing or sitting up) may result from ↓ cerebral perfusion.
- *Poor peripheral perfusion*: cool peripheries, clammy/sweaty skin, pallor, and ↓ capillary return, but note that in the early phase of endotoxic septic shock, there may be vasodilatation with warm peripheries.
- *Tachypnoea*.
- *Purpuric rash*.
- *Oliguria*: ↓ renal perfusion with urine output <50mL/hr (in adults).

Classification of shock

Traditional classification is artificial; mixed aetiologies are common.

Hypovolaemic shock

- Blood loss: trauma, GI bleed (haematemesis, melaena), ruptured abdominal aortic aneurysm, ruptured ectopic pregnancy.
- Fluid loss/redistribution ('third spacing'): burns, GI losses (vomiting, diarrhoea), pancreatitis, sepsis.

Cardiogenic shock

- Primary: MI, arrhythmias, valve dysfunction, myocarditis.
- Secondary: cardiac tamponade, massive PE, tension pneumothorax.

Septic shock

Includes relative hypovolaemia and cardiogenic shock (see ➲ Sepsis, pp. 62–3). More common at the extremes of age, with diabetes mellitus, renal/hepatic failure, and immunocompromise (eg HIV, underlying malignancy, post-splenectomy, steroid therapy), pregnancy/postnatal, IV drug users, recent surgery, *in situ* IV catheter. Note that fever, rigors and ↑ white cell count (WCC) may not be present.

- Organisms responsible include Gram +ve and –ve, especially *Staphylococcus aureus, Streptococcus pneumoniae, Neisseria meningitidis*, and coliforms including enterococci and *Bacteroides* (especially in patients with intra-abdominal emergencies such as ruptured diverticular abscess). In the immunocompromised, *Pseudomonas*, viruses, and fungi may cause septic shock.

Anaphylactic shock See ➲ Anaphylaxis, pp. 44–5.

Neurogenic shock See ➲ Spine and spinal cord injury, pp. 390–1.

Other causes

These include poisoning (see ➲ Poisons: supportive care, p. 191) and Addison's disease (see ➲ Addisonian crisis, p. 163).

Management of shock

Investigation and treatment should occur simultaneously. Get senior help immediately.

- Address the priorities—ABC.
- Give O_2 as required, according to SpO_2 measurements.
- Secure adequate venous access and take blood for FBC, U&E, glucose, LFTs, lactate, coagulation screen, and, if appropriate, blood cultures.
- Monitor vital signs, including pulse, BP, SpO_2, and RR.
- Check ABG.
- Monitor the ECG and obtain a 12-lead ECG and a CXR.
- Insert a urinary catheter and monitor urine output hourly.
- For shock associated with ↓ effective circulating blood volume, give IV crystalloid (0.9% saline) titrated in small boluses up to 20–30mL/kg according to response. Give further IV fluids ± blood [aim for haematocrit (Hct) >30%] according to aetiology and clinical response (and, in particular, pulse, BP, CVP, and urine output). Consider using the passive leg raise manoeuvre to help dynamically determine fluid responsiveness. Use caution with IV fluid infusion in shock related to cardiogenic causes and in ruptured or dissecting aortic aneurysm.
- Look for, and treat specifically, the cause(s) of the shock. Echocardiography, USS, CT, and/or surgical intervention may be required. Specific treatments include:
  - *Laparotomy*: ruptured abdominal aortic aneurysm, splenic and/or liver trauma, ruptured ectopic pregnancy, intra-abdominal sepsis.
  - *Thrombolysis/angioplasty*: MI.
  - *Thrombolysis*: PE.
  - *Pericardiocentesis/cardiac surgery*: cardiac tamponade, aortic valve dysfunction.
  - *Antidotes*: for certain poisons.
  - *Antibiotics*: sepsis. The choice of antibiotic will depend upon the perceived cause and local policies (eg ceftriaxone for meningococcal disease). Where there is no obvious source, empirical combination therapy is advised (eg co-amoxiclav + gentamicin + metronidazole). Obtain specialist microbiological advice early, especially in neutropenic/immunocompromised patients.
- Inotropic and vasoactive therapy, assisted ventilation, and invasive monitoring (including arterial and CVP lines) are often needed. Get specialist ICU help early, especially for COVID-19 (see ➲ COVID-19, p. 260.

