Fitness to Dive 2021

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Disclosure

Part of my income is derived from fitness to dive medical examinations for recreational, commercial, professional and police divers

I am the medical advisor for Seneca College's Underwater Skills Program (commercial diving)

Fitness to Dive

1. General principles
2. DAN statistics
3. Physical Fitness
4. Mental Fitness
5. Covid-19 & Fitness

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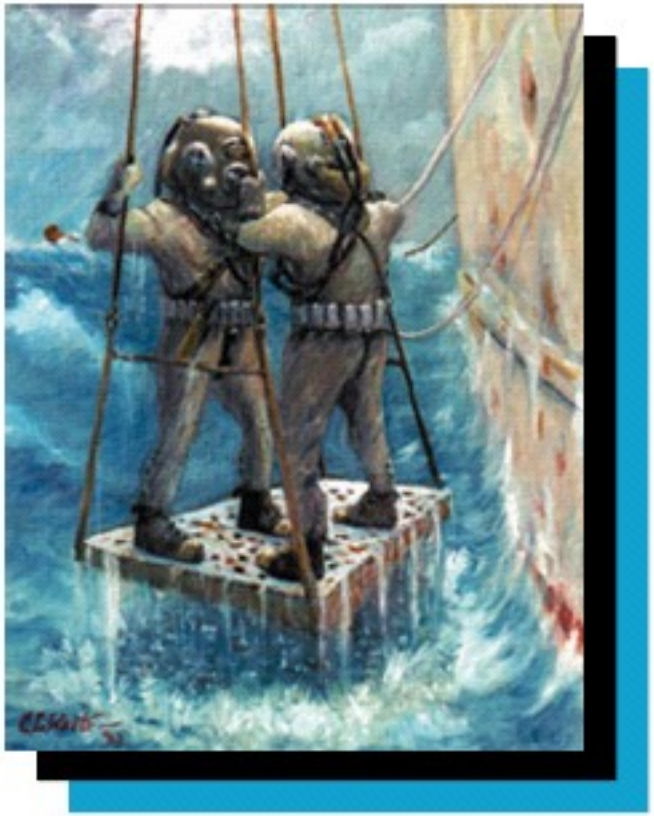
UNDERSEA & HYPERBARIC MEDICAL SOCIETY (UHMS)



MEDICAL ASSESSMENT OF FITNESS FOR DIVING

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Diving Medical Examination

& Certificate of Fitness

UK, EU, Australia & NZ:

for

Commercial & Recreational Diving

Required:

- Before starting course
- Periodically and more frequently with age
- By qualified Diving Physician

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Diving Medical Examination

& Certificate of Fitness

North America

for

Commercial Diving

Required:

- Before starting course
- Every 1 – 2 years ~ health & age
- By qualified Diving Physician

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Diving Medical Examination

& Certificate of Fitness

North America

for

Recreational Diving

Required:

- Before starting course
- By ***any*** Physician

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North America

Once Certified, sport divers may dive forever without any further medical evaluations

Fitness to Dive

Standards

- Set standards **too high**

  – **no one is fit & no one dives**

- Set standards **too low**

  - **unfit divers & injuries/deaths**

North America:

Would periodic Dive Medicals for recreational scuba divers significantly decrease morbidity and mortality?

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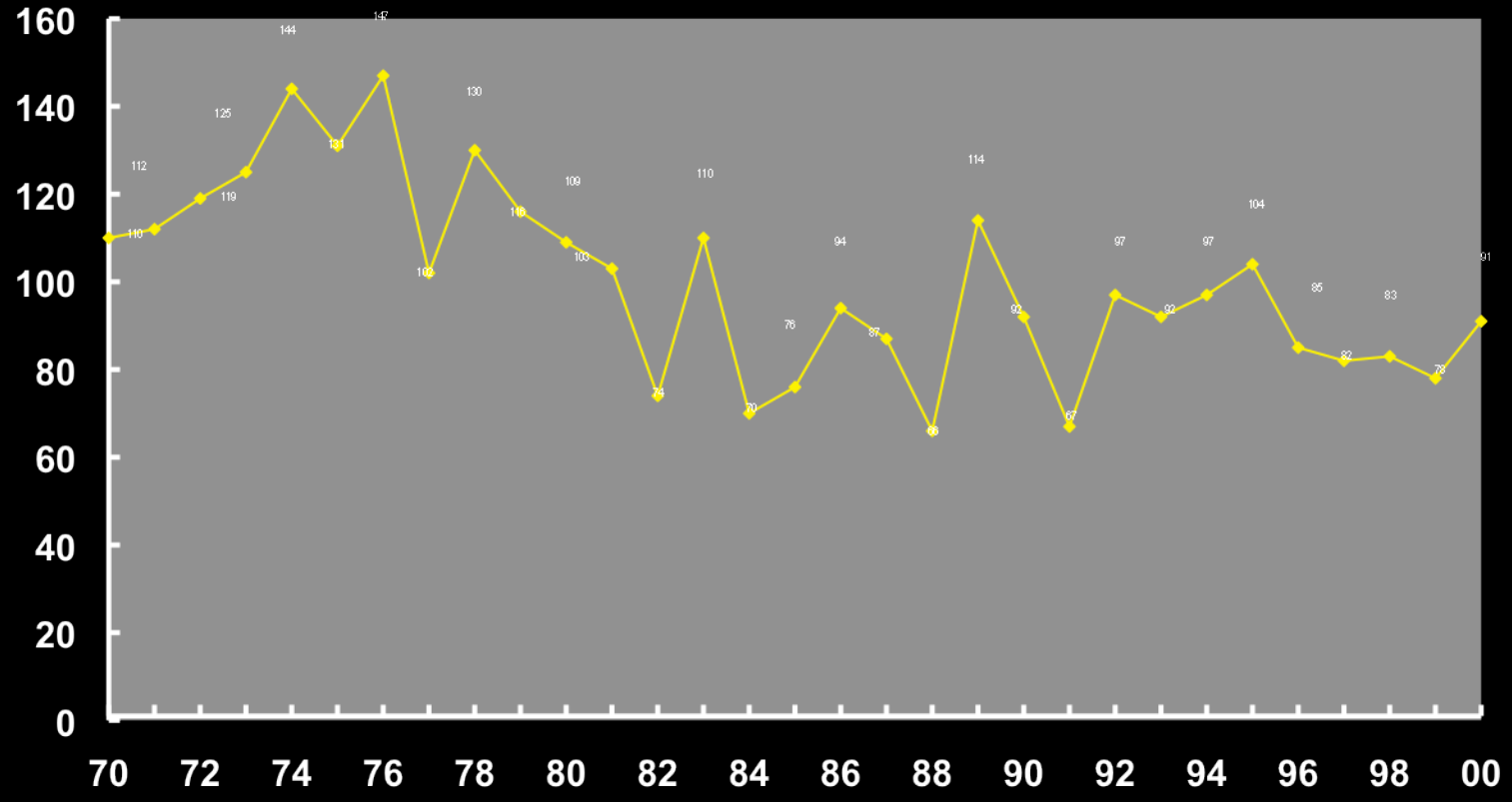
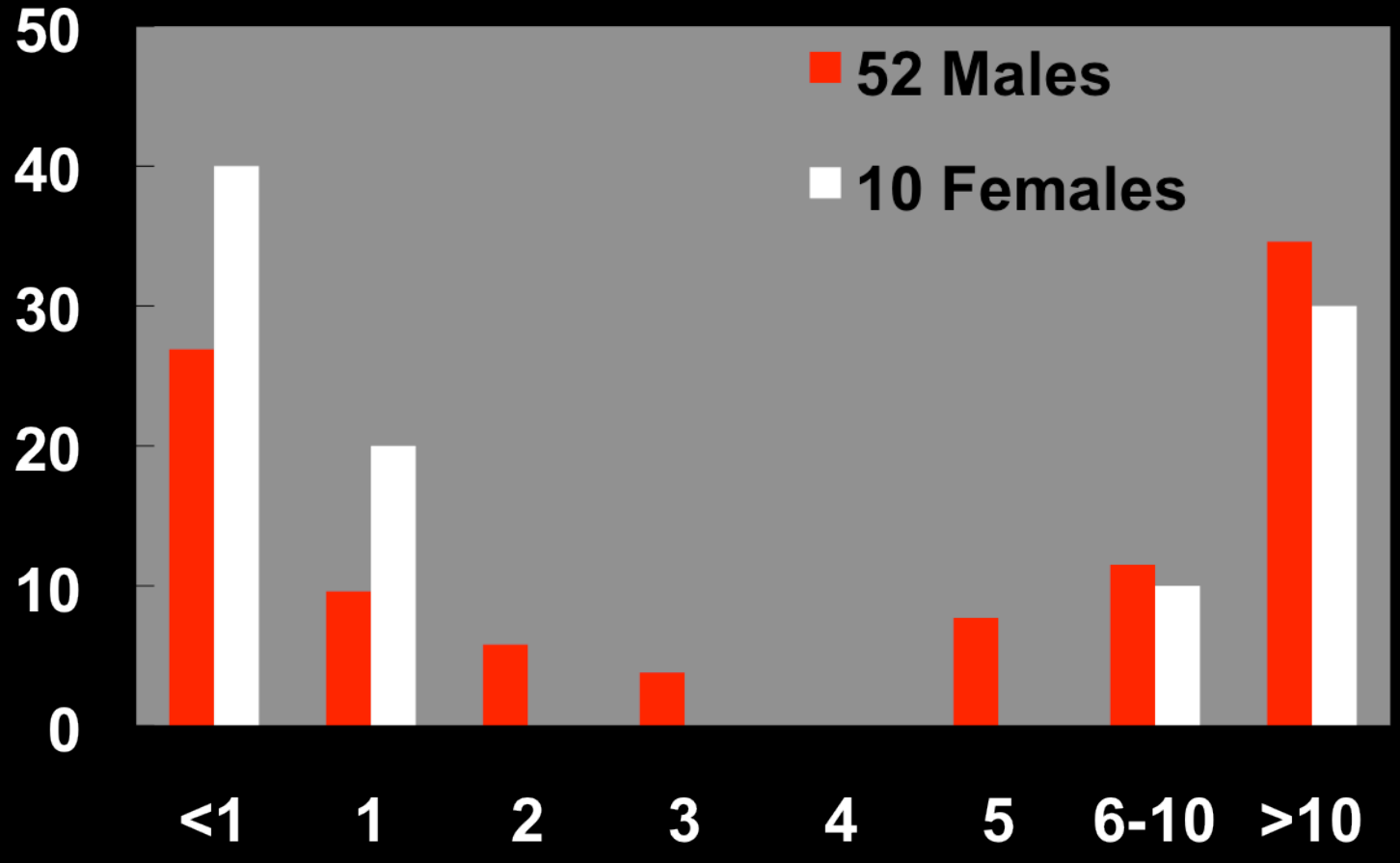
DAN: Diving Fatalities 1970 - 2000

