

ANNEX D: PHYSIOLOGICAL EPISODES

1. The Navy's definition of a physiological episode (PE) is when a pilot experiences loss in performance related to insufficient oxygen, depressurization, or other factors during flight. For the purposes of this review, the Comprehensive Review Medical Sub-Specialty Team considered five general categories of PEs, with appropriate sub-categories.

a. Hypoxia

(1) Hypoxic hypoxia: reduced oxygen available, usually caused by reduced partial pressure. In the aviation community, this would likely be due to altitude or a faulty oxygen supply system.

(2) Anemic hypoxia: reduced oxygen carrying capacity caused by reduced quantities of hemoglobin (i.e., reduced blood-carrying cells available to deliver oxygen.)

(3) Stagnant hypoxia: reduced oxygen carrying capacity caused by stagnation, or 'pooling', of blood. This could be experienced in a sustained G-load or from restrictive flight gear.

(4) Histotoxic hypoxia: reduced oxygen carrying capacity caused by a foreign substance, or toxin, preventing normal oxygen transport. An example of this would be carbon monoxide exposure.

b. Decompression Illness (DCI)

(1) Decompression Sickness, Type I (DCS-I): mild form of DCS, often called "the bends", typically limited to musculoskeletal or cutaneous (skin and subdermal tissue) manifestations and joint pain.

(2) Decompression Sickness, Type II (DCS-II): serious, potentially life-threatening form of DCS, potentially involving neurologic issues.

(3) Pulmonary barotrauma: physical rupturing of the tissue of the pulmonary system.

(4) Arterial gas embolism (AGE): gas bubble forming in or entering the blood vessels often resulting from pulmonary barotrauma.

c. Acapnia: abnormal levels of carbon dioxide (CO₂) in the blood resulting in abnormal control of respiration rate in the body. (Blood CO₂ levels sensed in the brain control the body's rate of breathing.)

(1) Hypocapnia (hypocarbia): low blood CO₂, often due to hyperventilation (increased breathing rate), thus 'breathing off' excess CO₂. This could lead to physiological symptoms similar to hypoxia.

(2) Hypercapnia (hypercarbia): high blood CO₂, often due to hypoventilation (decreased breathing rate), thus retaining excess CO₂. In the absence of supplemental oxygen and if excessive, this will have similar physiologic symptoms as hypoxia.

d. Vestibular

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(1) Spatial disorientation

(2) Motion sickness

e. Psychological and/or psychosocial

(1) Anxiety disorders

(2) Panic disorders

(3) Psychogenic hyperventilation (psychological state causing hyperventilation.)

(4) Aerophobia (fear of flying.)

(5) Somatoform disorders (psychological state manifesting in physical symptoms.)

2. The issue of 'mass-spectrum' or 'catch-all' characterizations have come into question. Many PEs are combined into a conceptual single, larger PE category. This potentially suggests a single, common cause. Finding a common, or root, cause is not likely.

3. General Navy guidance for when a PE is considered to have occurred, outside a naval aviation mishap, can be found in OPNAVINST 3750.6S NAVAL AVIATION SAFETY MANAGEMENT SYSTEM (Section 503.h). The Navy considers a PE to have occurred whenever any of the following specified conditions are present:

- a. Hypoxia, proven or suspected;
- b. Carbon monoxide poisoning or other toxic exposure;
- c. Decompression sickness (DCS) because of evolved gas (bends, chokes, neurocirculatory [blood supply to the brain] collapse or severe reaction to trapped gas resulting in incapacitation;
- d. Hyperventilation;
- e. Spatial disorientation (SD) or distraction resulting in unusual attitude;
- f. Loss of consciousness (LOC) for any cause;
- g. An unintentional rapid decompression exposing personnel to cabin altitudes above flight level (FL) 250 [or 25,000 ft pressure altitude], regardless of whether dysbarism [physiologic effects of excessive or decreased pressure] or hypoxia occurs;
- h. Other psychological, pathological, or physical problems that manifest during or after actual flight.

4. The 3 April 2017, Naval Safety Center (NAVSAFECEN) AMENDED AVIATION PHYSIOLOGIC EPISODE REPORTING REQUIREMENTS (copied at the end of this annex)

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modified the Navy instruction on PEs, specifically expanding the definition for PEs and adding requirements for reporting . The modified guidance read, in part:

a. PEs are reportable safety incidents in accordance with Navy policy and must be reported via Web Enabled Safety System (WESS). Squadrons shall generate a PE initial notification in WESS within 24 hours of any PE diagnosis and provide a brief description of the event and any medical treatment provided to aircrew. A completed Hazard Report (HAZREP) or Safety Investigation Report (SIR) is due on Risk Assessment Code (RAC) timeline. PEs are defined as:

- (1) Hypoxia, proven or suspected
- (2) Carbon monoxide poisoning or other toxic exposure
- (3) Decompression illness (DCI)
- (4) Hyperventilation
- (5) Spatial disorientation (SD)
- (6) Loss of consciousness (LOC) for any cause
- (7) Other psychological, pathological, or physical problems that manifest during or after actual flight
- (8) All aircraft pressurization events (in-flight or ground-based) resulting in aircrew or maintainer symptoms

b. With the inclusion of “all aircraft pressurization events” (the eighth condition listed above), unintentional rapid decompression with cabin altitude above FL250 was removed from the original list of conditions considered a PE and, unless symptomatic, is no longer a reportable PE event. This is appropriate because a cabin decompression event by itself does not necessarily result in a PE.

c. Historically, physiologic incidents were FA-18 focused. However, reported events illustrate the scope of the problem as it applies to all avial aircraft. The reduction, elimination and/or mitigation of PEs remain the top safety priority for Commander, Naval Air Forces (CNAF), CNAF, Commander, Naval Air Force Atlantic (CNAL), Chief, Naval Aviation Training (CNATRA), Bureau of Medicine and Surgery (BUMED) and Naval Air Systems Command (NAVAIR) staffs are in full alignment with PE mitigation strategies.

d. As the naval safety reporting system of record, WESS must contain all reported hazard and mishap events for documentation as well as for current and future safety analysis purposes.

e. Submission to NAVAIR of the NAVAIR Part A, B & C forms alone does not provide enduring documentation within the official naval safety reporting system, nor do they inform key Naval Aviation Enterprise (NAE) safety leadership in a timely manner when a PE occurs.

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f. In addition to expanding the definition for what is considered a PE, NAVSAFECEN's 3 April 2017 safety message set forth the following additional reporting requirements when PE-related hazards and mishaps occur:

(1) Classification of Severity:

(a) Post flight treatment protocols consisting of 100 percent oxygen, IV fluids, emergency room admission, or hyperbaric chamber therapy are greater than first aid treatment and are therefore classified, at a minimum, as a Class D mishap when treating PEs.

(b) One lost workday constitutes a Class C mishap.

(c) Permanent partial disability or three or more personnel hospitalized constitutes a Class B mishap.

(d) Fatality or permanent total disability is a Class A mishap.

(2) Physiologic Episode Team (PET) Reporting Guidance:

(a) Squadrons must continue to complete and submit NAVAIR Part A, B & C forms for PEs that resulted in/from hypoxia, carbon monoxide or other toxic exposure, decompression illness, hyperventilation, and any pressurization event resulting in physiological symptoms.

(b) Timeline for submission of the Part A: immediately upon event diagnosis but no later than 24 hours; Part B must be submitted within 10 working days of event diagnosis; Part C must be submitted within 48 hours post-medical treatment.

(c) Submission will be in parallel to safety investigations required per OPNAVINST 3750.6S. Over time, data requirements result in changes to the Parts A-C. These forms will continue to be updated and notification sent via CNAF message.

(d) Current versions of Parts A and B (for those communities that have created them) and Part C (for all aircraft) can be found at:
<http://www.public.navy.mil/navsafecen/pages/aviation/aeromedical/aeromedical.aspx>

(3) Slam Stick/mu Data:

(a) For all PE events, squadrons must submit a copy of the aircraft mu data file with the Part A.

(b) Squadrons flying with Slam Stick pressure recording devices must also include the recorded Slam Stick data file from the PE event when submitting the Part A form.

(c) Medical professional use of Slam Stick data supports proper diagnosis and treatment.

Note: Slam Sticks are small devices used in flight to measure and record pressure fluctuations in the cockpit; the data produced from the Slam Stick is referred to as "mu" data.

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(4) Medical Guidance:

(a) Blood samples are not required in support of Part C form protocol and shall not be sent to NAMRU-D for toxicological testing.

(b) At the discretion of the attending flight surgeon, focused laboratory testing may be deemed appropriate when considered relevant to PE investigation.

(c) Flight surgeons are encouraged to submit amplifying data in word document form or as attachments (e.g., 72-hour medical history, Armed Forces Health Longitudinal Technology Application (AHLTA) notes, etc.) when submitting the Part C form.

(d) Ensure flight surgeon name, phone number, and email address are included on the Part C form.

Note: To date, there is no standardized medical evaluation protocol. The flight surgeon evaluates suspected cases on scene and makes diagnosis based on patient presentation and available information.

(5) Endorsement:

(a) PE HAZREPs and mishap reports must be endorsed per OPNAVINST 3750.6S.

(b) To ensure all pertinent findings are included in the final report of record in WESS, NAVSAFCEN will conduct a close out of all PE HAZREPs and mishap reports pending NAVAIR summary of PET analysis and findings, to include a final closing endorsement statement.

(6) Pre-Mishap Guidance:

(a) Squadrons must incorporate DCI details into their mishap response plan and duty binders.

(b) At a minimum, include location of the two closest hyperbaric chambers with contact information for 24/7 assistance and a transportation plan for getting aircrew to a chamber, whether the aircrew are on or off base, at home, or deployed.

(c) In cases of suspected DCI, expert consultation is available 24/7 at NAMI's DCS hotline: 850-449-4629. Additional references are available directly on the Part C form.