Medical Evaluation for Diving (MED)

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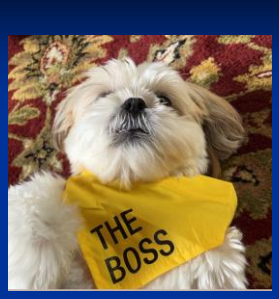

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Objectives

- Understand and describe how the medical evaluation process differs for working divers and recreational divers
- Understand and discuss causes of diving fatalities and how this information can be used to help define fundamental concerns during the medical evaluation process
- Discuss medical clearance for asthma, diabetes, cardiovascular diseases*
- Be familiar with expectations and the medical evaluation process for recreational, commercial and scientific divers

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Medical Clearance for Types of Diving

- Recreational
- "Working" Diver
  - Public Safety
  - Scientific
  - Commercial
  - Military
  - SCUBA Instructors

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Recreational vs. Working

- Not necessary
- Not dependent on diving for income
- Variable conditions
- Diver has choice about dive site/conditions
- Obligations to diver, buddy, supervisory staff
- Determine and convey risks to diver and others
- Final conclusions will be about risk management and assumption of risk
- Recommendations about specific acceptable safe diving conditions may be necessary
- Recommendations about scheduled medical re-evaluations

- Necessary
- Income dependent
- Variable conditions
- Diver cannot choose dive site/conditions
- Obligations to diver, employer, others
- Determine and convey risks to diver, employer and others
- Decision is often paternalistic
  - Yes or No
- Regularly scheduled medical evaluations are the norm

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Public Safety Divers

- Large variability in quality of training, job requirements, capabilities
- Volunteer vs. Employment
- Conditions
  - Can involve low visibility environments
  - Can involve swift water rescue/diving
  - Usually not deep, low risk for DCS

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Public Safety Divers

- No governing body to provide guidelines or recommendations
- Variable in level of medical evaluation and clearance
  - PMD (or any MD)
  - Occupational MD for Police or Fire Department (may or may not have any training in dive medicine)

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Scientific Divers

- Can be variable in physical and psychological demand
  - Frequently involves shallow, longer dives to collect scientific data
  - Underwater archeologists can have most variability
    - Archeological sites in variable depths/conditions
  - Saturation diving is rare

Aquarius (NOAA) →

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Scientific Divers

- Generally more strict with medical evaluation and clearance
  - AAUS provides guidelines
  - Most research diving entities (organizations) have established relationships with physicians trained in diving medicine
    - Scripps Institute
    - Woods Hole
    - NOAA
    - Universities with research diving programs

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APPENDIX 2
AAUS MEDICAL EVALUATION OF FITNESS FOR SCUBA DIVING REPORT

Name of Applicant (Print or Type) _____ Date (Month/Day/Year) _____

To The PHYSICIAN: This person is an applicant for training or is presently certified to engage in diving with self- contained underwater breathing apparatus (scuba). This is an activity that puts unusual stress on the individual in several ways. Your opinion on the applicant's medical fitness is requested. ***Scuba diving requires heavy exertion. The diver must be free of cardiovascular and respiratory disease (see references, following page). An absolute requirement is the ability of the lungs, middle ear and sinuses to equalize pressure. Any condition that risks the loss of consciousness should disqualify the applicant.***

TESTS: THE FOLLOWING TESTS ARE REQUIRED:

DURING ALL INITIAL AND PERIODIC RE-EXAMS:
(Exam Period: every 5 years if age <40; every 3 years age 40 to 60; every 2 years if age >60)
- Medical history
- Complete physical exam, with emphasis on neurological and otological components
- Hematocrit or Hemoglobin
- Urinalysis
- Any further tests deemed necessary by the physician

DURING INITIAL EXAM & FIRST EXAM OVER AGE 40 (optional during other exams at physician's discretion):
- Chest x-ray
- Spirometry

DURING FIRST EXAM OVER AGE 40 (optional during other exams at physician's discretion):
- Resting ECG
- Assessment of coronary artery disease using Multiple-Risk-Factor Assessment[1] (age, lipid profile, blood pressure, diabetic screening, smoker)
  Note: Exercise stress testing may be indicated based on Multiple-Risk-Factor Assessment[2]

RECOMMENDATION:
[ ] APPROVAL. I find no medical condition(s) that I consider incompatible with diving.
[ ] RESTRICTED ACTIVITY APPROVAL. The applicant may dive in certain circumstances (Provide remarks and conditions of approval on attached page(s), including letterhead and signature).
[ ] FURTHER TESTING REQUIRED. I have encountered a potential contraindication to diving. Additional medical tests must be performed before a final assessment can be made. (Provide requirements for approval on attached page(s), including letterhead and signature).
[ ] REJECT. This applicant has medical condition(s), which, in my opinion, clearly would constitute unacceptable hazards to health and safety in diving.