2002 DAN REPORT



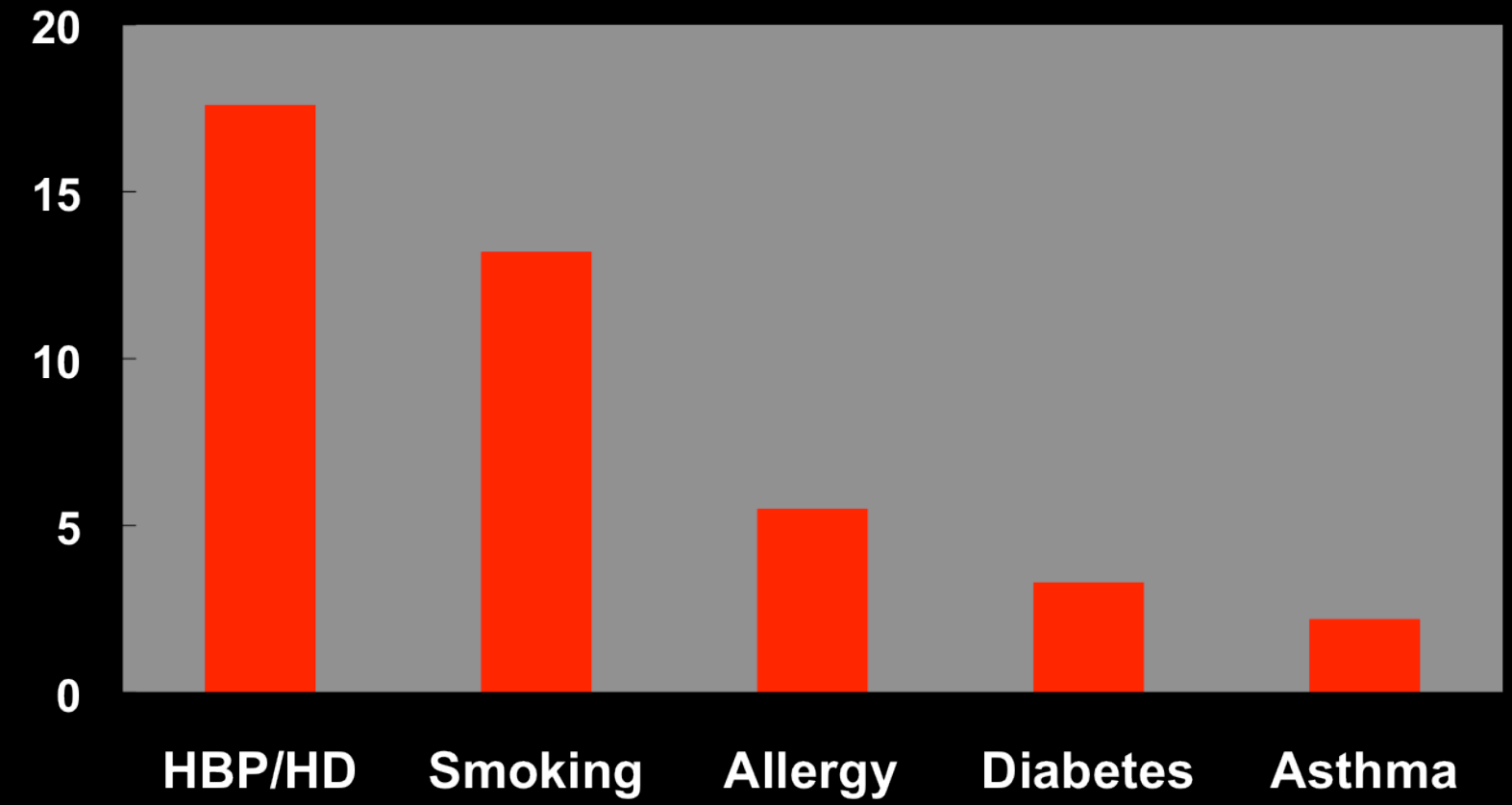
DAN: Years Since Initial Certification of Diving Fatalities



