

BUMED PHYSIOLOGICAL EPISODES CLINICAL PRACTICE GUIDELINE

16 JUNE 2020

This Clinical Practice Guideline (CPG) should be viewed as a bare minimum checklist. Its use will standardize evaluation and re-evaluation. All aircrew from any flight that results in physical symptoms should be initially triaged and evaluated to identify red flags and any medical emergencies. If any medical emergency is identified, call 911 or facilitate transport to the highest level of care available. For Physiological Episodes and Events, documentation in the medical record is required.

Evaluate for Red Flags in all Aircrew (Symptomatic and Asymptomatic)

Red Flags

- ☐ Glasgow Coma Scale (GCS) < 13
- ☐ Deteriorating level of consciousness
- ☐ Double vision
- ☐ Increased restlessness, combative or agitated behavior
- ☐ Repeat vomiting
- ☐ Seizures
- ☐ Weakness in arms or legs
- ☐ Severe or worsening headache

Decompression Syndrome Red Flags

- ☐ Suspected Decompression Syndrome (DCS) requires:
 - Aviation Exposure (rapid decompression at altitude, usually cabin altitude of 18,000 ft or greater)
- AND**
- DCS Signs and Symptoms:
 - Chest pain, dyspnea, dysrhythmia (indications of coronary artery disease [CAD])
 - Slurred speech, facial droop (indications of cardiovascular disease [CVD])

For expanded information on DCS and Arterial Gas Embolism (AGE) see Section E

If red flags are present call 911 or take to emergency room in ambulance on 100% oxygen and initiate oral or parenteral hydration. Neurological signs and symptoms associated with the above occurrences require rapid treatment.

If DCS red flags are present and DCS is suspected after medical evaluation or for any questions or concerns, call the NAMI UMO hotline 850-449-4629 (if unavailable, call 911/take to emergency room/contact regional hyperbaric chamber).

- ☐ No Red Flags -> proceed with CPG

Aviation Exposure and Flight Parameters

The aviation exposure and flight parameters information needs to be documented in both the Naval Safety Center, Part C, and the patient's electronic medical record encounter as part of the patient history.

- ☐ Environmental Control System (ECS)/Pressurization Malfunction or Fluctuation
- ☐ On-Board Oxygen Generation System (OBOGS)/Breathing Gas Malfunction or Degrade
- ☐ Timeline of symptom(s) onset in relation to aircraft malfunction/degrade/warning
- ☐ Flight Altitude at time of malfunction/degrade/warning and time of symptom(s) onset
- ☐ Flight Profile and Event Type
- ☐ All aircrew with similar symptoms and onset

Naval Aviation Physiological Event Clinical Practice Guideline Flight Line Response and Aviation Medicine Clinic Evaluation

Development of a full differential diagnosis including etiologies possibly related to prior medical conditions, current medications or supplements, and recent illness or injury is expected. Aircrew symptoms may not always have a direct cause from pressure and altitude change, breathing gas, or other occupational exposures known to aviation, but may be contributory to initiating or worsening symptoms from pre-existing conditions [1].

A Physiological Event (PE) occurs when a known or suspected aircrew or aircraft system (pressurization system-ECS or breathing gas system-OBOGS/LOX) malfunction and aircrew physiologic symptoms occur during or after the flight.

When notified, an Aviation Medicine Provider does one of the following depending on reported aircrew symptoms:

1. Advise aircrew to proceed directly to Aviation Medicine Clinic. Obtain labs (section C) immediately.
2. Aviation Medicine Provider meets aircrew at flight line with PE evaluation kit.
3. EMS transports aircrew to emergency department (on 100% O₂) and flight surgeon rides along if allowed or meets aircrew at emergency department to communicate this is a PE-related patient.

Once all aircrew are triaged as stable, the Aviation Medicine Provider shall contact the local Aeromedical Safety Officer (AMSO) to activate the Physiological Event Rapid Response Team (PERRT) and request the AMSO obtain the Slam-Stick and maintenance report of aircraft malfunction while provider performs initial aircrew assessment.