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AAUS Guidelines

5.20 Frequency of Medical Evaluations

Medical evaluation must be completed:		
Before Age 40	After age 40 Before Age 60	After Age 60
Before a diver may begin diving, unless an equivalent initial medical evaluation has been given within the preceding 5 years	Before a diver may begin diving, unless an equivalent initial medical evaluation has been given within the preceding 3 years	Before a diver may begin diving, unless an equivalent initial medical evaluation has been given within the preceding 2 years
At 5-year intervals	At 3-year intervals	At 2-year intervals
Clearance to return to diving must be obtained from a healthcare provider following a medically cleared diver experiencing any Conditions Which May Disqualify Candidates From Diving (Appendix 1), or following any major injury or illness, or any condition requiring chronic medication. If the condition is pressure related, the clearance to return to diving must come from a physician trained in diving medicine.		

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Military Divers

- Usually very demanding both physically and psychologically
  - Mission-based diving (must complete the mission)
  - Highly trained, increased pay, expensive equipment, personnel not easily replaceable
  - Technical diving can be involved
  - Surface supply, saturation, decompression diving with Sur-D O_2, other extreme exposures may be involved

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Military Divers

- Medical evaluation and screening is very thorough
  - Physician (trained in diving medicine) often outranks the diver and has final say
  - Several absolute disqualifications
  - Frequent, regularly scheduled medical reassessments
  - Must maintain cardiovascular fitness within standards

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Commercial Divers

- Can be very demanding both physically and psychologically
  - Work must get done (must complete the job/task)
  - Surface supply diving is most common
  - Mixed gas diving often involved
  - Decompression diving with Sur-D O_2 may be involved
  - Saturation diving may be involved
  - Contaminated water exposure can be involved

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Commercial Diving

- Can be variable in medical evaluation and screening for fitness to dive
  - Commercial diver training programs may not require comprehensive medical evaluations and screenings
  - Once employed...it is what the company requires
    - They may or may not have their own properly trained doc
  - There are some generally accepted absolute contraindications
  - Association of Diving Contractors International (ADCI) Form
  - Diving Medical Advisory Committee (DMAC) and International Marine Contractors Association (IMCA)

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DMAC/IMCA

- There are certification courses for physicians that are approved by DMAC/IMCA
- The certifications are recognized and often "required" by reputable commercial diving training programs and companies throughout the world
- DMAC levels
  - Level 1: Medical assessment of divers (Medical Examiners of Divers)
  - Level 2D: Medical management of diving accidents and illnesses (Diving Medical Physician)

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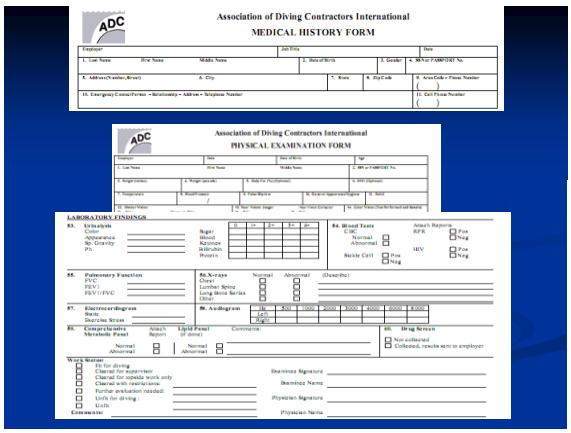
Association of Diving Contractors International
MEDICAL HISTORY FORM

Association of Diving Contractors International
PHYSICAL EXAMINATION FORM

LABORATORY FINDINGS

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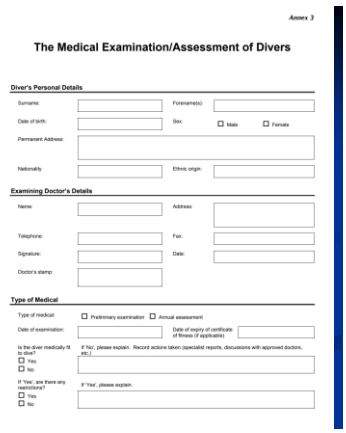
DMAC/IMCA Form


Annex 3

The Medical Examination/Assessment of Divers

Diver's Personal Details

Examining Doctor's Details

Type of Medical

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Equipment Needs

The doctor should have access to suitable facilities for examining divers and for carrying out testing in:

- audiometry
- electrocardiography
- spirometry
- exercise testing.

Access to radiology and clinical laboratory services is also required.

Equipment used needs to be calibrated and serviced in line with the manufacturers' recommendations.