2002 DAN REPORT

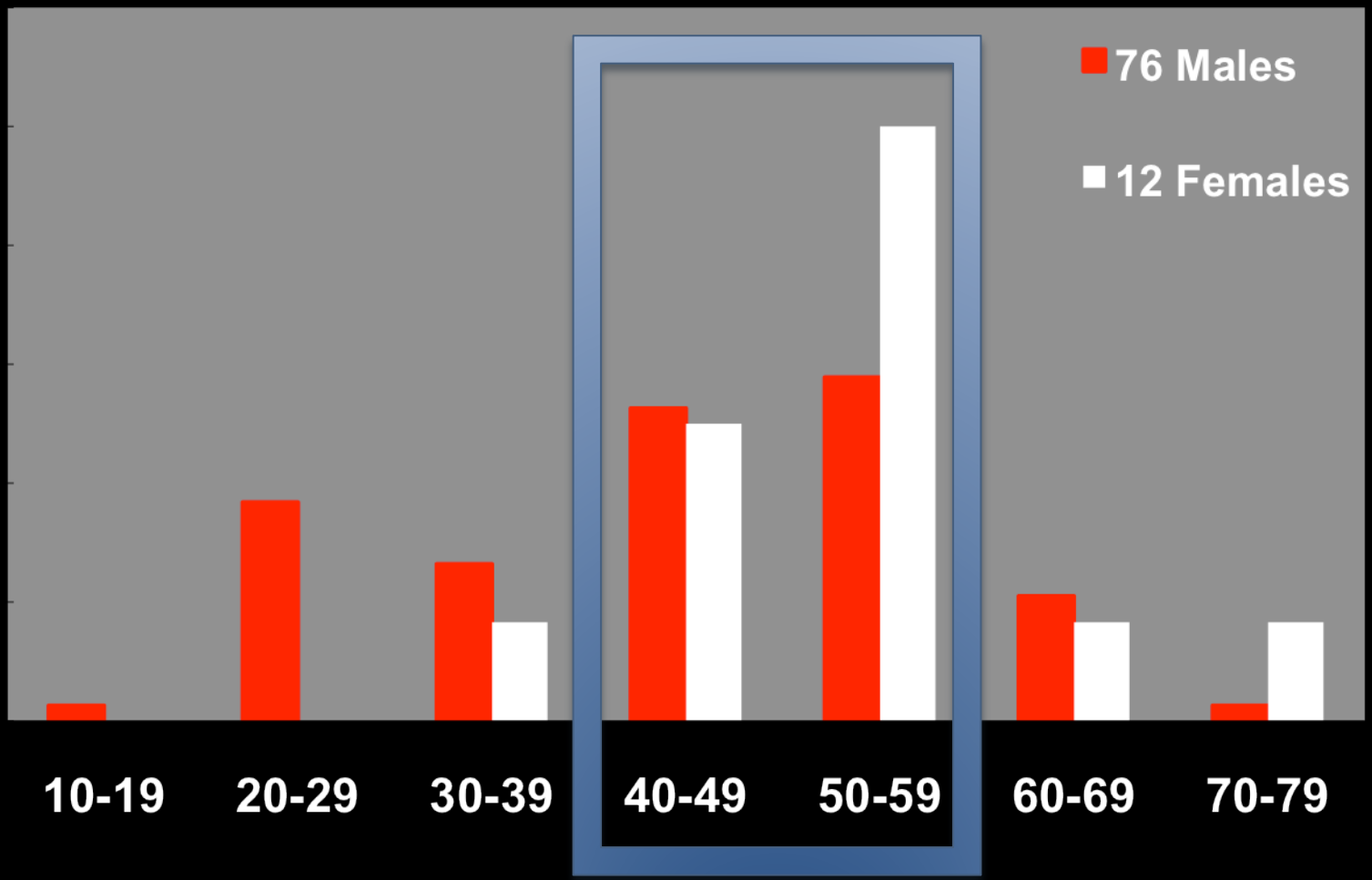
DAN: Chronic Health Conditions of Diving Fatalities

2002 DAN REPORT



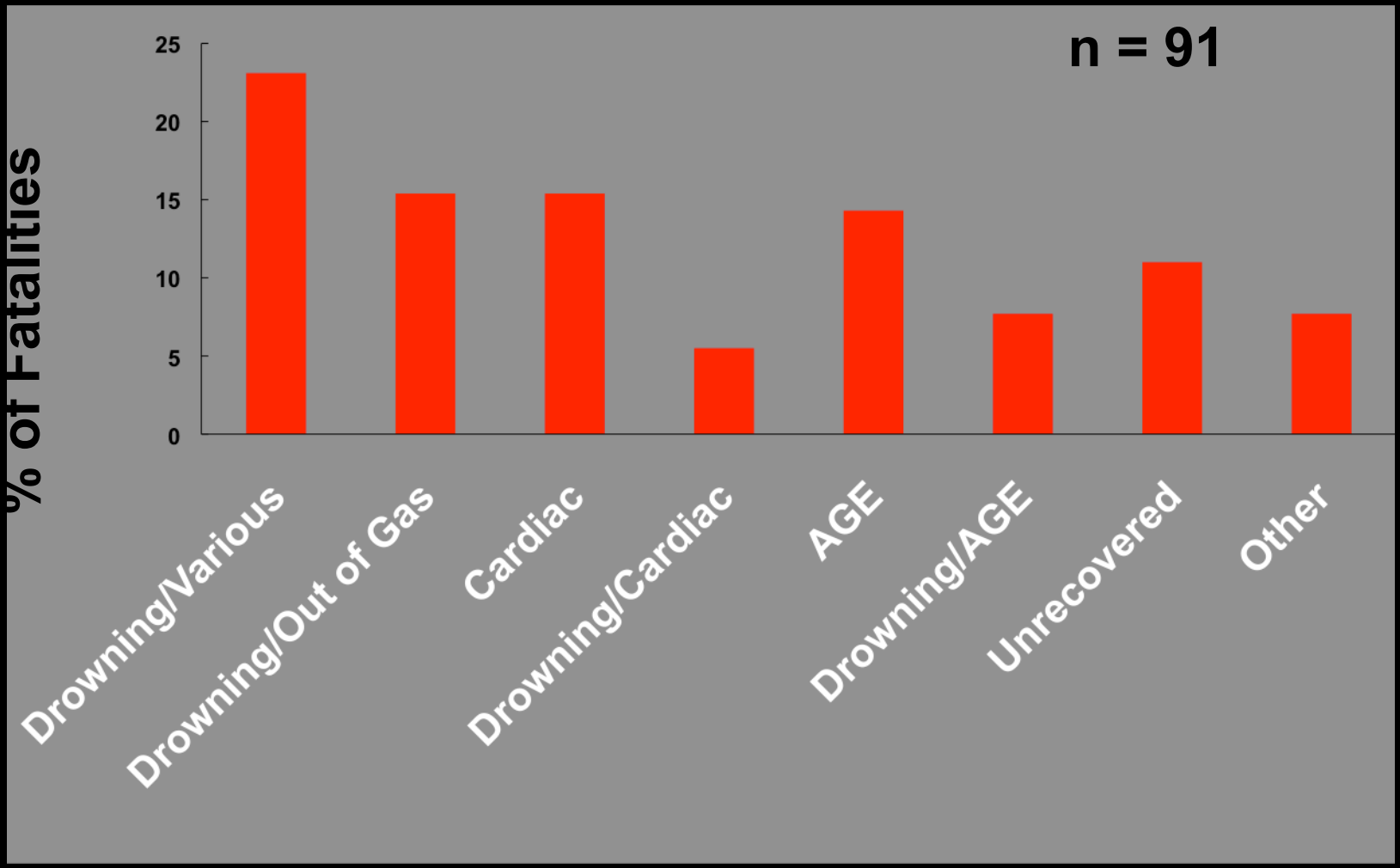
DAN: Age & Gender for Diving Fatalities

2002 DAN REPORT



DAN: Primary Cause of Death Among Diving Fatalities

2002 DAN REPORT



DAN 2019 Statistics

Table 1-1. Number of collected fatalities worldwide (n=228)