A) Initial Screening at the Flight Line or in the Aviation Medicine Clinic

Obtain Vital Signs and Blood Analysis:

- Blood pressure
- Heart rate
- Respiratory rate
- Temperature
- Rad-57 or Rad-97 (SpO₂, SpCO)
SpCO is screening NOT diagnostic (if SpCO > 10%, place on 100% O₂ and draw COHb if available) [2, 3, 4, 5, 6]
- iSTAT Point-of-Care Handheld Blood Analyzer ABG [7, 8, 9, 10, 11, 12]

Neurological Screen [13, 14]:

1. Can the aircrew read aloud and follow instructions without difficulty?
2. Are aircrew oriented to day/month/year/time/squadron/flight event?
3. Without moving their head or neck, can the aircrew look side-to-side and up-down without double vision or nystagmus?
4. Can the aircrew perform the finger to nose coordination test normally?
5. Can the aircrew perform tandem gait normally (with boots on if on the flight line)?

If screening performed at flight line: NO red flags and stable vitals with normal neurological screen, then proceed to Aviation Medicine Clinic. If oxygen not available at Aviation Medicine Clinic and either SpCO >10% or abnormal ABG, proceed to higher level of care.

B) Initial History and Physical in the Aviation Medicine Clinic

Obtain history of physiological event and symptom onset. Include information required for Naval Safety Center Part C as practical. In addition to completing the Part C, the aircrew evaluation resulting from this CPG shall be documented in the electronic medical record using the Tri-Service Workflow template (TSWF) for "Flight Event." This TSWF template is located on the TSWF Navigator under the Operational Medicine tab (not available in AHLTA-T and pending in MHS Genesis).

A 72-hour retrospective history is a Naval Safety Center requirement for a PE that meets classification as a Flight Mishap. It is not required as part of the PE CPG or to be documented in the medical record.

Review of Systems:

- ☐ Headache (location, severity, and unilateral/bilateral)
- ☐ Nausea/vomiting (evaluate for pre-flight cause, food, recent illness)
- ☐ Numbness/tingling (location, onset, duration, prior history or injury, occupational exposure)
- ☐ Respiration (difficulty with inspiration or exhalation, change in depth or rate)
- ☐ Changes to vision (double, blurry, color, depth, field, unilateral/bilateral)
- ☐ Changes to hearing (hypersensitive, reduced, ringing, unilateral/bilateral, hobbies)
- ☐ Dizziness (onset, change with emergency O₂ if used, medication)
- ☐ Vertigo (onset, flight maneuver at the time, day/night, recent illness, prior history, medication)
- ☐ Balance/coordination difficulties (onset, egress difficulty, landing difficulty)
- ☐ Cognitive concerns (feeling behind the jet, fog, slowed down, dazed, confused)
- ☐ Fatigue (onset, last meal, hydration, recent illness, stressors, work tempo)
- ☐ Sleep (last 24, 48, 72 hours initially, during usual cycle?, on re-evaluation each night prior)
- ☐ Recent Illness (especially upper respiratory, sinus, ear, eye infections, OTC medications)
- ☐ Hydration (last 24 hours and last water intake prior to flight, energy drinks, diuretic drinks)
- ☐ Physical Activity (last workout, recent changes in workout frequency or intensity)
- ☐ Diet (recent change in diet, started new diet, allergies, food in last 24 hours including during flight)

Pertinent Aerospace Medical History:

- ☐ History of Prior PE, Date _____
 - ☐ Waiver or history of Headache
 - ☐ Waiver or history of Ear/Vestibular disease
 - ☐ Waiver or history of Respiratory disease
 - ☐ Waiver or history of Head Trauma/Concussion/TBI
 - ☐ Recent flight with cabin pressure abnormalities
 - ☐ Scuba Diving in last 72 hours
 - ☐ Waiver or history of Sinus disease
 - ☐ History of contact sports/high impact activities
- If Concussion/TBI: year, mechanism of injury, loss of consciousness, associated symptoms

Physical Exam:

- ☐ Full exam and detailed neurological exam to include MACE II.
MACE II Vestibular/Ocular-Motor Screening (VOMS) for Concussion Score Card is required to be fully filled out. VOMS Score Card section can be found in the TSWF Flight Event template.