Key Elements in the Medical Examination

The medical examination should include examination in the following areas:

- morphology
- respiratory system
- cardio-vascular system
- exercise testing
- peripheral nervous system
- musculo-skeletal system
- ears
- vision
- dental
- urology
- integument
- radiology
- haematology

} as required

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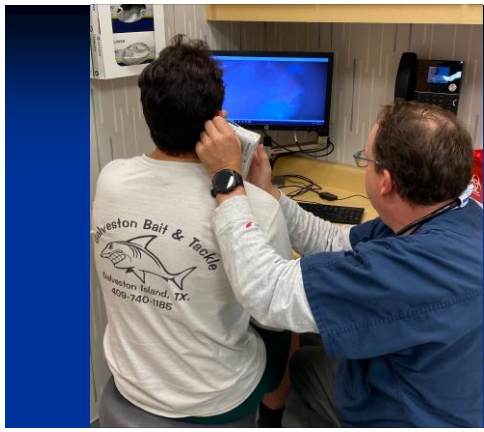

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Exercise Testing?

Harvard Step Test Protocol

Equip
-Step
-Time
-EKG
-Metr

Fitness Index Table

Rating	Fitness Index
> 96	Excellent
83-96	Good
68-82	Average
54-67	Low Average
< 54	Poor

1.
2.
3. until
for
4. 30

second rhythm strips from EKG monitor during these time periods.

5. To calculate the fitness result, add together the number of heart beats during each 30 second period above. Divide by (100 x 300) (300 or the total number of seconds patient was able to complete test if it was less than 5 min)

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Recreational Diving

- Can vary in level of physical and psychological demand
  - Warm water only divers ("easy" diving, but they tend to dive less frequently with rusty skills)
  - Local divers (tend to dive more frequently)
  - Cold water diving (tends to be more arduous)
  - Technical divers (their own breed!)
  - Scuba instructors (a different breed!)

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Recreational Diving (USA)

- Scuba Instructor/Training agency does the initial medical screening
- Form with check boxes
- Checked the "wrong" box?
  - Needs MD evaluation/clearance
  - Who does the evaluation/clearance? Any training in diving medicine?
- Agencies list relative and absolute contraindications on back of form in small print
  - Do we all agree?

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DAN WRSTC RSTC R·S·T·C Europe CMAS

Diver Medical | Participant Questionnaire

Recreational scuba diving and freediving requires good physical and mental health. There are a few medical conditions which can be hazardous while diving, listed below. Those who have, or are predisposed to, any of these conditions, should be evaluated by a physician. This Diver Medical Participant Questionnaire provides a basis to determine if you should seek out that evaluation. If you have any concerns about your diving fitness not represented on this form, consult with your physician before diving. If you are feeling ill, avoid diving. If you think you may have a contagious disease, protect yourself and others by not participating in dive training and/or dive activities. References to "diving" on this form encompass both recreational scuba diving and freediving. This form is principally designed as an initial medical screen for new divers, but is also appropriate for divers taking continuing education. For your safety, and that of others who may dive with you, answer all questions honestly.

Directions

Complete this questionnaire as a prerequisite to a recreational scuba diving or freediving course.
Note to women: If you are pregnant, or attempting to become pregnant, *do not dive.*

1	I have had problems with my lungs, breathing, heart and/or blood affecting my normal physical or mental performance.	Yes ☐ Go to box **A**	No ☐
2	I am over 45 years of age.	Yes ☐ Go to box **B**	No ☐
3	I struggle to perform moderate exercise (for example, walk 1.6 kilometers/one mile in 14 minutes or swim 200 meters/yards without resting), OR I have been unable to participate in a normal physical activity due to illness or health reasons within the past 12 months.	Yes ☐*	No ☐
4	I have had problems with my eyes, ears, or nasal passages/sinuses.	Yes ☐ Go to box **C**	No ☐
5	I have had surgery within the last 12 months, OR I have ongoing problems related to past surgery.	Yes ☐*	No ☐
6	I have lost consciousness, had migraine headaches, seizures, stroke, significant head injury, or suffer from persistent neurologic injury or disease.	Yes ☐ Go to box **D**	No ☐
7	I am currently undergoing treatment (or have required treatment within the last five years) for psychological problems, personality disorder, panic attacks, or an addiction to drugs or alcohol; or, I have been diagnosed with a learning or developmental disability.	Yes ☐ Go to box **E**	No ☑
8	I have had back problems, hernia, ulcers, or diabetes.	Yes ☑ Go to box **F**	No ☐
9	I have had stomach or intestine problems, including recent diarrhea.	Yes ☐ Go to box **G**	No ☐
10	I am taking prescription medications (with the exception of birth control or anti-malarial drugs other than mefloquine (Lariam))	Yes ☐*	No ☑

