Certified Diver Medic®

Approved Training Course Outline

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NBDHMT Approved DMT Training Course Content

The NBDHMT approved DMT training course is designed to prepare 'topside' medics to be equally effective when dealing with diving related accidents and injuries. Diver medics are expected to work within their respective scope of practice, consistent with company policy and under the supervision of a medical control physician.

One important difference between land-based medics and the common operational setting of the professional diver medic is the increased degree of medical isolation and geographic remoteness. Injured divers are rarely able to be handed off to direct physician care within time frames common for accidents and injuries that occur on land. In some cases it may be as long as a week for patient to complete their required decompression in order to be medically evacuated.

The NBDHMT approved training course is designed to prepare students for formal certification. Certified diver medics are those who have completed Board approved DMT training and have successfully completed the certification examination. Required training course content is listed below. It is listed in sections that reflect the makeup of the certification exam, both by question bank category and by weight (percent) of questions from each category that constitute the exam.

SECTION 1: **Introductions; Setting the Stage**

i. Attendance Requirements; Course Completion Testing
ii. Preview of Course Content, Knowledge and Skills Expectations
~emphasize in-chamber clinical/invasive skills requirements
iii. Roles and Responsibilities of the Diver Medic
~company policies; medical control physician; standing orders
~constant updating of medical evacuation/transfer processes
~medical kits; record keeping; local and regional resources
~maintain proficiency; encourage dive team health and fitness

DMT Instructor Note: While none of the above topics are represented in the DMT certification exam their importance cannot be over-stated.

SECTION 2: **Physics and Physiology Review; International Issues**

i. Defining, Measuring and Converting Pressure
~absolute and gauge
~standard and metric
~absolute, gauge and metric
ii. Converting Temperature
~ Fahrenheit and Celsius
iii. Key Gas Laws
~Boyle's: Dalton's; Henry's; Guy-Lussac's

iv. Emergency Gases
~definition
~computing for patient/diver depth

v. Treatment Gases
~definition
~computing for patient/diver depth

vi. Converting Weight and Drug/Fluid Dosage
~pounds to kilograms
~cc's to ml's and liters

vii. Cylinder Gas Color Coding; International Differences
~air; *oxygen-nitrogen mixtures (nitrox); medical oxygen; nitrogen; helium, oxygen-helium mixtures (heliox/oxyhelium); oxygen-helium-nitrogen mixtures*

DMT Instructor Note: The section will be something of a review for many students. It also adds an international aspect to training, reflecting that commercial diving is a global enterprise. Nine questions (7.5%) from this section constitute the DMT certification examination.

Sample Questions:

1. With a maximum desired oxygen partial pressure of 2.8 ATA, a 85/15 HeO2 treatment gas could be employed to what maximum depth?
   A. 550 fsw
   B. 583 fsw
   C. 616 fsw
   D. 649 fsw
2. At 225 fsw, a treatment gas of 80/20 HeO2 provides an oxygen partial pressure of?
   A. 1.52 ATA
   B. 1.54 ATA
   C. 1.56 ATA
   D. 1.58 ATA

SECTION 3: **Decompression Sickness & Cerebral Arterial Gas Embolism**

A. Decompression Sickness

i. Basic Pathophysiology
~evolution of a gas phase
~intravascular and extravascular gas
~direct and indirect bubble effects

ii. Predisposing/Risk Factors
~dehydration; increasing age; poor physical conditioning; exercise during/post decompression; ambient temperatures; inert gas switching

iii. Surface Orientated, Bell Bounce and Saturation Diving Aspects

iv. Symptom Presentation and Clinical Findings: Type 1 ('minor') DCS

~non-radiating joint pain
~minor skin irritation

v. Signs and Symptoms and Clinical Findings; Type 2 ('serious') DCS
~radiating and other sensory-related musculoskeletal discomfort
~significant cutaneous changes (cutis marmorata; "marbling")
~slowed lymphatic drainage; abdominal/thoracic pain; cardiopulmonary changes ('chokes'); cranial nerve involvement; sensory/motor impairment

vi. Differential Diagnosis; Type I vs. Type II DCS
~to optimize therapy
~determine need for subsequent diagnostic testing
~guide fitness to return to diving decisions

vii. Immediate Management & Evacuation Issues; No On-site Chamber

viii. Treatment Table Selection Criteria and Application
~U.S. Navy treatment tables 5, 6, 6A, 7, 8, 9
~Comex Cx 30
~gas bounce decompression sickness
~saturation decompression sickness (U.S. Navy protocol)

ix. Adjunctive Therapies
~oral & intravenous fluids
~pharmacology; guided by evidence-based position statement (www.uhms.org)
~in-water recompression risk-benefit controversy