At each required 24 hour re-evaluation, perform detailed neurological exam to include MACE II

C) Initial Labs and Imaging in the Flight Medicine Clinic

Labs should be obtained **as soon as possible** after the flight to analyze the effects of the aviation environment exposure. Draw labs **immediately** upon the aircrew arrival to the clinic and **before** the history and physical.

Labs:	<input type="checkbox"/> CBC	<input type="checkbox"/> CMP	<input type="checkbox"/> U/A	<input type="checkbox"/> SRS
	<input type="checkbox"/> VBG (if iSTAT ABG not obtained during initial screening) Consider COHb if indicated (SpCO >10% and symptoms)			
Imaging:	No initial screening imaging required CXR if respiratory symptoms or exam findings Water's View if new onset frontal or maxillary headache/pain from pressure related PE			

D) Treatment Plan and Duty Status

For all symptomatic aircrew regardless of symptom resolution, re-evaluation must occur within 24 hours post initial evaluation and after a complete period of sleep.

Provide 24-hour **future** history sheet at each evaluation to journal symptoms, meals, exercise, social interactions, naps/sleep, and medication/supplement/vitamin use. Provide sheets even if aircrew are asymptomatic to use until returned to Up Flight Duty Status or instructed otherwise. (Appendix C)

Whether symptomatic or not, provide family, friend, or roommate PE CPG Family Friend Handout (Appendix B) detailing red flags, caution signs, and contact information for Flight Medicine Clinic and after hour care options.

Initial Evaluation:

- ☐ **Aircrew asymptomatic:** Aircrew have no exam findings or become completely asymptomatic after a period of 100% Ground Level Oxygen. Discharged with a 24-hour Sick-In-Quarters (SIQ) form to indicate No Duty and No Flying. Re-evaluate in 24 hours and if still asymptomatic issue DD 2992 (Up Chit).
- ☐ **Aircrew symptomatic:** Discharge to family member, friend or roommate and place on 72-hour SIQ with instructions; complete rest other than re-evaluation and **No Duty, No Flying, No Tobacco Products, and No Alcohol x 72 hours**. Return for re-evaluation in 24 hours. Non-narcotic pain medication may be used. Continue pre-PE prescribed medication as appropriate. If shipboard, may eat in wardroom as tolerated and normalize sleep/wake cycle.

24 Hour Re-Evaluation:

- ☐ **Aircrew newly asymptomatic:** Continue with Sick-In-Quarters (SIQ) to indicate No Duty and No Flying. Re-evaluate in 24 hours and if still asymptomatic issue DD 2992 (Up Chit).
- ☐ **Aircrew symptomatic:** Discharge to family member, friend or roommate and continue SIQ x 48 hours with instructions; complete rest other than re-evaluation in 24 hours.

48 hour Re-evaluation (only required if persistent abnormalities at 24 hour assessment or new onset of symptoms):

- ☐ **Aircrew newly asymptomatic:** Continue with Sick-In-Quarters (SIQ) to indicate No Duty and No Flying. Re-evaluate in 24 hours and if still asymptomatic issue DD 2992 (Up Chit).
- ☐ **Aircrew symptomatic:** Discharge to family member, friend or roommate and continue SIQ x 24 hours with instructions; complete rest other than re-evaluation in 24 hours.