Chapter 3

Medicine

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Electrocardiogram interpretation

The ECG is normally recorded so that a deflection of 10mm = 1mV. The recording rate is 25mm/s, 1mm = 0.04s, 1 large square = 0.2s. There is an ECG ruler on the inside back cover. Follow a systematic approach. The components of a normal ECG are shown in Fig. 3.1.

Rate Calculate the rate by dividing 300 by the number of large squares in one R–R interval.

Frontal plane axis Normally lies between –30° and +90° (see Fig. 3.2). With a normal axis, QRS complexes in I and II are both +ve. An axis more –ve than –30° (I +ve, aVF and II –ve) is *left axis deviation* (LAD) (causes: left anterior hemiblock, inferior MI, VT, Wolff–Parkinson–White (WPW) syndrome). An axis more +ve than +90° (I –ve, aVF +ve) is *right axis deviation* (RAD) (causes: PE, cor pulmonale, lateral MI, left posterior hemiblock).

P wave Normally <0.12s wide and <2.5mm tall. They are best seen in leads II and V_1 which are chosen for rhythm strips or monitoring. A tall peaked P wave in II may reflect right atrial hypertrophy, and a widened bifid P wave left atrial hypertrophy. P waves are absent in atrial fibrillation (AF).

PR interval Normally 0.12–0.2s (3–5 small squares). A short PR interval (abnormally fast conduction between atria and ventricles) implies an accessory pathway (eg WPW syndrome). A prolonged PR interval occurs in heart block (*first-, second-, or third-degree*) (see ➲ Bradyarrhythmias, p. 84).

QRS width Normally 0.05–0.11s (<3 small squares). Prolonged QRS complexes may be due to: right bundle branch block (RBBB) (RsR′ or M shape in V_1), left bundle branch block (LBBB) (QS or W shape in V_1 with RsR′ or M shape in V_6), tricyclic antidepressant poisoning (see ➲ Tricyclic antidepressant poisoning, p. 202), hypothermia, ventricular rhythms, and ectopics.

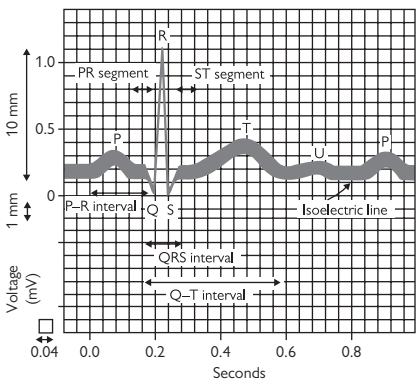

Fig. 3.1 Components of a normal ECG trace.

QRS amplitude The QRS amplitude can indicate left ventricular hypertrophy (LVH). Signs of LVH are: (S in V_2 + R in V_5) >35mm; R in I >15mm; and R in aV_L >11mm.

Q waves May be normal in III, aV_R, and V_1 but are abnormal in other leads if >0.04s or more than half the height of the subsequent R wave.

ST segment elevation Caused by: acute MI, pericarditis (concave up), ventricular aneurysm, Prinzmetal's angina, LVH, Brugada syndrome, hypertrophic cardiomyopathy (HCM), benign early repolarization.

ST segment depression Caused by: ischaemia, digoxin, LVH with strain.

QT interval = start of Q wave to end of T wave.

QT_c = QT/√R–R (Bazett's formula). Normal QT_c is <440ms. At rates of 60–100/min, QT should be less than half the R–R interval.

A *prolonged* QT_c predisposes to 'torsades de pointes' (see ➔ Broad complex tachyarrhythmias, p. 91) and is caused by acute MI, hypothermia, hypocalcaemia, drugs (quinidine, tricyclic antidepressants), and certain congenital diseases (eg Romano–Ward syndrome).

T waves Abnormal if inverted in V_4 to V_6. Peaked T waves are seen in early acute MI and hyperkalaemia (see ➔ Hyperkalaemia, p. 170). Flattened T waves (sometimes with prominent U waves) occur in hypokalaemia.