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BOX A — I HAVE/HAVE HAD:		
Chest surgery, heart surgery, heart valve surgery, an implantable medical device (eg, stent, pacemaker, neurostimulator), pneumothorax, and/or chronic lung disease.	Yes ☐*	No ☐
Asthma, wheezing, severe allergies, hay fever or congested airways within the last 12 months that limits my physical activity/exercise.	Yes ☐*	No ☐
A problem or illness involving my heart such as: angina, chest pain on exertion, heart failure, immersion pulmonary edema, heart attack or stroke. OR am taking medication for any heart condition.	Yes ☐*	No ☐
Recurrent bronchitis and currently coughing within the past 12 months. OR have been diagnosed with emphysema.	Yes ☐*	No ☐
Symptoms affecting my lungs, breathing, heart and/or blood in the last 30 days that impair my physical or mental performance.	Yes ☐*	No ☐
BOX B — I AM OVER 45 YEARS OF AGE AND:		
I currently smoke or inhale nicotine by other means.	Yes ☐*	No ☐
I have a high cholesterol level.	Yes ☐*	No ☐
I have high blood pressure.	Yes ☐*	No ☐
I have had a close blood relative die suddenly or of cardiac disease or stroke before the age of 50, OR have a family history of heart disease before age 50 (including abnormal heart rhythms, coronary artery disease or cardiomyopathy).	Yes ☐*	No ☐
BOX C — I HAVE/HAVE HAD:		
Sinus surgery within the last 6 months.	Yes ☐*	No ☐
Ear disease or ear surgery, hearing loss, or problems with balance.	Yes ☐*	No ☐
Recurrent sinusitis within the past 12 months.	Yes ☐*	No ☐
Eye surgery within the past 3 months.	Yes ☐*	No ☐
BOX D — I HAVE/HAVE HAD:		
Head injury with loss of consciousness within the past 5 years.	Yes ☐*	No ☐
Persistent neurologic injury or disease.	Yes ☐*	No ☐
Recurring migraine headaches within the past 12 months, or take medications to prevent them.	Yes ☐*	No ☐
Black-outs or fainting (full partial loss of consciousness) within the last 5 years	Yes ☐*	No ☐
Epilepsy, seizures, or convulsions. OR take medications to prevent them.	Yes ☐*	No ☐
BOX E — I HAVE/HAVE HAD:		
Behavioral health, mental or psychological problems requiring medical/psychiatric treatment.	Yes ☐*	No ☐
Major depression, suicidal ideation, panic attacks, uncontrolled bipolar disorder requiring medication/psychiatric treatment.	Yes ☐*	No ☐
Been diagnosed with a mental health condition or a learning/developmental disorder that requires ongoing care or special accommodation.	Yes ☐*	No ☐
An addiction to drugs or alcohol requiring treatment within the last 5 years.	Yes ☐*	No ☐
BOX F — I HAVE/HAVE HAD:		
Recurrent back problems in the last 6 months that limit my everyday activity.	Yes ☐*	No ☐
Back or spinal surgery within the last 12 months.	Yes ☐*	No ☐
Diabetes, either drug or diet controlled, OR gestational diabetes within the last 12 months.	Yes ☐*	No ☐
An uncorrected hernia that limits my physical abilities.	Yes ☐*	No ☐
Active or untreated ulcers, problem wounds, or ulcer surgery within the last 6 months.	Yes ☐*	No ☐
BOX G — I HAVE HAD:		
Gastric surgery and do not have medical clearance to swim or engage in physical activity.	Yes ☐*	No ☐
Dehydration requiring medical intervention within the last 7 days.	Yes ☐*	No ☐
Active or untreated stomach or intestinal ulcers or ulcer surgery within the last 6 months.	Yes ☐*	No ☐
Frequent heartburn, regurgitation, or gastroesophageal reflux disease (GERD).	Yes ☐*	No ☐
Active or uncontrolled ulcerative colitis or Crohn's disease.	Yes ☐*	No ☐
Bariatric surgery within the last 12 months.	Yes ☐*	No ☐

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Evaluation Result

☐ Approved – I find no conditions that I consider incompatible with recreational scuba diving or freediving.

☐ Not approved – I find conditions that I consider incompatible with recreational scuba diving or freediving.

Signature of certified medical doctor or other legally certified medical provider | Date (dd/mm/yyyy)

Medical Examiner's Name
(Print)

Clinical Degrees/Credentials

Clinic/Hospital

Address

Phone | **Email**

Physician/Clinic Stamp (optional)

Created by the Diver Medical Screen Committee in association with the following bodies:
The Undersea & Hyperbaric Medical Society
DAN (US)
DAN Europe
Hyperbaric Medicine Division, University of California, San Diego

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Recreational Diving

- Certified for life
- No requirement for health maintenance or formal medical re-evaluation
- Type of diving may change through time
  - Recreational ⇒ Technical
- The aging diver and changes in health status
  - New diagnoses (heart disease, diabetes, COPD....)
  - Obesity and cardiovascular de-conditioning

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"Three Question" Approach to Individual Disorders

Courtesy of Dr. Simon Mitchell

1. Does the candidate have a condition that could be exacerbated by diving?

Diving → Worsening of condition

2. Does the candidate have a condition that could precipitate a diving disorder?

Condition → Diving Problem

3. Does the candidate have a condition that could compromise consciousness or physical performance in the water?

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Evidence based?