72 hour Re-evaluation (only required if persistent abnormalities at 48 hour assessment or new onset of symptoms):

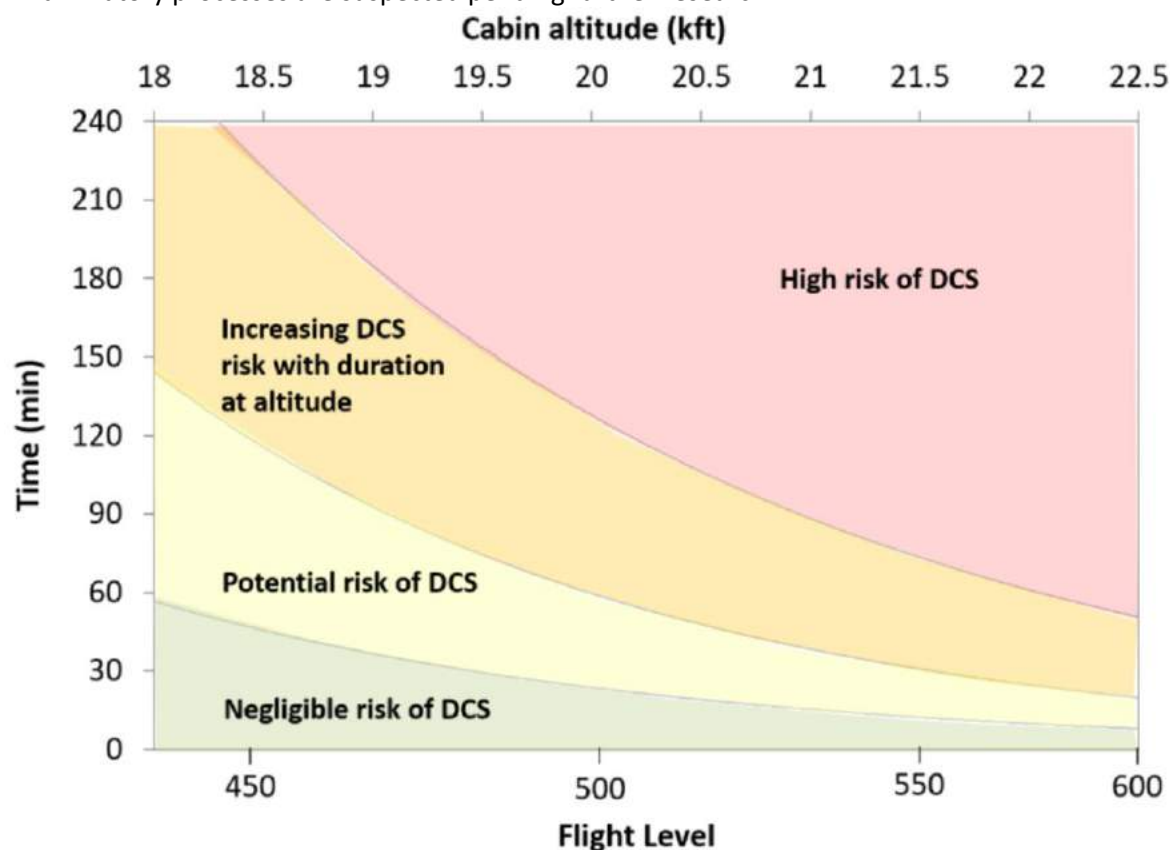
- ☐ **Aircrew newly asymptomatic:** Issued additional 24 hours Sick-In-Quarters (SIQ) form to indicate No Duty and No Flying. Re-evaluate in 24 hours and if still asymptomatic issue DD 2992 (Up Chit).
- ☐ **Aircrew symptomatic:** Contact Regional Intrepid Spirit Center to discuss case and timeline for referral. Inform Senior Region Flight Surgeon (SRFS) or Marine Air Group (MAG) Surgeon. Inform TYCOM Force Surgeon per their current guidance.