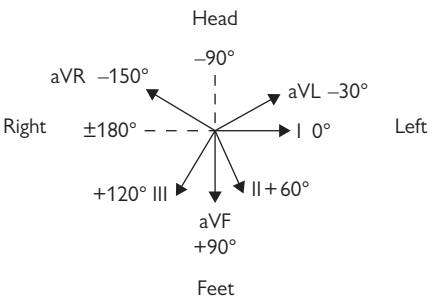

Fig. 3.2 Diagram of the ECG frontal axis.

Chest pain

Take chest pain seriously—it may reflect life-threatening illness. Triage as 'urgent', so patients are seen within a few minutes. IHD is understandably the first diagnosis to consider, but chest pain may be due to other disease processes, which may also be potentially life-threatening (see Table 3.1).

Table 3.1 The differential diagnosis of chest pain

Common causes	Less common causes
Musculoskeletal (eg costochondritis)	Aortic dissection*
Acute coronary syndrome*	Cholecystitis
Pneumothorax*	Herpes zoster
Oesophagitis	Oesophageal rupture*
Pneumonia	Pancreatitis*
Pulmonary embolism*	Vertebral collapse
Obscure origin (eg precordial catch)	Tabes dorsalis (very rare)

* Potentially rapidly fatal.

Reaching the correct conclusion requires accurate interpretation of the history, examination, and investigations, bearing in mind recognized patterns of disease presentations.

History

Characterize the pain

- Site (eg central, bilateral, or unilateral).
- Severity.
- Time of onset and duration.
- Character (eg 'stabbing', 'tight/gripping', or 'dull/aching').
- Radiation (eg to arms and neck in myocardial ischaemia).
- Precipitating and relieving factors (eg exercise/rest/GTN spray).
- Previous similar pains.

Enquire about associated symptoms Breathlessness, nausea, and vomiting, sweating, cough, haemoptysis, palpitations, dizziness, loss of consciousness.

Document Past history, drug history, and allergies. Old notes and old ECGs are invaluable—review them at an early stage.

Quickly consider Contacting cardiologists if ACS is likely (see ➲ STEMI: treatment, pp. 80–1).

Examination and resuscitation

Evaluate ABC and resuscitate (O_2, venous access, IV analgesia), as appropriate. Listen to both lung fields to check for tension pneumothorax and severe left ventricular failure (LVF). Complete full examination.

Investigations

These depend upon the presentation and likely diagnosis, but an ECG and a CXR are usually required. Remember that these may initially be normal in MI, PE, and aortic dissection. Ensure that all patients receive ECG monitoring in an area where a defibrillator is readily available.

Cardiac ischaemia

Angina occurs when coronary artery blood flow fails to meet the myocardial O_2 demand (eg exercise, coronary artery spasm, anaemia). It may cause ST depression or T wave inversion, which resolves on recovery.

Patients may come to the ED with angina as a first presentation of IHD. Always consider the possibility of MI, particularly if any pain lasts >10min.

► *A normal examination, a normal ECG, and a normal baseline troponin do not exclude MI. If in doubt, undertake formal rule-out with serial troponins.*

If considering discharge (eg with daily aspirin and chest pain clinic follow-up), discuss with senior ED staff.

Rule out strategies for acute coronary syndrome

Acute MI is still occasionally missed. Cardiac chest pain may be poorly localized and present with musculoskeletal features or GI upset. If the history is suspicious of being cardiac (especially with risk factors), formally exclude ACS. Interpret ECG and troponin in clinical context (old ECGs help). Become familiar with the hospital's troponin assay—there are many, with different 'cut' points to diagnose ACS. Unless significantly ↑, most high-sensitivity troponin assays use a 20% rise in absolute troponin level (over >3hr) to diagnose ACS, rather than a defined level. Clinical scores, such as the HEART score (see Table 3.2), may help to determine the probability of underlying myocardia ischaemia. If serial troponins are negative and HEART score low, ACS is an unlikely cause of the pain.

Table 3.2 HEART score for myocardial ischaemia

Risk factor	Feature	Points
History	Highly suspicious	2
	Moderately suspicious	1
	Slightly suspicious	0
ECG	Significant ST deviation	2
	Non-specific repolarization changes	1
	Normal	0
Age	>65y	2
	45–65y	1
	<45y	0
Risk factors	≥3 from: ↑ cholesterol, ↑ BP, smoker, diabetes, family history, obesity	2
	1–2 risk factors	1
	No risk factors	0
Troponin	>3x normal limit	2
	Between 1–3x normal limit	1
	Under normal limit	0

Total 0–3 = low score; 4–6 = moderate score; 7–10 = high score.