Diver Classification	USA & Canada citizens	Foreign	Not Recreational	Breath-hold	Total
Recreational	65	59	0	0	124
Technical	2	10	1	0	13
Uncertified	1	3	0	0	4
Military	0	2	1	0	3
Student	1	1	0	0	2
Task	0	0	1	0	1
Public Safety	0	0	1	0	1
Unknown	1	17	5	0	23
Breathhold	0	0	0	57	57
Total	**70**	**92**	**9**	**57**	**228**

DAN 2019 Statistics

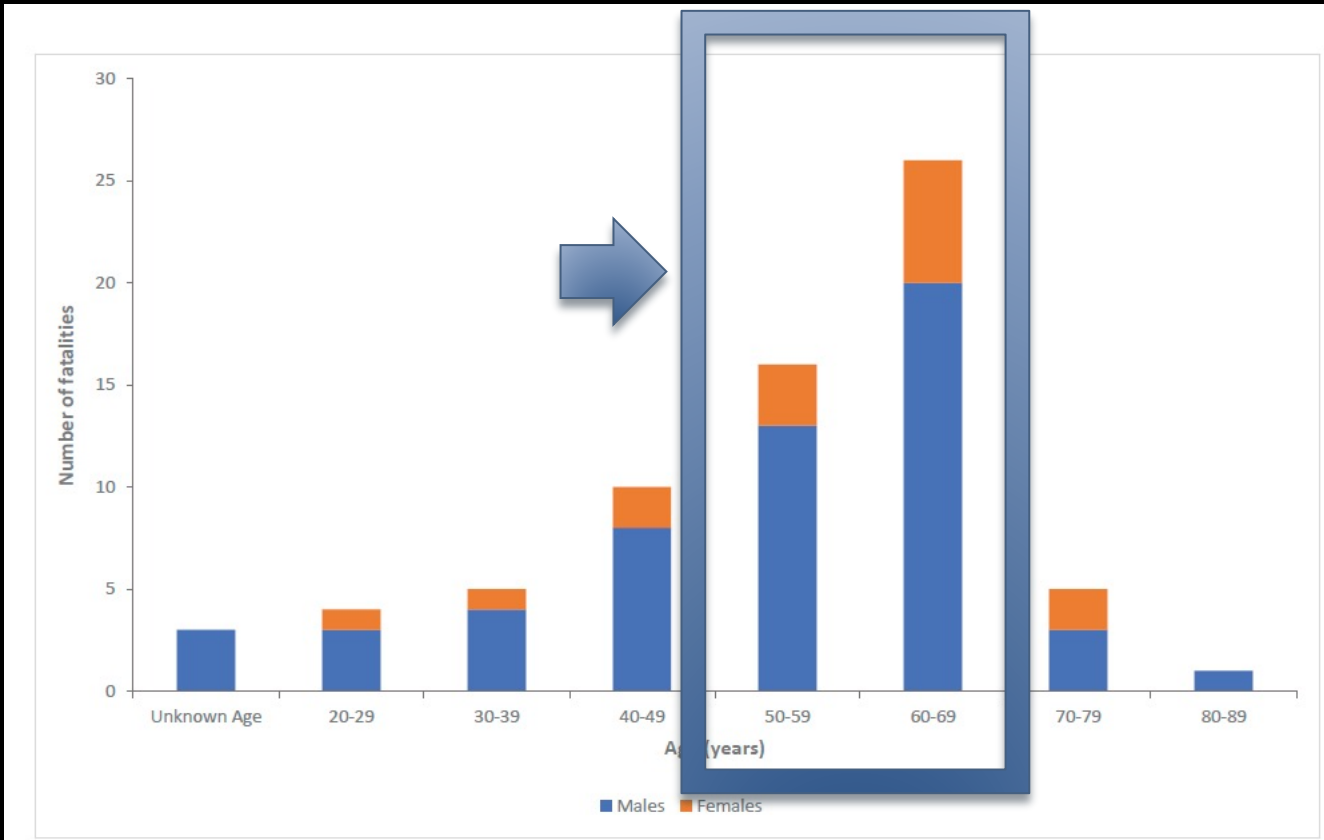


Figure 1-5. Age and sex distribution

DAN 2019 Statistics

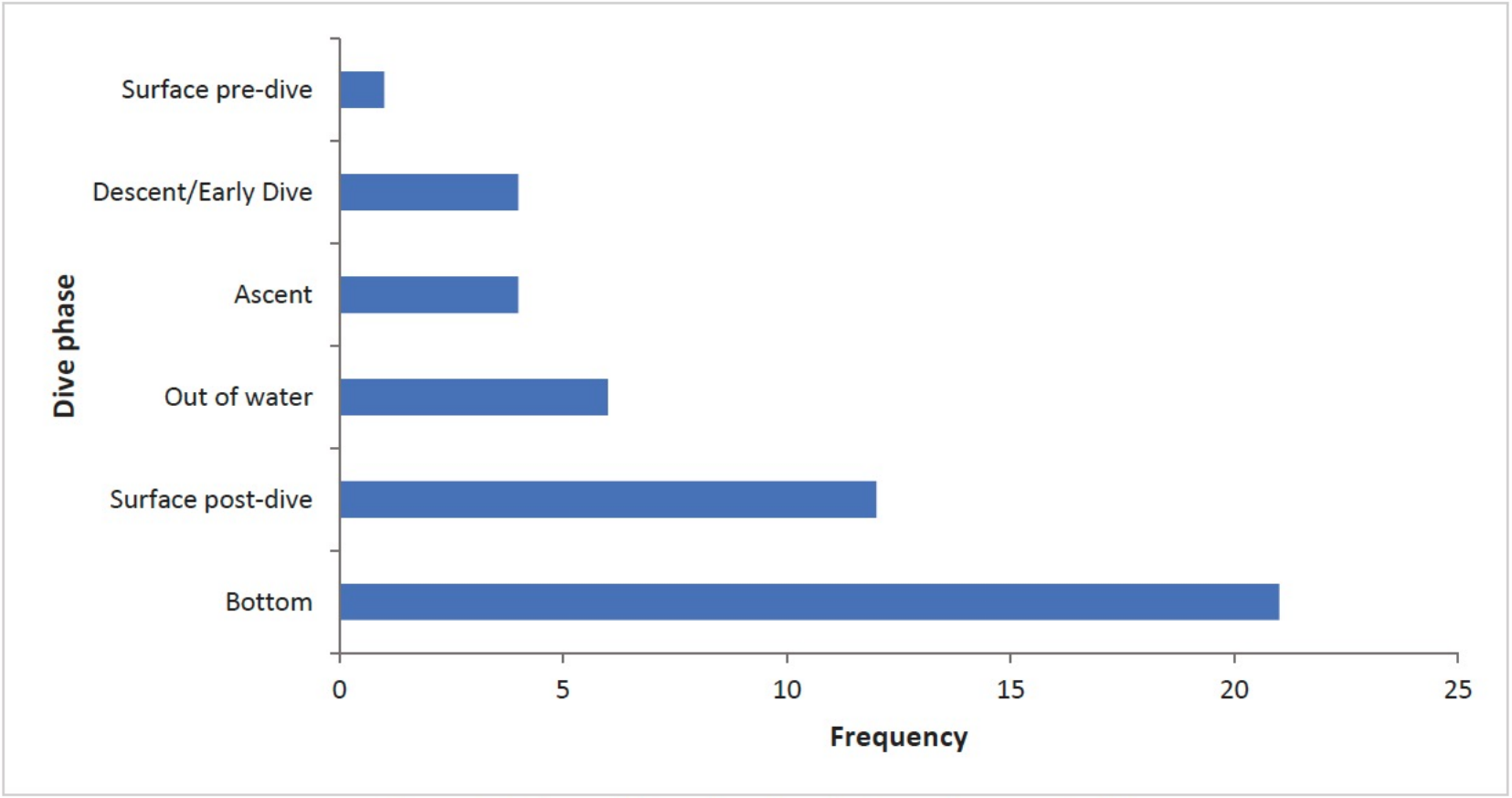


Figure 1-9. Phase of dive when diver lost consciousness (n=48)

DAN 2019 Statistics

Table 1-6. Disabling injury

Disabling Injury	n
Heart problem	9
Unknown	3
Loss of conciousness	1
Respiratory distress	1
Gastrointestinal bleeding	1
AGE	1
Severe DCS	1
Panic	1
Asphyxia	1

DAN

- 50% diving deaths: 50 – 69 years old
- **Cardiovascular disease** most common medical condition in those who die
- “Responsibility for maintaining personal health remains with diver, as well as reassessment of fitness after illness, injury or effects of aging”

FITNESS TO DIVE

- Mental & physical fitness.
- Absence of medical conditions that compromise diver's safety

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Fitness to Dive

The question I ask myself when conducting a dive medical examination…

Would I want this person to be my dive partner?

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Diving Medical Exam

Check for conditions:

- **Significant**/insignificant on surface
- **Significant/dangerous** underwater

Contraindications