- There is no "cook book"
- How do divers die?
- What are most common diving related medical problems?
- Always remember the fundamental concerns
- Absolute vs. Controversial?
- Permanent vs. Temporary?

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How do Divers Die?

Common causes of open-circuit recreational diving fatalities.

P. J. DENOBLE[1], J. L. CARUSO [1,2], G. de L. DEAR,[1,3], C. F. PIEPER,[4], and R. D. VANN[1,3]

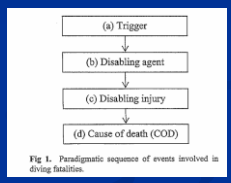

Fig 1. Paradigmatic sequence of events involved in diving fatalities.

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Common Disabling Injuries Associated with Recreational Diving Fatalities

1. Asphyxia (drowning) – 33%
2. Arterial gas embolism – 29%
3. Cardiac events – 26%
4. Trauma – 5%
5. DCS – 3%
6. Unexplained loss of consciousness
7. Inappropriate gas mixture

Denoble et al., UHM, 2008

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Common Causes of Recreational Diving Fatalities

- What increases your odds ratio for asphyxia?
  - Entrapment (OR>30)
  - Running out of gas (OR=15.9)
  - Buoyancy and equipment problems (OR=4.5)
- What increases your odds ratio for AGE?
  - Emergency ascent (OR>30)
- What increases your odds ratio for cardiac events?
  - Previous CVD (OR>10.5)
  - Age >40 (OR=5.9)

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Common Causes of Recreational Diving Fatalities

- What increases your odds ratio for trauma?
  - Rough water (OR=2.6)
- What increases your odds ratio for DCS?
  - Diving deeper than 180 fsw (55 msw) (OR>30)
  - Diving alone (OR=17.2)
  - Emergency ascent with omitted decompression (OR=16)
- What increases your odds ratio for unexplained LOC?
  - Diabetes (OR=12)

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ANNUAL DIVING REPORT

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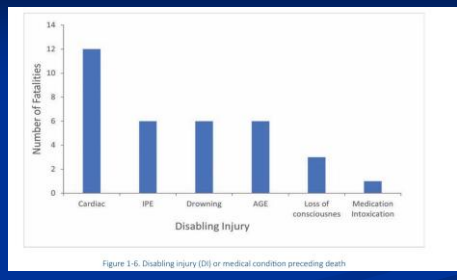

Figure 1-6. Disabling injury (DI) or medical condition preceding death

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DIVING RELATED	2014–2017 (mean)	2018 (count)	2018 (% of 2014–2017 mean)
Barotrauma	1,008	1,053	104
Decompression Sickness	606	624	103
Marine Envenomation	234	202	86
Immersion Pulmonary Edema (IPE)	46	47	102
Arterial Gas Embolism (AGE)	40	41	104
Fatality	41	18	44
Non-Fatal Drowning	23	17	76
Gas Contamination	22	18	84
Finfoot	18	13	71
Motion Sickness	14	24	171
Mask Squeeze	15	5	33
Loss of Consciousness	11	5	45
Cardiac Arrhythmia	7	0	0
Nitrogen Narcosis	3	2	62

Table 2-3. Diving and non-diving related injuries reported to DAN in 2018 compared to the previous four-year average.

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Hennepin Approach to Diving Medical Evaluations

- The "three question" approach
- Special consideration to the "top" disabling injuries that result in fatalities
  - Asphyxia
  - AGE (as a result of pulmonary barotrauma)
  - Cardiac events
  - Trauma
  - DCS
  - "Unexplained loss of consciousness"
- Special consideration to the most common non-fatal diving injuries
  - Non-pulmonary barotrauma (ears, sinuses)
  - Otitis externa

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Fundamental Concerns

- Drowning
  - Possibility of altered level or loss of consciousness?
- Barotrauma
  - Pulmonary Barotrauma → AGE
  - Middle ear barotrauma (ENT issues)
  - GI
  - Surgical implants/devices?
- Exertion/Work
  - Risk for cardiac events?
  - Poor exercise tolerance leading to incapacitation?
  - Risk of physical injury/trauma?
- Decompression sickness
  - Increased risk for DCS?
- Poor judgment and decision making
  - Running out of gas
  - Diving beyond skill level/limitations
  - Inappropriate risk-taking behavior
  - Poor/Inadequate training

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Neurological

- Fundamental concern is loss of consciousness or incapacitation leading to drowning

Absolute	Controversial
Seizure disorder	History of seizure disorder (no longer on meds, seizure free for >5 y)
CVA/TIA	Prior neurosurgery (must have no sequelae)
Progressive neurodegenerative disorders	Prior Neuro DCS or CAGE (must have no sequelae)
Active CNS malignancy	Peripheral neuropathy
Head injury/TBI with sequelae	Spinal cord injury
Prior Neuro DCS or CAGE with sequelae	
Narcolepsy with cataplexy	

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Cardiovascular

- Fundamental concerns include:
  - Loss of consciousness with risk of drowning
  - Cardiac event
  - Shunting of VGE (risk for DCS/CAGE?)