Acute coronary syndromes

Coronary artery plaque rupture can result in a variety of ischaemic conditions which fall under the overall term of 'acute coronary syndrome' and include unstable angina, non-ST segment elevation MI (NSTEMI), and ST segment elevation MI (STEMI). Patients labelled as having ACS, but without initial ST elevation, comprise a relatively heterogenous group—some later proving (on the basis of elevated blood troponin levels) to have suffered an NSTEMI.

The patient presenting with unstable angina or NSTEMI

Unstable angina can occur as worsening angina or as a single episode of 'crescendo' angina, with a high risk of infarction. Features include angina at rest, ↑ frequency, ↑ duration, and severity of pain (including response to GTN). It may be difficult to distinguish between unstable angina and NSTEMI in the ED. ECG changes may be subtle or non-existent (see Figs. 3.3 and 3.4).

- Provide O_2 if SpO_2 is <90%—aim to maintain SpO_2 at 90–94%.
- Attach a cardiac monitor.
- Administer IV opioid analgesia (± antiemetic) as required.
- Give aspirin 300mg orally (PO), if not already administered prehospital.
- Give clopidogrel 300mg PO (or prasugrel 60mg PO or ticagrelor 180mg PO), according to local guidelines.
- Start fondaparinux 2.5mg subcutaneous (SC) daily, unless there is a high risk of bleeding, renal impairment, or there is a plan to go to the Cath Lab, in which case give IV unfractionated heparin instead.
- If pain is unrelieved, commence GTN intravenous infusion (IVI). Start at 0.6mg/hr and ↑ as necessary, provided systolic BP is >90mmHg.
- Discuss all patients with NSTEMI and TIMI (thrombolysis in myocardial infarction) score >3 (see Table 3.3) or GRACE score >100 with the cardiology team—they may benefit from an early revascularization procedure (via angiography in the Cath Lab).
- If the patient has a high TIMI/GRACE score and a low risk of bleeding, consider glycoprotein IIb/IIIa inhibitors (eg eptifibatide and tirofiban) with IV heparin. *Note*: bivalirudin is an alternative—follow local protocols.
- If high risk of NSTEMI, haemodynamically stable, and no contraindications, consider atenolol (5mg IV slowly over 5min, repeated once after 15min), according to local policy. Contraindications include: hypotension, bradycardia, second- or third-degree heart block, heart failure, and severe reactive airways disease.
- Maintain blood glucose <11mmol/L.
- Refer for admission, repeat ECGs, and troponin.

Table 3.3 TIMI risk score: increasing score predicts mortality or adverse event

Risk factor	Points
Age >65	1
3+ risk factors for coronary artery disease: Family history of IHD, hypertension, hypercholesterolaemia, diabetes, or smoker	1
Known coronary artery disease with stenosis ≥50%	1
Aspirin use in last 7 days	1
Recent episode of angina prior to this event	1
Raised troponin levels (or other cardiac marker)	1
ST segment deviation ≥0.5mm on ECG	1

Normal lead II

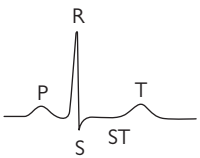

Fig. 3.3 Normal lead II.

Ischaemic changes in lead II

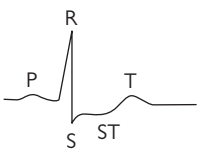

Fig. 3.4 Ischaemic changes in lead II.

Prinzmetal's or 'variant' angina

Angina associated with ST elevation may be due to coronary artery vasospasm. This may occur with or without a fixed coronary abnormality and may be indistinguishable from an acute MI until changes resolve rapidly with GTN as pain is relieved.

ST segment elevation MI

IHD is the leading cause of death in the Western world. Contributory risk factors for MI include smoking, hypertension, age, ♂ sex, diabetes, hyperlipidaemia, and family history.