- **RELATIVE** ~ Severity of disease
- **ABSOLUTE** ~ Regardless of severity

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Medical History

1. Occupation
2. Personal history
   - Water-related interests
   - Comfort around water
   - History of drug/alcohol abuse
   - History of frequent accidents, careless driving, inattention

Medical History

3. Past illnesses & surgery
4. Current medical conditions
5. Current medications **
6. Immunizations

Physical Examination

1. Physical fitness
2. Cardiovascular system
3. Respiratory system
4. Ear, nose & throat
5. Neurological system
6. Musculoskeletal system
7. Endocrine system
8. Mental health

1. Physical Fitness

Exercise fitness **13 METS** recommended

- Running 7 mph
- Swimming 50 yds/min
- X-C skiing 5 mph

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2. Cardiovascular Fitness

- **Atherosclerosis/CAD**
  - **Pulse, HR, HS, BP, EKG, Stress test**
- Patent Foramen Ovale
- Arrhythmias, pacemakers
- Congestive Heart Failure
- Hypertension
- Medications

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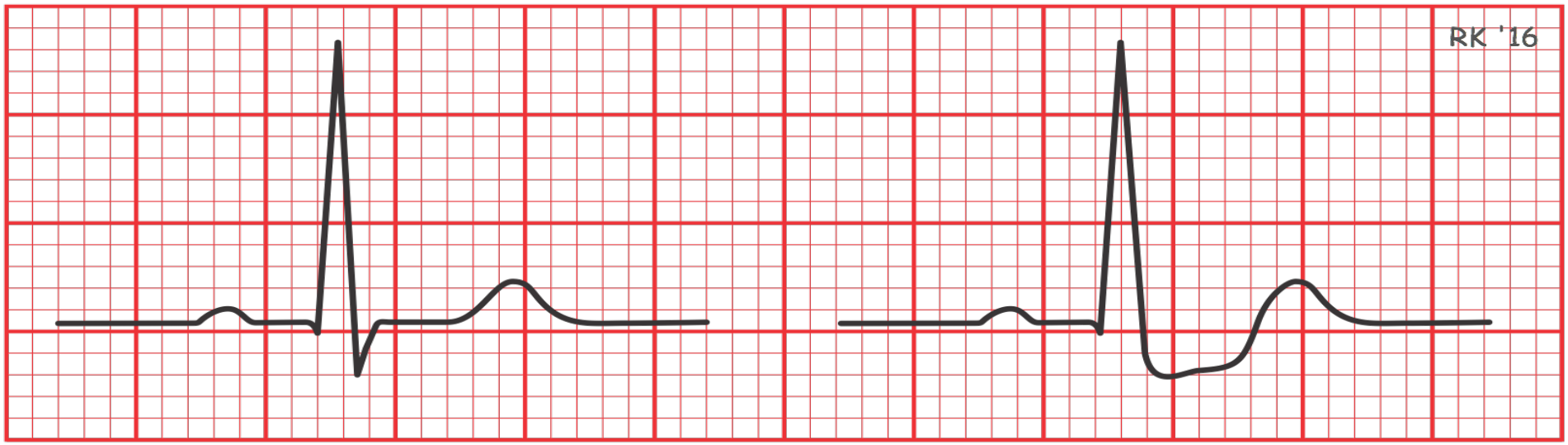
106
60%
100/70
106
60%



Normal

ST Depression

- ST depression may indicate CAD/angina
- 15% false positive/negative
- Confirmed with additional tests
- Angina - **Absolute** contraindication

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2. Cardiovascular Fitness

- Atherosclerosis/CAD
- **Patent Foramen Ovale (PFO)**
- Arrhythmias, pacemakers
- Congestive Heart Failure
- Hypertension
- Medications