Absolute	Controversial
Symptomatic CAD, CHF	CAD s/p intervention (with normal stress test)
Hypertrophic cardiomyopathy	Pacemaker (with no risk of syncope, device pressure rated)
Septal defects (right to left shunt)	Controlled arrhythmias (with no risk of syncope)
Stenotic valvular disorders	Mild regurgitative valvular disorders
Arrhythmias with risk of syncope (prolonged QT syndrome, WPW)	Therapeutic anticoagulation (what is the underlying disease?)
AICD	
Cardiac transplant	

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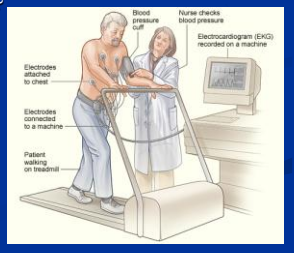
Cardiovascular

- Divers with known CAD (status-post intervention) or divers at risk for CAD (older)
  - Cardiac risk stratification
  - Exercise cardiac stress testing
  - Achieve at least 13 MET?



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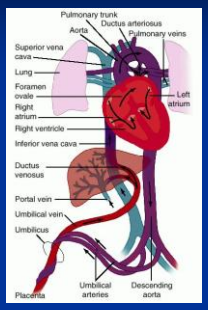
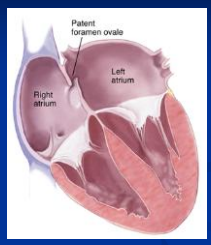
Patent Foramen Ovale (PFO)





PFO in postnatal circulation

Fetal circulation

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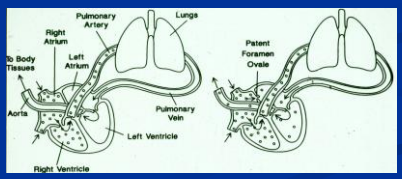
PFO

- We know that VGE are common after diving (even no-decompression diving)
- The existence of a PFO provides a possible shunt from venous to arterial circulation (bypassing the lungs)
- VGE can become AGE….does this increase risk for DCI or CAGE?



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PFO

- Common
  - ~25-33% detected at autopsy in humans
- More prevalent in divers diagnosed with severe DCI?
  - Moon, et al. Lancet, 1989…screening for PFO in divers diagnosed with DCI
    - All DCI = 37% (11/30)
    - Serious DCI = 61% (11/18)
- Need a special test to screen for this
  - Bubble echocardiogram (TTE or TEE)
    - At rest and with Valsalva (right atrial pressure > left atrial pressure)

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PFO and DCS??

ORIGINAL RESEARCH **Annals of Internal Medicine**

Decompression Illness in Divers With or Without Patent Foramen Ovale

A Cohort Study

Hyun-Jong Lee, MD, PhD*†; Dal Soo Lim, MD*; Juneyoung Lee, PhD; Dong-geun Lee, MD; Mi-Young Oh, MD, PhD; Jinsik Park, MD, PhD; Chi-Hoon Kim, MD; Ji-Hyun Jung, MD; Rak Kyeong Choi, MD, PhD; and Young Cheon Kang, MD, PhD†

Ann Intern Med. 2023;176:934-939. doi:10.7326/M23-0260 **Annals.org**

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Recent Prospective Cohort Study PFO/DCS

- 100 experienced divers, >50 dives per year
  - 76% were diving instructors
- All got bubble echo, screened for PFO, PFO characterized
  - High risk
    - atrial septal aneurysm, hypermobility, large PFO size (>2 mm separation of septum primum/secundum), spontaneous shunting in resting state
- 68 divers had PFO (68%)
  - High risk: 37
  - Low risk: 31
- Divers were followed for 3 years, surveyed for incidence of DCS

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Recent Prospective Cohort Study PFO/DCS

- Overall incidence of DCS was 13%
- Only 1 diver was treated with recompression therapy

Table 3. Unadjusted and Multivariable Logistic Regression Analyses of High-Risk PFO for the Association With DCI

Variable	Unadjusted*		Adjusted for Multivariable Model†	
	Odds Ratio (95% CI)	*P* Value	Odds Ratio (95% CI)	*P* Value
High-risk PFO	10.04 (2.17-46.45)	0.003	9.34 (1.95-44.88)	0.005

DCI = decompression illness; PFO = patent foramen ovale.
* The variable of number of dives is used as an offset in logistic regression model.
† Variables adjusted are hypertension, body mass index, history of DCI, and current smoker.

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Screening for PFO??