Hyperbaric Oxygen Therapy (HBOT) prescribed in consultation with NAMI UMO:

- ☐ Issue 24-hour SIQ form to indicate No Duty and a DD 2992 grounding chit to the treated aircrew for 14 days from date of last HBOT treatment.
- ☐ Re-evaluate at the end of the SIQ and discuss results with NAMI UMO.
- ☐ See *Section E* below

E) Altitude Decompression Illness (DCS/AGE)

A rare condition in aviation that requires a combination of **cabin altitude** usually greater than 18,000 feet cabin altitude and rapid and/or drastic changes in ambient pressure together with maladaptive responses. Results in the formation of bubbles in predisposed tissues and/or barotrauma. Other inflammatory processes are suspected pending further research.



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DCS/AGE expresses itself in a variety of manifestations that can occur singly or in an overlapping fashion to include:

Constitutional	Headache and fatigue BEYOND that which might be expected after flight or strenuous exercise, anorexia, poorly localized muscular aches and pains.
Neurological	Paresthesia, hyperesthesia, or numbness throughout dermatomal or regional areas. *Tingling on its own is not significant unless persistent after initial medical treatment.
Cognitive	Amnesia, depressed mood, behavioral changes, depressed executive thinking.
Musculoskeletal	Deep, aching pains difficult to localize with any precision, commonly centered on a synovial joint, with the most frequently being shoulder>elbow>knee, usually

without evidence of inflammation. The joint pain does not exacerbate on movement or palpation of the joint.

May precede a symptom of serious decompression sickness. Starts as intense itching, progresses to redness, and then gives way to a patchy, dark-bluish discoloration of the skin. The skin may feel thickened. In some cases, the rash may be raised. *Itching by itself is generally transient and does not require recompression. Faint skin rashes may be present in conjunction with itching. These rashes also are transient and do not require recompression.

**Cutis marmorata
(Mottling or
marbling of the
skin)**



Regardless of presentation standard of care should not be delayed in-lieu of hyperbaric consultation. If no etiology is identified and the symptoms persist after completion of medical workup, contact the NAMI UMO for consultation.

EXCEPTION: In cases presenting cutis marmorata (see above image), or loss of consciousness, and/or paralysis, even if resolved, contact the UMO immediately.

If decompression illness is suspected, call the NAMI UMO hotline 850-449-4629 (if unavailable, call 911/take to emergency room/contact regional hyperbaric chamber).

Appendix A: Report of Physiological Episode/Event Medical History

For aircrew and aeromedical provider (AMS, FS, AME, APA) to complete and review.

CPG RED FLAGS

PATIENT	YES	NO
Do you have double vision?		
Do you have increased restlessness, combative, or agitated behavior?		
Do you have repeat vomiting?		
Do you have weakness or tingling in the arms or legs?		
Do you have a severe or worsening headache?		
PROVIDER	YES	NO
Is the patient's Glasgow coma scale below 13?		
Does the patient have deteriorating level of consciousness?		
Did the patient have a seizure?		

If any of the above are checked yes, immediately consult higher level of care and consider urgent evacuation according to evaluation precedence/TCCC.

DESCRIPTION OF PHYSIOLOGICAL EPISODE/EVENT

What do you remember? What happened?

What was the flight profile and event type?

Was there an Environmental Control System (ECS) malfunction or pressure fluctuation?

Was there an On-Board Oxygen Generation System (OBOGS) degrade or breathing gas malfunction?

What was your flight altitude at the time of aircraft system malfunction?

What was your flight altitude when you first experienced symptoms?

What was the timeline of symptoms in relation to aircraft system malfunction?

Did you require emergency oxygen? Did it resolve your symptoms?

Did all aircrew have similar symptoms?

GENERAL REVIEW OF SYSTEMS	YES	NO
Do you feel fatigued?		
Have you had any recent illness or symptoms?		
Have you had any nausea or vomiting? How often?		
Have you had any diarrhea? How often?		
Have you travelled anywhere in the last two weeks?		
<ul style="list-style-type: none"> List locations: 		
Have you had any contact with someone sick?		
Have you noticed any change in the depth or rate of your breathing or had any difficulty breathing?		