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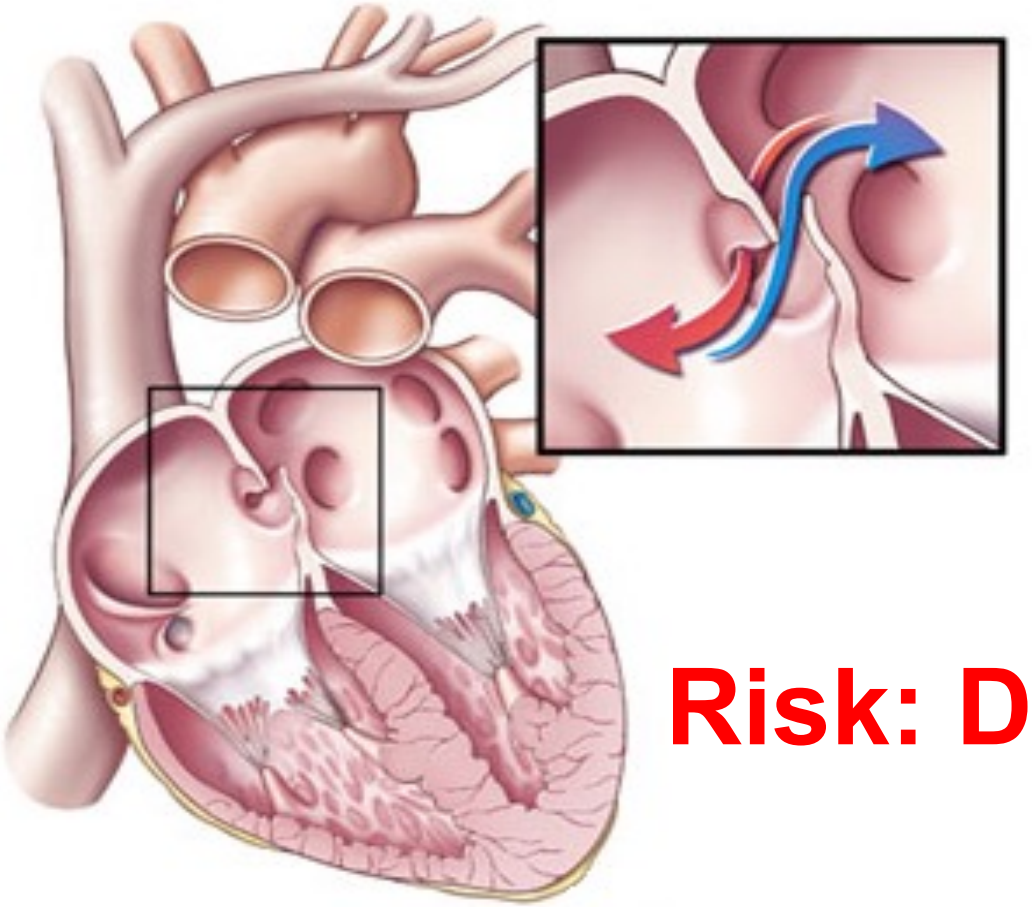
Patent Foramen Ovale

Shunting of blood & gas bubbles from right side of heart to left



Risk: DCS/AGE

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PFO Diagnosis

1. SYMPTOMS & SIGNS:

Majority of patients

None

PFO Incidence

Echocardiography & postmortem studies show PFO in:

- 25 to 30% of general population
- 25 to 30% of divers

PFO - Progression

Size of PFO increases with age, from mean of **3.4** mm in 20 yr olds to **5.8** mm in 90 yr olds

Hagen, PT. Incidence & size of PFO during the first 10 decades of life: an autopsy study. Mayo Clin Proc 1984;59: 17-20

Wisdom of Yogi Berra

I don’t mind being surprised,
so long as I know about it
beforehand

PFO: Risk for divers

1. Studies of divers with severe DCS have shown a rate of PFO higher than general population
2. Divers who have a PFO are more likely to have undiagnosed damage or lesions in their brains

Knauth M. Brain lesions in sports divers: role of PFO. Brid Med J 1997; 314: 701 -705

PFO: Risk for divers

3. Multiple brain lesions in divers who had never experienced Type II DCS, most likely caused by sub-clinical gas embolism
4. Significant correlation between size of PFO and multiple brain lesions on MRI

Knauth M. Brain lesions in sports divers: role of PFO. Brid Med J 1997; 314: 701 - 705

Factors that increase PFO risk

1. Release of Valsalva
2. Strain
3. Coughing
4. Negative Pressure Breathing
5. Oral inflation of BC

Relative risk for divers

PFO increases risk

of Type II DCS

250%

Germonpre P. PFO & DCS in Sports Divers, J Appl Physiol 1998;84(5):1622-1626

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Actual risk for divers

Risk of Type II DCS is **2.3** / 10,000 dives

Bove, A.A. Risk of DCS with PFO, Undersea Hyperb Med 1998: 25(3): 175-178

PFO increases risk **250%** or **5.7** / 10,000 dives

Germonpre P. PFO & DCS in Sports Divers, J Appl Physiol 1998;84(5):1622-1626

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What do we do about diagnosing PFO's?

- Most diving physicians agree risk of DCS with PFO not significant enough to warrant widespread screening of all divers
- Episode of DCS not explained by dive profile: ***MUST*** examine for PFO

Recommendations

Absolute contraindication:

Diver with PFO who suffered gas embolism or DCS after low-risk dive profile…

Option is to have surgical correction

Recommendations

Relative contraindication:

Diver with known PFO who never suffered gas embolism or DCS

1. Dive conservatively
2. Avoid deep dives
3. Avoid decompression dives
4. Slow rate of ascent
5. Routine safety stops

2. Cardiovascular Fitness

- Atherosclerosis/CAD
- Patent Foramen Ovale
- **Valve Disease**
- Arrhythmias, pacemakers
- Congestive Heart Failure
- Hypertension

Valve Disease

Relative contraindication

- Mild aortic stenosis – asymptomatic

  - **FIT** to diving

- Severe aortic stenosis/prolapse:

  Decreased cardiac output, shortness of breath, pulmonary congestion/edema, arrhythmias

  - **UNFIT** to dive

Arrhythmias

Relative contraindication:

- Occasional extra beats:
  -**FIT** to diving

- Associated with angina/valve disease
  - **UNFIT** to dive

Pacemakers

Relative contraindication:

- Underlying cardiac disease?
- Fixed rate, limits maximum exercise tolerance
- Maximum depth 130 feet

Congestive Heart Failure

Absolute contraindication:

- Reduced cardiac output
- Shortness of breath
- Risk of pulmonary edema

Hypertension

Relative contraindication:

- Cause of hypertension (essential/cardiac)
- Controlled/mild – **FIT** to dive
- Uncontrolled/moderate to severe – **UNFIT** to dive

Cardiac Medications

Relative Contraindication:

- Pharmaco-dynamics ~ ATA
- Beta blockers ~ cardiac output
- Calcium channel blockers ~ cause swelling of ankles, DCS
- Diuretics – dehydration and DCS?

3. Respiratory Disease

- Smoking history
- Asthma
- Chronic obstructive/restrictive lung disease
- Spontaneous pneumothorax
- Acute/chronic respiratory infections, TB
- **CXR & PFT Essential**

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FVC Report

Largest Pre FVC value = 3.766 liters: Test #1
Largest Pre FEV1 value = 3.090 liters: Test #1

Largest Post FVC value = 3.526 liters: Test #1
Largest Post FEV1 value = 2.978 liters: Test #1

Best Pre FVC: Test #1

	Value	Pred	%Pred
FVC (L)	3.766	4.471	84.2
FEV1 (L)	3.090	3.545	87.1
FEV3 (L)	3.544	4.156	85.2
FEV1/FVC%	82.0	79.2	103.5
FEF.25 (L/S)	6.630	7.278	91.0
FEF.50 (L/S)	3.917	4.398	89.0
FEF.75 (L/S)	1.336	1.659	80.5
FEF.25-.75 (L/S)	3.372	3.452	97.6
PEF (L/S)	7.270	8.212	88.5
IVC (L)	3.495	4.261	82.0