MI pathology

MI mostly affects the left ventricle (LV). It usually results from sudden occlusion of a coronary artery or one of its branches by thrombosis over a pre-existing atheromatous plaque. Patients with IHD are at risk of sustaining an MI if additional stresses are placed upon their already critically impaired myocardial circulation (eg a high level of carboxyhaemoglobin (COHb) following smoke inhalation). MI may also occur in vasculitic processes, eg cranial arteritis (see ➲ Giant cell arteritis, p. 137) and Kawasaki disease.

MI diagnosis

The diagnosis of acute MI requires two out of the following three features:

- A history of cardiac-type ischaemic chest pain.
- Evolutionary changes on serial ECGs.
- A rise in serum cardiac markers.

Note that 50–60% of patients will not have a diagnostic ECG on arrival and up to 17% will have an entirely normal initial ECG. Late presentation does not improve the diagnostic accuracy of the ECG.

History

The classic presentation is of sudden onset, severe, constant central chest pain, which radiates to the arms, neck, or jaw. This may be similar to previous angina pectoris but is much more severe and unrelieved by GTN. The pain is usually accompanied by one or more associated symptoms: sweating, nausea, vomiting, and breathlessness.

Atypical presentation is common. Have a high level of suspicion. Many patients describe atypical pain, some attributing it to indigestion (be wary of new-onset 'dyspeptic' pain). Up to a third of patients with acute MI do not report any chest pain. These patients tend to be older, are more likely to be ♀, have a history of diabetes or heart failure, and have higher mortality. These patients may present with:

- LVF.
- Collapse or syncope (often with associated injuries, eg head injury).
- Confusion.
- Stroke.
- An incidental ECG finding at a later date.

In a patient who presents with possible MI, enquire about past medical history (IHD, hypertension, diabetes, hyperlipidaemia) and contraindications to thrombolysis. Ask about drug history, including drugs of abuse (particularly cocaine; see ➲ Cocaine, p. 223).

Examination

Examination and initial resuscitation (maintain SpO_2 in the normal range, IV cannula, analgesia) go hand in hand. The patient may be pale, sweaty, and distressed. Examination is usually normal, unless complications have supervened (eg arrhythmias, LVF). Direct initial examination towards searching for these complications and excluding alternative diagnoses:

- Check pulse and BP, and monitor trace (? arrhythmia or cardiogenic shock).
- Listen to the heart (? murmurs or third heart sound).
- Listen to the lung fields (? LVF, pneumonia, pneumothorax).
- Check peripheral pulses (? aortic dissection).
- Check legs for evidence of deep vein thrombosis (DVT) (? PE).
- Palpate for abdominal tenderness or masses (? cholecystitis, pancreatitis, perforated peptic ulcer, ruptured aortic aneurysm).

Investigations

The diagnosis of STEMI within the first few hours is based upon the history and ECG changes (serum cardiac markers may take several hours to rise—see below).

- Record an ECG as soon as possible, ideally within a few minutes of arrival at hospital. Sometimes patients arrive at hospital with ECGs of diagnostic quality already recorded by paramedics. If the initial ECG is normal, but symptoms are suspicious, repeat the ECG after 15min and re-evaluate (see ➲ Myocardial infarction: ECG changes 1, pp. 76–7 for a detailed explanation of the typical ECG features of acute MI).
- Review old notes (and, most importantly, previous ECGs for comparison).
- Ensure continuous cardiac monitoring and pulse oximetry.
- Monitor BP and RR.
- Obtain venous access and send blood for cardiac markers, U&E, glucose, FBC, and lipids.
- Obtain a CXR if there is suspicion of LVF or aortic dissection.

Cardiac markers

Troponins are now universally used. Troponin T (cTnT) and troponin I (cTnI) are proteins virtually exclusive to cardiac myocytes. However, cardiac cells may release troponin into the blood when cardiac muscle is damaged by pericarditis, PE with a large clot burden, or sepsis. Renal impairment reduces the excretion of troponin, so can result in higher levels.

Myocardial infarction: ECG changes 1

Infarction of cardiac muscle results in ECG changes that evolve over hours, days, and weeks in a relatively predictable fashion (see Fig. 3.5).