NEUROLOGICAL REVIEW OF SYSTEM	YES	NO
Do you have a headache?		
<ul style="list-style-type: none"> Describe the headache: 		
Do you have neck pain?		
Do you feel lightheaded?		
Do you have dizziness?		
Do you feel like room is spinning when you are sitting still or like you are on a boat?		
Do you have memory problems?		
Has your reaction time slowed? Do you "feel slow"?		
Do you now have difficulty making decisions?		
Do you have balance problems?		
Do you any visual disturbances (double vision, blurry vision, changes in color vision or depth)?		
<ul style="list-style-type: none"> Describe the changes: 		
Do you have a new sensitivity to light?		
Do you have any ringing in the ears?		
Do you have any other changes to your hearing?		
Do you have a new sensitivity to noise?		
<ul style="list-style-type: none"> Describe the changes: 		

PSYCHOLOGICAL REVIEW OF SYSTEMS	YES	NO
Have you had difficulties with sleep?		
Do you feel tired or drowsy?		
Do you feel irritable?		
Do you feel inattentive?		
Do you feel sad depressed?		
Do you feel nervous or anxious?		
Do you have difficulty concentrating?		
Do you "not feel right"?		

AEROSPACE MEDICAL HISTORY	YES	NO
Have you previously had a physiological event or physiological episode?		
<ul style="list-style-type: none"> Dates: 		
Do you have a history of headache?		
Do you have a waiver for headache?		
Do you have a history of head trauma, traumatic brain injury (TBI), or concussion?		
<ul style="list-style-type: none"> Dates: Method of injury: Symptoms (include if there was loss of consciousness): 		
Do you have a waiver for head trauma, traumatic brain injury (TBI), or concussion?		

Do you have a history of impact activities or contact sports (played high school football, rugby, etc.)?		
Do you have a history of ear or vestibular disease?		
AEROSPACE MEDICAL HISTORY (CONTINUED)	YES	NO
Do you have a waiver for ear or vestibular disease?		
Do you have a history of sinus disease?		
Do you have a history of respiratory disease?		
Have you had a recent flight with cabin pressure abnormalities?		
Have you SCUBA dived in the last 72 hours?		

MEDICAL HISTORY
List your medications (include over the counter medications, herbal supplements, and workout supplements):
List your physical activity in the last 24 hours (include last workout and recent changes in frequency or intensity):
List all your food intake in the last 24 hours (include any recent dietary changes):
List all fluid intake in the last 24 hours (include last fluid intake prior to flight, any fluid intake during flight, energy drink, soda, coffee, etc. – include volumes of fluid intake):
List all other concerns:

72 HOUR SLEEP HISTORY

Fill in the blocks for all time periods when asleep for the past three days.

Example: Slept from 2200-0600 with a nap from 0900-1000 and 1430-1445.

00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
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00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23

Appendix B: Family and Friends Handout For Physiological Event Patients

This handout is given to aircrew after a physiological event (PE) flight if symptoms persist or have not developed but there is potential that symptoms might. Aircrew that have experienced a physiological event during a recent flight have either been exposed to changes in barometric pressure at altitude and/or changes in their respiration due to the flight environment. Most of the time the symptoms that occur from these flights resolve during the flight or shortly thereafter. It is important to understand that symptoms may develop over 72-hours after the flight. In some cases, the symptoms can continue for many days. It is important to monitor patients for up to 72-hours if symptoms persist.

PE symptoms may include, but are not limited to, headache, nausea, fatigue, difficulties breathing, vertigo or dizziness, disorientation, cognitive disorders like difficulties with concentration, numbness/tingling of extremities, sensory alterations, visual changes or difficulty tracking/reading. You will want to watch for and ask if there is any increase in symptom severity or new symptoms that have developed. When symptoms do not develop in flight but there has been an unusual change in cockpit pressure, symptoms appear within 2-hours in 61% of cases, 10-hours in 83%, 20-hours in 94%, and 24-hours in 97% of cases. As symptoms can develop after a prolonged time (72-hours or more), exposed aircrew may not recognize their decreased cognitive performance or other symptoms. A family member or friend informed about the PE flight may be the best at noticing developing symptoms.