Best Post FVC: Test #1

	Value	%Pred	%Best Pre
FVC (L)	3.526	78.8	93.6
FEV1 (L)	2.978	84.0	96.3
FEV3 (L)	3.357	80.7	94.7
FEV1/FVC%	84.4	106.5	102.9
FEF.25 (L/S)	6.890	94.6	103.9
FEF.50 (L/S)	4.031	91.6	102.9
FEF.75 (L/S)	1.487	89.6	111.3
FEF.25-.75 (L/S)	3.574	103.5	105.9
PEF (L/S)	7.941	96.6	109.2
IVC (L)	3.662	85.9	104.7

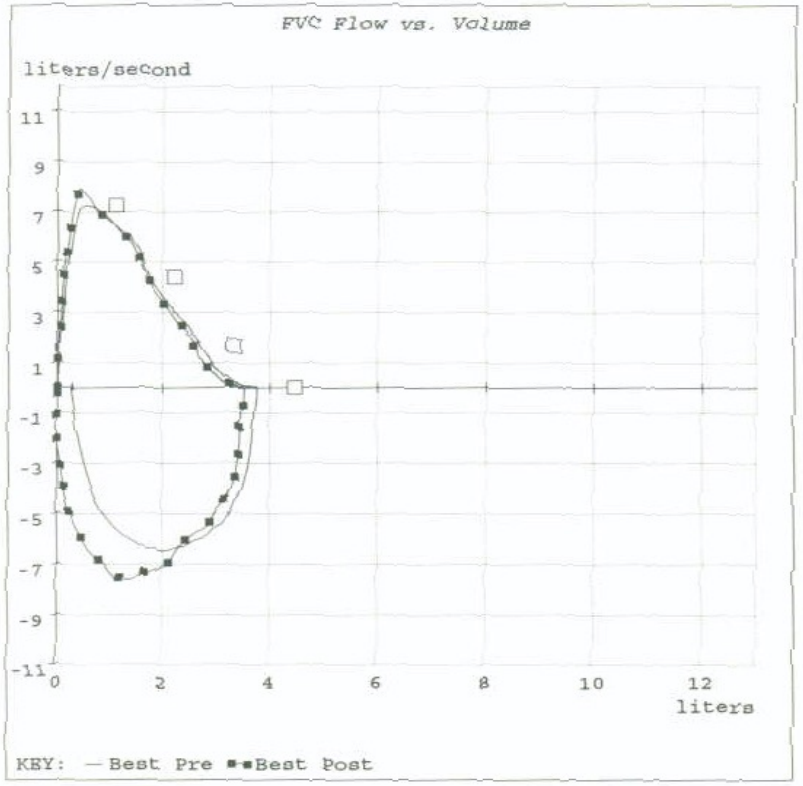
Interpretation

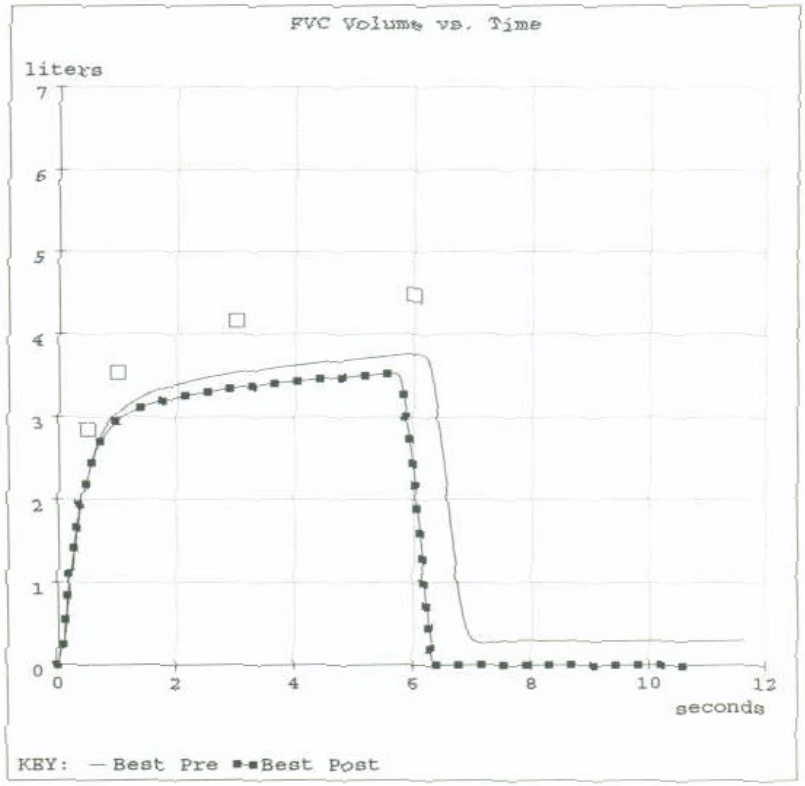
NORMAL SPIROMETRY

Interpretation

NORMAL SPIROMETRY

Spirometry not improved post dilator.





Asthma

1. Significant controversy re safety
2. **Absolute** contraindication if asthma:
    - Active
    - Occurs with exercise/cold air exposure

Pneumothorax

1. **Relative** contraindication if resulted from trauma
2. **Absolute** contraindication if spontaneous

4. ENT

Relative contraindications:

- Tinnitus/Vertigo/Deafness
- Eustachian Tube Dysfunction

Absolute contraindication:

- Perforated eardrum

5. Neurological

Absolute contraindications:

1. Epilepsy
2. Narcolepsy
3. Syncope

6. Musculoskeletal

Relative contraindications:

- Active arthritis/joint pain
  ~ varies with severity

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7. Endocrine

Relative contraindications:

- Morbid Obesity - increased risk of DCS
- Poorly controlled Diabetes Mellitus - risk of hypoglycemia & loss of consciousness
- Hypo/hyper thyroid disease
- Metabolic Syndrome

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Metabolic Syndrome

Any **3** of 5:

1. Increased Abdominal girth
2. Elevated triglycerides (blood fat)
3. Low HDL ('good' cholesterol)
4. Elevated BP
5. Elevated Fasting Blood Sugar