Hyperacute changes

Frequently ignored, although often subtle, some or all of the following may be observed within minutes of infarction:

- ↑ *ventricular activation time*, since the infarcting myocardium is slower to conduct electrical impulses. The interval between the start of the QRS complex and the apex of the R wave may be prolonged >0.045s.
- ↑ *height of R wave* may be seen initially in inferior leads in inferior MI.
- *Upward-sloping ST segment*—having lost normal upward concavity, the ST segment straightens, then slopes upwards, before becoming elevated.
- *Tall, widened T waves.*

Evolving acute changes

In isolation, none of these changes are specific to MI. In combination and with an appropriate history, they can diagnose MI:

- *ST elevation*: the most important ECG change. ST segments become concave down and are significant if elevated >1mm in two limb leads or >2mm in two adjacent chest leads (see Figs. 3.6 and 3.7).
- *Reciprocal ST depression* may occur on the 'opposite side' of the heart (see Fig. 3.6).
- *Pathological Q waves* (defined in ➲ Electrocardiogram interpretation, p. 69) reflect electrically inert necrotic myocardium. ECG leads over a large transmural infarct show deep QS waves. Leads directed towards the periphery of a large infarct or over a smaller infarct may show a QR complex or a *loss of R wave amplitude*.
- *T wave inversion*: typically deeply inverted, symmetrical, and pointed.
- *Conduction problems* may develop. LBBB in a patient with acute cardiac chest pain makes interpretation of the ECG very difficult. LBBB does not have to be new to be significant. Do not delay intervention in patients with a good clinical history of MI in order to obtain old ECGs.

Sgarbossa criteria for diagnosing ACS in the presence of LBBB

- ST segment elevation >1mm in leads with positive QRS complexes.
- ST segment depression in leads V_1, V_2, or V_3.
- ST segment elevation >5mm in leads with negative QRS complexes.

If all three are present, MI is likely.

Chronic changes

In the months following an MI, ECG changes resolve to a variable extent. ST segments become isoelectric, unless a ventricular aneurysm develops. T waves gradually become +ve again. Q waves usually remain, indicating MI at some time in the past.

Electrocardiogram changes following myocardial infarction

Fig. 3.5 Electrocardiogram changes following myocardial infarction.

Electrocardiograms after myocardial infarction

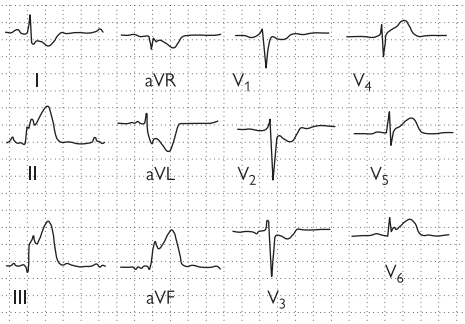

Fig. 3.6 Acute inferolateral infarction with 'reciprocal' ST changes in I, aV_L, and V_2 to V_3.

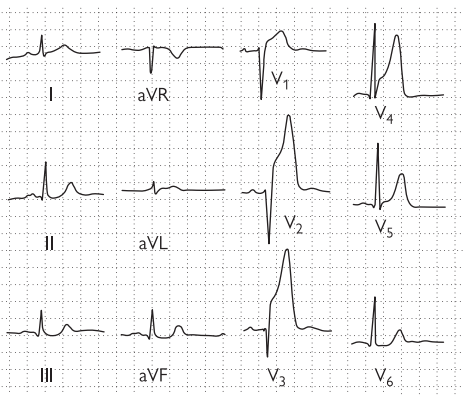

Fig. 3.7 Acute anteroseptal infarction with minimal 'reciprocal' ST changes in III and aV_F.

Myocardial infarction: ECG changes 2

Localization of myocardial infarction

MI usually affects the LV and occasionally the right ventricle (RV), but virtually never the atria. The part of the myocardium affected is implied by which leads show changes (see Table 3.4).

Table 3.4 ECG leads showing changes in various MIs

ECG leads	Location of MI
$V_{1–3}$	Anteroseptal
$V_{5–6}$, aV_L	Antero-lateral
$V_{2–4}$	Anterior
$V_{1–6}$	Extensive anterior
I, II, aV_L, V_6	Lateral
II, III, aV_F	Inferior
V_1, V_4R	RV

Posterior myocardial infarction

Posterior MI nearly always occurs as part of inferior (postero-inferior) or lateral (postero-lateral) MI. No conventional electrode views the posterior heart, since intervening tissues result in an attenuated signal. ECG diagnosis of true posterior MI may be made from the use of $V_{7–9}$ and from reciprocal changes seen in leads $V_{1–3}$: tall, slightly widened R (reciprocal of Q), concave-up ST depression (reciprocal of ST elevation), and upright tall, widened T (reciprocal of inverted T).