- No prescreening for PFO
- Screen divers with "unexpected hit" or early onset neurological DCS
- You found a PFO!....No what do you do?
  - High risk PFO?
  - Stop diving?
  - Dive more conservatively ("bubble free")?
  - Surgical (endovascular) repair?
  - Can be an absolute contraindication in military and commercial diving

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Pulmonary

- Fundamental concerns:
  - Exercise tolerance (risk for incapacitation/drowning)
  - Pulmonary barotrauma leading to CAGE

Absolute	Controversial
Poorly controlled asthma (asthma with cold/exercise trigger)	Well controlled asthma
COPD/Emphysema	Traumatic pneumothorax
Spontaneous pneumothorax	Previous thoracic/lung surgery (>6 months post-op, normal lung imaging and function)
Active URI or pneumonia	Previous diving related pulmonary barotrauma/AGE (no sequelae)
Previous diving related pulmonary barotrauma/AGE with sequelae	

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Asthma

- What are the concerns?
  - Asthma exacerbation with air trapping and risk of pulmonary barotrauma/AGE
    - Exposure to cold, dry air
    - Possibility of accidental inhalation of sea water
    - Exercise as a trigger
  - Diminished exercise capacity
    - Cannot respond to increases in workload/demand with risk of incapacitation and drowning
  - Risk of anxiety/panic attack

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Asthma

- Which asthmatics can be cleared for recreational diving?
  - History of childhood asthma is not a concern
  - Must have normal rest and exercise PFTs
    - MEF 50% is most sensitive screening for exercise limitations
    - Low FVC may be predictive of PBT from SETT (UK Navy data)
  - Must be educated that they cannot dive during active disease state
  - We recommend pre-dive peak flow meter testing to screen for subacute exacerbations prior to diving

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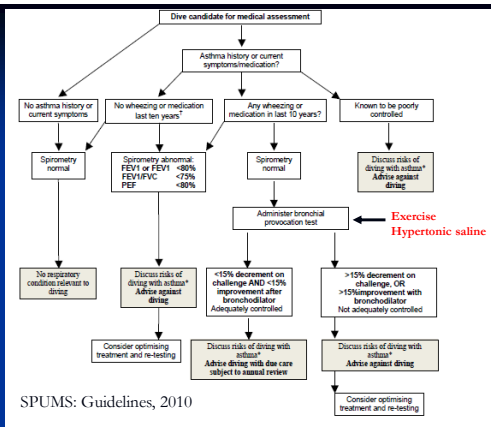

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Diabetes

- What are the concerns?
  - Loss (altered level) of consciousness from hypoglycemia
  - Secondary effects of diabetes
    - Cardiovascular disease
    - Peripheral neuropathy
    - Retinopathy
    - Nephropathy

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Diabetes: Who can Dive? See DAN/UHMS Guidelines (2005)

1. Age >18 y (16–18 with special training)
2. >3 months since initiation or change in treatment regimen
3. No episodes of hypo- or hyperglycemia requiring 3rd party intervention within the last year, no history of hypoglycemic unawareness
4. HbA1c <9%
5. No evidence of secondary diabetes complications (retinopathy, nephropathy, CAD, PVD, neuropathy)
6. Primary care doctor involved who can confirm above
7. Diving medical exam should include input from a physician properly trained as diving medical examiner
8. Diver expresses understanding of risks, intention to follow diabetic diving protocols, will cease diving if an event occurs while diving related to diabetes
9. Must have annual exam/medical assessment for fitness for diving

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Diabetes: Scope of Diving? See DAN/UHMS Guidelines (2005)

1. Recommendations
   - <100 fsw (30 msw) (narcosis or hypoglycemia?)
   - <60 minutes
   - No decompression diving
   - No overhead environments
2. Buddy
   - Must be informed of the diver's condition
   - Be able to respond in the event of hypoglycemia
   - Should not also have diabetes
3. Avoid
   - Cold or arduous diving

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Diabetes: Diving Protocol? See DAN/UHMS Guidelines (2005)

1. Do not dive if…
   - Doesn't feel right (anxiety, unwell)
   - Glucose pattern abnormal
2. Goal FSBG >150 mg/dL (8.3 mmol/L)
   - Checked 60 min, 30 min and right before dive (trend)
   - Eat snack if needed to maintain FSBG
3. Goal FSBG <300 mg/dL (16.7 mmol/L)
4. Must carry oral glucose (glucagon also recommended)
   - Oral glucose available at surface and during dive
   - Buddy should be able to assist
   - "L" sign
5. Check FSBG after diving
6. Stay hydrated
7. Log all dives (including FSBG, fluid and glucose intake)

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Other systems

- GI
  - Fundamental concern is barotrauma
- Ophthalmological
  - Fundamental concerns:
    - Barotrauma: intra-ocular gas
    - Trauma: Poor vision
- ENT
  - Fundamental concern is barotrauma, immersion
- Psychiatric
  - Fundamental concerns:
    - Altered LOC (drowning), medication issues (CNS O2 tox)
    - Risk taking behaviors
    - Improper motivation and diving beyond one's limitations/skills

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Return to Diving After DCI (DAN)

- In all cases of DCI (DCS/AGE) a diver should not return to diving if they have residual symptoms- MUST BE SYMPTOM FREE
- After Mild DCS (Type I or "pain only") - wait at least 2 weeks
- After DCS with "mild" neurological symptoms – wait at least 1 month
- After "severe" DCS/AGE – stop diving?, must consult Diving Medicine Physician
- Can risk be mitigated?