Risk of heart attack significantly increased

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8. Gastro-intestinal

Relative contraindication:

~~~ ***Motion sickness*** ~~~

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~~~

9. Mental Fitness

Absolute contraindications:

1. Psychosis
2. Schizophrenia
3. Severe or Uncontrolled Bipolar disorder
4. Use of some medications to treat these conditions

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9. Mental Fitness

Relative Contraindications

1. Anxiety
2. Panic Disorders
3. Medications used

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ANXIETY, PANIC & DIVING

1. Lifetime prevalence rates 7.2 – 11.3%
2. Panic is the leading cause of diving fatalities (Bachrach and Egstrom, 1987)
3. Stressors;
    1. Cold
    2. Fatigue
    3. Unfamiliar equipment
    4. Excess equipment

ANXIETY, PANIC & DIVING

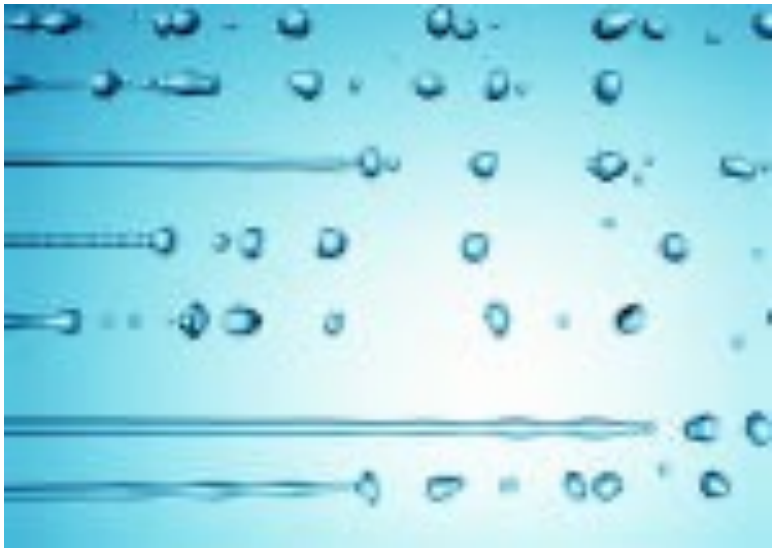
4. Event causing anxiety - diver unable to handle (e.g., regulator free flow, loss of mask, lack of training

5. **COUNTER-PHOBES**

4. **Encounter with phobic stimulus**

HYDROPHOBIA

Fear of Water



ICHTHYOPHOBIA

Fear of Fish

NYCTOPHOBIA

CLAUSTROPHOBIA

Fear of Being Enclosed or Enveloped

BAROPHOBIA

Fear of Being Crushed!

PNIGOPHOBIA

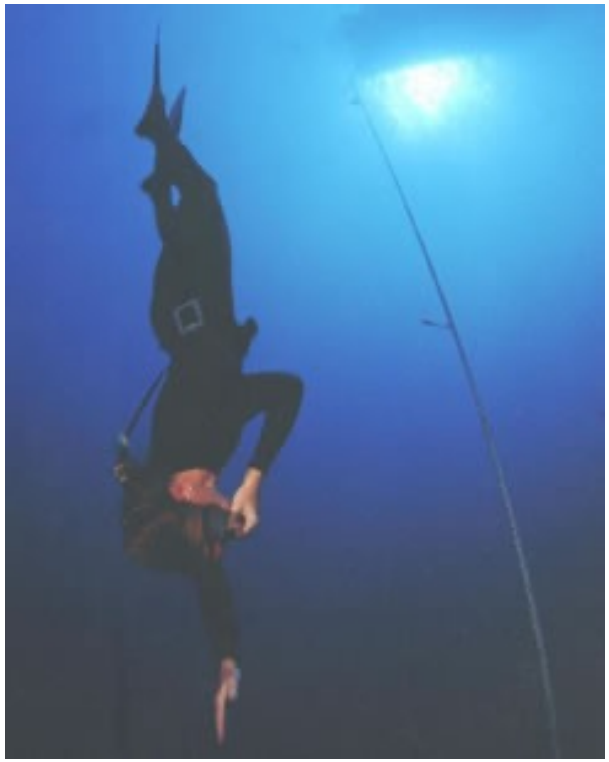
Fear of Being Choked or Unable to Breathe

PHAGOPHOBIA

Fear of Being Eaten Alive...

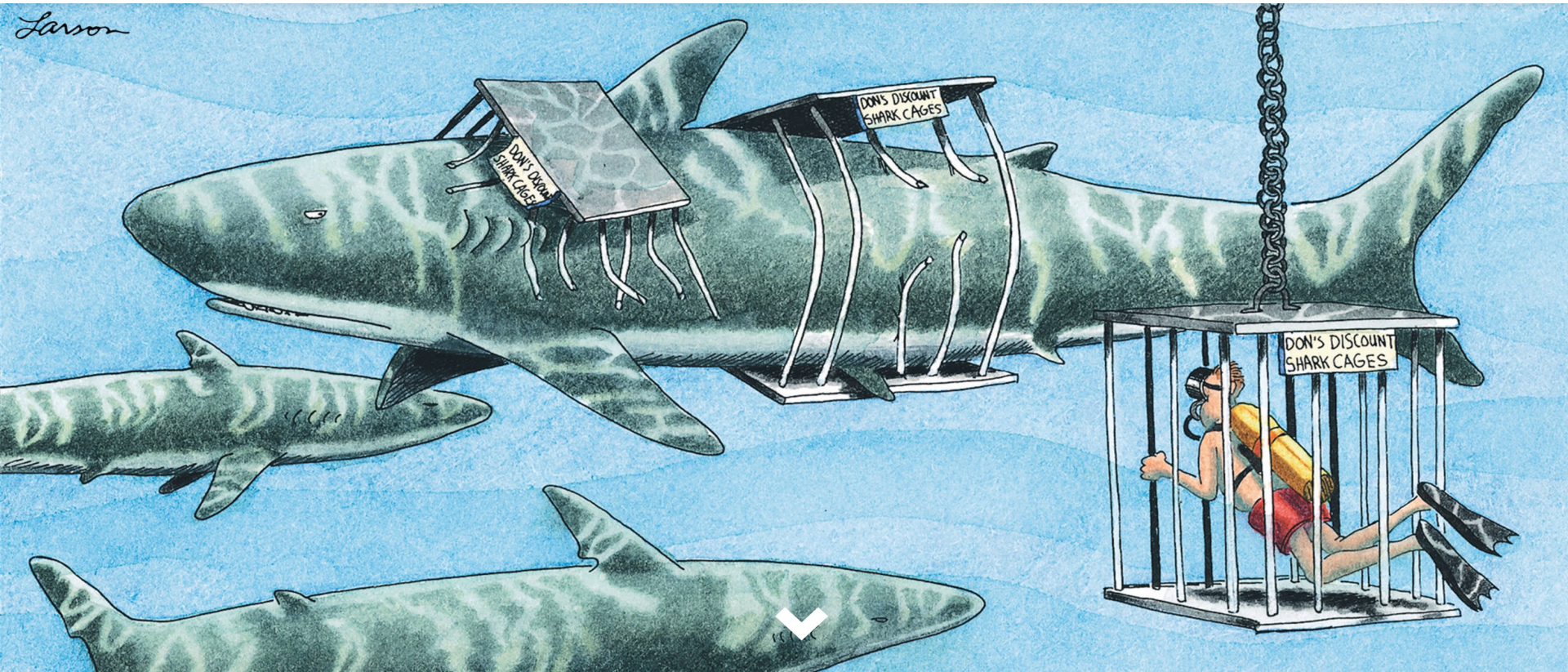
BATHOPHOBIA

Fear of Depth or Sinking



THANATOPHOBIA

Fear of Dying



Personality Disorders

Relative contraindications:

1. Buccaneer/cowboy/gunslinger

Personality Disorders

Relative contraindications:

1. Buccaneer/cowboy/gunslinger
2. Drug & alcohol abuse

Personality Disorders

Relative contraindications:

1. Buccaneer/cowboy/gunslinger
2. Drug & alcohol abuse
3. Anti-social behavior

Personality Disorders

Relative contraindications:

1. Buccaneer/cowboy/gunslinger
2. Drug & alcohol abuse
3. Anti-social behavior
4. Severe ADD

COVID – 19
& Fitness to Dive

- Major concern after symptomatic infection
- Possible long-term effects
- Comprehensive medical examination includes;
    1. Pulmonary function tests
    2. Chest X-ray, CT scan, MRI
    3. EKG, Exercise/stress test

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North America:

Would periodic Dive Medicals

for recreational scuba divers

significantly decrease morbidity and mortality?

Dive medicals & re-certification

every 5 - 10 years

& after major illness/injury/surgery

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THE END