Documenting this observation period in the provided journal style pages will help medical staff understand these symptoms and best work to resolve them. We thank you for being part of our healthcare team and want you to know we are here for questions or concerns 24-hours a day. If you have increasing concerns from your observations or interaction with your family member or friend, please encourage them to follow-up with their healthcare provider or if you believe there is significant change please bring them to the nearest medical facility or dial 911.

Flight Surgeon Contact Information:

AMSO Contact Information:

Follow-Up Appointment(s):

Appendix C: 24 Hour Daily Post-Event Journal

List all activities in the categories below for 24 hours after symptomatic flight. Please provide a minimum of three journal entries for a total of 72 hours and an additional entry for each day with symptoms.

Flight Surgeon Contact Information:

AMSO Contact Information:

List all symptoms (previously documented, new onset, and mood changes) and if there have been any changes since last evaluation:

List all medication intake (include over the counter medications, herbal supplements, and workout supplements):

List your physical activities in the last 24 hours to include housework and leisure activity:

List all your food intake in the last 24 hours to include meals and snacks:

List all fluid intake in the last 24 hours to include type of fluid and volume:

List all social interactions:

24 HOUR SLEEP HISTORY

Fill in the blocks for all time periods when asleep.

Example: Slept from 2200-0600 with a nap from 0900-1000 and 1430-1445.

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00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
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References:

1. Roach RC, Lawley JS, Hackett PH. Wilderness medicine. 7th ed. Philadelphia (PA): Elsevier; c2017. Chapter 1, High-altitude physiology; p. 2.
2. Ernst A, Zibrak JD. Carbon monoxide poisoning. *N Engl J Med*. 1998 Nov;339(22):1603-8.
3. Kao LW, Nanagas KA. Carbon monoxide poisoning. *Emerg Med Clin North Am*. 2004 Nov;22(4):985-1018.
4. Haper A, Croft-Baker J. Carbon monoxide poisoning: undetected by both patients and their doctors. *Age Ageing*. 2004 Mar; 32(2):105-9.
5. Touger M, Birnbaum A, Wang J, et al. Performance of the RAD-57 pulse CO-oximeter compared with standard laboratory carboxyhemoglobin measurement. *Ann Emerg Med*. 2010 Oct;56(4): 382-8.
6. O'Malley GF. Non-invasive carbon monoxide measurement is not accurate. *Ann Emerg Med*. 2006 Oct;48(4):477-8.
7. British Thoracic Society; Association of Respiratory Technicians and Physiologists. Guidelines for the measurement of respiratory function. Recommendations of the British Thoracic Society and the Association of Respiratory Technicians and Physiologists. *Respir Med*. 1994 Mar;88(3):165-94.
8. American Association for Respiratory Care. AARC clinical practice guideline. Sampling for arterial blood gas analysis. *Respir Care*. 1992 Aug;37(8):913-7.
9. Williams AJ. ABC of oxygen: assessing and interpreting arterial blood gases and acid-base balance. *BMJ*. 1998 Oct 31;317(7167):1213-6
10. Hansen JE. Arterial blood gases. *Clin Chest Med*. 1989 Jun;10(2):227-37.
11. Harsten A, Berg B, Inerot S, et al. Importance of correct handling of samples for the results of blood gas analysis. *Acta Anaesthesiol Scand*. 1988 Jul;32(5):365-8.
12. Swenson ER. Advances in experimental medicine and biology. Vol 903, Hypoxia. Boston (MA): Springer; c2016. Chapter 5, Hypoxia and its acid-base consequences: from mountains to malignancy; p. 301-323.
13. Yates BJ, Miller AD. Physiological evidence that the vestibular system participates in autonomic and respiratory control. *Res Vestib Sci*. 1998 Jan-Feb;8(1):17-25.
14. Raichle ME, Plum F. Hyperventilation and cerebral blood flow. *Stroke*. 1972 Sep-Oct;3(5):566-75.