x. Management of Incomplete Resolution and Relapse

xi. Differential Diagnosis; Pulmonary DCS vs. Immersion Pulmonary Edema

B. Cerebral Arterial Gas Embolism

i. Basic Pathophysiology
~pulmonary over pressure during ascent; structural lung failure
~right (venous) to left (arterial) passage of decompression-induced bubbles
~gas bubbles become gas columns as arterial vascular bed narrows
~ischemic brain insult; vascular reactivity and vasoconstriction

ii. Predisposing/Risk Factors
~accelerated/uncontrolled/breath-holding ascents
~underling pulmonary diseases
~breach of pulmonary filtration system
~cardiac abnormality; anatomic or functionally patent foramen (PFO)

iii. Clinical Presentation
~typical rapid onset, within 10 minutes of surfacing for pulmonary barotrauma
~delayed onset in paradoxical (venous bubbles to arterial circulation) cases
~dramatic, obvious neurological impairment
~loss of consciousness; stroke-like clinical picture; abnormal behavior, speech, vision;
impaired motor function/weakness usually affecting one side of the body

iv. Differential Diagnosis
~CAGE vs. Type I (cerebral) DCS

v. Immediate Management & Evacuation Issues; No On-site Chamber
vi. Treatment Table Selection Criteria
~U.S. Navy treatment tables 6, 6A, 7, 8
~Comex Cx 30
vii. Adjunctive Therapies
~as per decompression sickness
viii. Management of Incomplete Resolution and Relapse
ix. Potential for Concurrent Pneumothorax, Mediastinal and Subcutaneous Emphysema

DMT Instructor Note: Eighteen questions (15%) from this section constitute the DMT certification examination.

Sample Questions:

1. The classic sign of pulmonary DCS is:
   A. Chokes
   B. Tracheal deviation
   C. Uneven chest excursion
   D. Bloody sputum
2. Symptoms of inner ear DCS commonly occur:
   A. Upon compression
   B. During decompression or soon after surfacing
   C. At pressure
   D. All of the above are correct
3. In cases of CAGE, it is particularly important to listen to breath sounds following decompression from 60 fsw to 30 fsw because:
   A. Uneven breath sounds suggest relapse
   B. Respiratory distress may require treatment table extensions
   C. CAGE and pneumothorax are common concurrent complications of pulmonary barotrauma
   D. It will provide a diagnosis of pulmonary oxygen toxicity

SECTION 4: **Patient Assessment**

i. Vital Signs
ii. Physical Examination Fundamentals
iii. Neurological Examination Fundamentals
~brief and detailed versions
iv. Diagnostic Equipment
~BP cuff; stethoscope; penlight; 'neurological' reflex hammer; tuning fork; otoscope
v. Evaluation of Hearing
~Weber; Rinne; Schwabach; diver self test
vi. Evaluation of External Ear, Middle Ear, Ear Drum

vii. Anticipated Findings; DCS, CAGE, Ear, Lung and Other Barotraumas

DMT Instructor Note: Thirty questions (25%) from this section constitute the DMT certification examination.

Sample Questions:

1. Which of the following should occur during examination of the eyes?
   A. Both eyes should track together, up and down, side to side
   B. Both pupils should be round and essentially the same size
   C. Both pupils should constrict when gaze is quickly shifted from far away to a finger held 4-6 inches in front of the nose
   D. All of the above are correct
2. A diver who experiences an accelerated in-water ascent presents soon thereafter with hoarseness. Physical examination reveals 'rice krispie' like pockets of gas at the base of the neck. The likely diagnosis is:
   A. Subcutaneus emphysema
   B. Pulmonary oxygen toxicity
   C. Type II DCS
   D. Cardiac tamponade

SECTION 5: **Barotrauma**

i. Air containing anatomic locations
~mediastinum; subcutaneous sites; middle ear; external ear; paranasal sinus spaces; teeth; GI tract;

ii. Pathophysiology
   i. lungs: per cerebral arterial gas embolism, Section 3 above
   ii. mediastinum and subcutaneous: air tracking from lung over-pressure
   iii. middle ear: pressure imbalance between naso-pharynx and middle ear
   iv. external ear: material (wax, bony in-growth) occluding the external canal
   v. paranasal sinus spaces: pressure imbalance between these spaces and the oro-pharynx
   vi. teeth: gas spaces existing within diseased or incompletely filled cavities, or failure of the dental cementum
   vii. G.I. tract: expansion gas formed secondary to dietary intake or underlying disease

iii. Predisposing/Risk Factors
~pulmonary pathologies; upper respiratory infections; polyps; poor equalization technique; rapid and poorly compensated changes in pressure; poor dental health; smoking

iv. Symptom Presentation and Clinical Findings

~pneumothorax; tension pneumothorax; subcutaneous emphysema; mediastinal emphysema; ear pain; sinus pain; dental pain, abdominal discomfort

v. Management

~pneumothorax; varies from observation and high partial pressure oxyxgen breathing to surgical intervention

~tension pneumothorax; surgical intervention vs. inherent unsaturation with treatment gases while under pressure vs. recompression to depth of distinct improvement in cases occurring under pressure

~subsutaneous and mediastinal emphysema; observation, rest, oxygen delivery, medical transfer

~ear and sinus spaces, symptomatic relief including decongestants; ENT referral for all inner ear and severe middle ear injuries

~teeth; symptomatic relief and dental referral

~G.I. tract; symptomatic relief

vi. Differential Diagnosis: Inner Ear Barotrauma vs. Inner Ear DCS

DMT Instructor Note: Certification exam questions related to barotrauma will be incorporated into the questions in Sections 3 and 7.