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Return to Diving after DCI (ADCI)

2.4.10 RETURN TO DUTY AFTER DIVING RELATED INCIDENTS

ADCI Recommendations on Return to Diving	
Diving Related Incident	**Time to return to diving**
Simple pain only with complete resolution after single treatment table	24 to 72 hours
Pain only needing more than one treatment table for complete resolution	7 days
Altered sensation in limbs resolvable by one treatment table	7 days
Motor or other neurological deficit resolvable by one treatment table	28 days
Neurological injury needing several treatment tables to resolve	4 to 6 months
Pulmonary barotrauma resolved	3 months
Pneumothorax resolved (other than spontaneous)	3 months
Vestibular decompression sickness	4 to 6 months
Round window rupture	6 months after repair
Central nervous system oxygen toxicity (after complete evaluation)	7 days
Perforated tympanic membrane	6 weeks after healed
Other ENT barotrauma	Determined by examiner

All cases except simple pain only decompression sickness resolved by a single treatment table must be cleared by medical examination from a qualified diving medical examiner before return to diving.

Persistent neurological deficits following diving related incidents are generally disqualifying.

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Return to Diving After DCI (DMAC/IMCA)

A) Limb pain, or non-specific manifestations (e.g., persistent headache, excessive fatigue, loss of appetite, nausea)
- With uncomplicated recovery: 7 days
- After recurrence or relapse mandating further recompression: 14 days

B) Cutaneous and lymphatic manifestations without neurological involvement, i.e. skin rash with severe itching or swelling of tissues: 7 days

C) Neurological manifestations uncomplicated and complete recovery after one recompression treatment
- No involvement of visual, cognitive, brain stem, vestibular, cerebellar, autonomous or motor function: 28 days
  Return to diving only after review by a diving medicine specialist.
- Pulmonary DCS (Chokes), visual, cognitive, brain stem, vestibular, cerebellar, autonomous or motor dysfunction: 3 months
  Return to diving only after review by a diving medicine specialist.

D) Pulmonary barotrauma resulting in a pneumothorax or mediastinal/subcutaneous emphysema. Following appropriate investigation, including HRCT of chest, a diver may be considered fit to return to diving, but no earlier than 3 months after complete recovery.
Return to diving only after review by a diving medicine specialist.

E) In cases where multiple treatments were required to achieve improvement or there are residual neurological manifestations due to DCI, the diver should be considered on a case-by-case basis, but usually not allowed to return to diving for 3 months following the injury.

Divers having experienced livedo racemosa (cutis marmorata) or who have previously experienced DCI should not be allowed to return to diving until reviewed by a diving medicine specialist.

Shortening of these minimum time intervals should only be done on the written advice of a diving medicine specialist experienced in the handling of DCI.

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Return to Diving after DCI (USN)

- DCS I, "pain only" - complete recovery with initial treatment
  - Remain symptom free for 7 days
- DCS II or AGE - complete recovery with initial treatment
  - Must have normal MRI brain/spine
  - Remain symptom free for 30 days
- DCS/AGE with residual symptoms or recurrent DCS/AGE – DISQUALIFIED (unless waiver)
- DCS II requires evaluation for PFO or ASD!!
  - Then what??

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Medical Evaluation for Diving: The Process

- Regardless of the reason for evaluation, **there is no substitute** for a thorough interview, exam and review of pertinent medical records with the diver
- Primary purpose is to assess and explain medical risks of harm associated with diving for the individual
  - May include risks to others who will dive with the individual
- Further testing may be appropriate and necessary prior to making final recommendations (interface with PCP!)
- Involve the referring entity whenever possible to discuss findings/recommendations
  - Scuba Instructor
  - Employer
- Have the diver actively participate in the process and demonstrate that they understand findings/recommendations
  - A signed statement of understanding may be appropriate

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Bottom Line/Summary?

- Must evaluate each diver as an individual on a case-by-case basis
  - Perfect time to educate divers about diving medicine and safety as it pertains directly to them
  - Communication and understanding between the medical professional and the diver/referring entity are of paramount importance!
  - Take the time to research medical conditions that you are not familiar with (utilize resources)
    - DAN, UHMS, recognized expert opinions
  - Conscientious, educated, careful and defendable recommendations must be made

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