Right ventricular infarct

This occurs most often as part of an inferior MI. In the presence of changes of acute MI in the inferior leads, ST elevation in V_1 suggests RV involvement. In this case, record an ECG trace from lead V_4R. The diagnosis of RV infarct helps determine treatment of ensuing cardiac failure. Treat RV failure with IV fluids to maintain adequate filling pressure, and exercise caution if considering use of nitrates.

Blood supply to the heart and coronary artery dominance

The left anterior descending artery supplies the anterior and septal cardiac areas (see Fig. 3.8). The circumflex branch supplies the antero-lateral aspect of the heart. The right coronary artery supplies the RV. In most people, the right coronary artery also supplies the sino-atrial (SA) node, the inferior wall of the LV, and the ventricular septum. In 15% of individuals, the inferior wall is supplied by the circumflex branch of the left coronary artery (left dominance).

Subendocardial infarcts can produce dramatic ECG changes (see Fig. 3.9) without the ST elevation seen in transmural infarction.

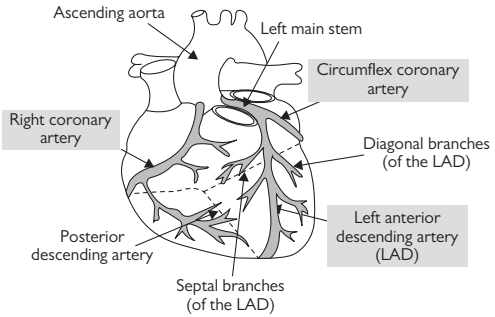

Fig. 3.8 Blood supply to the heart.

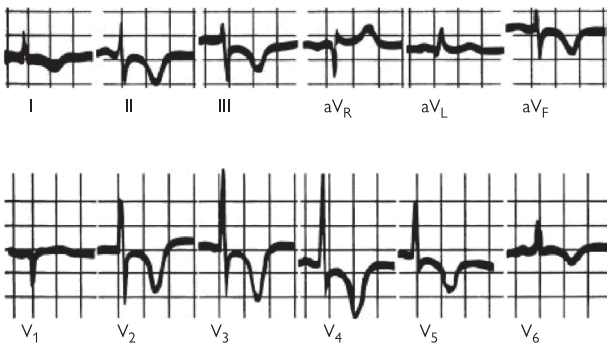

Fig. 3.9 ECG of subendocardial infarct.

STEMI: treatment

Speed is crucial—time is muscle. Work efficiently as a team to ensure treatment is not delayed.

- Give O_2 if needed (to maintain SpO_2 90–94%; see ➔ Oxygen, p. 99), and attach a cardiac monitor.
- Contact cardiology for primary percutaneous coronary intervention (PCI).
- Provide IV morphine, titrated to effect (± antiemetic).
- Ensure the patient has had aspirin 300mg—this is likely to have been given prehospital, but check and give it if not.
- Obtain IV access and take samples for U&E, glucose, FBC, and troponin.
- Give a second antiplatelet agent as per local protocol (eg ticagrelor loading dose 180mg PO, or prasugrel or clopidogrel). Avoid ticagrelor if the patient has a history of intracranial haemorrhage, has active bleeding or moderate hepatic impairment, and is on an anticoagulant.
- Arrange immediate transfer to the Cath Lab for PCI if <12hr from symptom onset (or >12hr with cardiogenic shock).
- If PCI cannot be delivered within 90min, assess the risk of bleeding and offer thrombolysis using local protocol (tenecteplase, reteplase, or alteplase).
- If pain continues, give IVI GTN (start at 0.6mg/hr and ↑ as necessary), provided systolic BP is >90mmHg.
- Consider atenolol (5mg IV slowly over 5min, repeated once after 15min) or metoprolol, unless contraindicated (eg uncontrolled heart failure, hypotension, bradyarrhythmias, COPD).

Indications for PCI or thrombolysis

- ST elevation of >1mm in two limb leads, or
- ST elevation of ≥2mm in two or more contiguous chest leads, or
- LBBB in the presence of a typical history of acute MI (*Note*: LBBB does not have to be new—see ➔ Sgarbossa criteria for diagnosing ACS in the presence of LBBB, p. 76).

Primary angioplasty for ST segment elevation MI

Primary PCI (coronary angioplasty and stenting) is the treatment of choice for STEMI. Compared to thrombolysis, PCI administered within 12hr of symptom onset results in lower mortality and re-infarction rates. The sooner it is performed, the greater the benefits.

Thrombolysis

If PCI cannot be performed within 90min of diagnosis, thrombolysis is an alternative. The benefits reduce markedly with time delay, so if PCI is not available, do not delay thrombolysis. Rural areas with long hospital transfers may have a protocol for ambulance-administered thrombolysis, aided by telemedicine advice from the ED or cardiology. Patients presenting >12hr after symptom onset will not benefit from thrombolysis.

Strokes, intracranial haemorrhage, and major bleeds are more common in patients given thrombolysis. Intracranial bleeding is more common in older patients, those with hypertension on admission, and those given tissue plasminogen activator (tPA). Prior to administering thrombolysis, always explain the benefits and risks. Obtain verbal consent to give it and record this in the notes.

Contraindications to thrombolysis

Absolute contraindications include:

- Stroke in past 3 months, neurosurgery within 6 months, intracranial bleed within a year.
- Any cerebral tumour or metastases.
- GI, genitourinary (GU), retroperitoneal, or intraocular bleeding within the last month.
- Coagulopathy (eg haemophilia), anticoagulation (warfarin, rivaroxaban, apixaban, dabigatran, edoxaban, or LMWH).
- Platelet count $<50 \times 10^9$/L.
- Severe hypertension: systolic BP >200mmHg, diastolic BP >120mmHg.
- Major surgery within the last 2 weeks.

Relative contraindications include:

- Pregnancy.
- Stroke within past year.
- Major bleeding within past 3 months.
- History of any intracranial bleed.
- Traumatic CPR.
- Puncture of non-compressible vessel (eg subclavian vein).
- Major surgery within past month.

Choice of thrombolytic agents

- Alteplase (recombinant tPA (rtPA)): give by an accelerated regimen, eg 15mg IV bolus, followed by 0.75mg/kg (max 50mg) IVI for 30min, then 0.5mg/kg (max 35mg) IVI over 60min. Give LMWH (eg enoxaparin 1mg/kg stat) or heparin concomitantly through a separate IV line (5000U IV bolus, then 1000U/hr IV), according to local protocols.
- Reteplase (modified tPA): give as two IV boluses of 10U each, exactly 30min apart. Give LMWH/heparin as for alteplase.
- Tenecteplase (modified tPA): give as a single IV bolus over 10s. Dose according to weight (<60kg = 30mg; 60–69kg = 35mg; 70–79kg = 40mg; 80–89kg = 45mg; >90kg = 50mg). Give LMWH/heparin as for alteplase.
- Streptokinase: give as 1.5 mega-units by IVI over 1hr. Streptokinase is allergenic (may need slow IV chlorphenamine 10mg and IV hydrocortisone 100mg) and causes hypotension (↓ IVI rate and tilt the bed head down—treatment rarely needs to be stopped). Patients can develop antibodies to streptokinase, so do not give if administered in the past year.

Further management

Arrhythmias Occur commonly after MI. Occasional ventricular ectopics or transient AF (lasting <30s) require no treatment. Watch for sudden VT/VF and treat as described in ➲ Cardiac arrest, p. 48.

Hypokalaemia Treat if K^+ <4mmol/L.

Pulmonary oedema Treat as described in ➲ Cardiogenic pulmonary oedema, p. 105.

Cardiogenic shock Mortality is high. Contact ICU/cardiology. Emergency echocardiography may exclude conditions requiring urgent surgery (mitral regurgitation from papillary muscle rupture, aortic dissection, ventricular septum rupture, cardiac tamponade from ventricular wall rupture). If these are excluded, emergency coronary intervention may ↑ survival.