Sample Questions:

1. Which of the following would favor a diagnosis of inner ear barotrauma vs. inner ear DCS?
    A. Damaged tympanic membrane
    B. Dive shallower than 30 fsw
    C. Middle ear equalization difficulties
    D. All of the above are correct
2. In a tension pneumothorax, the trachea is usually observed as:
    A. Midline
    B. Displaced towards the effected side
    C. Displaced away from the effected side
    D. Either displaced towards or away from the effected side

SECTION 6: **Recompression Treatment Procedures**

i. Recompression Decisions Based Upon Symptom Presentation, Symptom Classification, Initial Treatment Response

ii. U.S. Navy Treatment Protocols

iii. Operational Issues and Complications

~treatment table extensions; incomplete resolution; relapse; residual symptoms; tender/medic decompression; medical evacuation/transfer

iv. Omitted Decompression

v. Decompression of the Medic/Tender

DMT Instructor Note: Twenty-seven Category 5 questions (22.5%) constitute the DMT certification examination.

Sample Questions:

1. According to US Navy protocols, initial recompression for saturation DCS not involving recent excursions is:
    A. To previous storage depth
    B. To depth of distinct improvement, at 25 fpm
    C. To depth of distinct improvement, at 5 fpm
    D. To depth of relief, at 10 fpm
2. According to US Navy protocols recurrence of DCS following ascent from 60 fsw mandates:
    A. Return to 60 fsw and complete 3 oxygen cycles
    B. Hold at recurrence depth, complete 3 oxygen cycles
    C. Continue decompression, observe closely
    D. Recompress to 165 fsw with patient off oxygen
3. Extensions at 60 fsw and 30 fsw on US Navy Treatment Table 6 can result in clinical manifestations of:
    A. Pulmonary oxygen toxicity
    B. Hypothermia
    C. Dehydration
    D. None of the above are correct

SECTION 7: **Invasive Procedures**

Emergent management of pneumothorax/tension pneumothorax; routes of fluid and medication administration and rate calculations; nasogastric tubes; wound closure; sterile technique; Foley catheter; airway control; transfer of vials and ampoules into the chamber.

See Appendix 1: 'In-chamber Clinical Skills Requirements'

See Appendix 2: 'Essential and Valuable Invasive Skills' listing

DMT Instructor Note: Twelve Category 6 questions (10%) constitute the DMT certification examination.

Sample Questions:

1. In order to lessen the chance of infection when inserting a Foley catheter you should do all of the following except:
    A. Touch the items in the kit only with sterile gloves
    B. Swab the patient's anatomy several times with iodine prep
    C. Use only sterile lubricant
    D. Have the patient wear a protective face shield
2. Using microdrip IV tubing, how many drops of fluid equals 1 ml/cc?

A. 15
B. 60
C. 10
D. 20

3. To ensure that a nasogastric tube will be inserted far enough, measure the distance from the patient's _____ and down to their _____, then mark the tube:
    A. Nose to chin; xyphoid process
    B. Nose to earlobe; xyphoid process
    C. Chin to earlobe; xyphoid process
    D. Chin to forehead; xyphoid process

SECTION 8: **Other Diving Related Injuries, Side Effects, and Complications**

i. CNS Oxygen Toxicity
ii. Pulmonary Oxygen Toxicity
iii. Marine Life Injuries
iv. Thermal Imbalance; Hyperthermia, Hypothermia

DMT Instructor Note: Eighteen Category 7 questions (15%) constitute the DMT certification examination.

Sample Questions:

1. Which of the following is considered a premonitory sign of CNS oxygen toxicity?
    A. Nausea
    B. Twitching of lips and/or facial muscles
    C. Auditory hallucinations
    D. All of the above are correct
2. A vinegar soak is the recommended first aid for which of the following aquatic animal injuries:
    A. Stings
    B. Bites
    C. Scrapes
    D. Punctures

SECTION 9: **Chamber, Equipment, Operational Safety**

i. Diagnostic Equipment Compression/Decompression Precautions
ii. Chamber Fire Safety
iii. Medic/Tender Decompression Procedures
iv. Chamber Ventilation
v. Atmosphere Sampling
vi. Fundamentals of Chamber Operation
vii. Medical Lock/Entry Lock Operation

DMT Instructor Note: Six questions (5%) from Section 8 constitute the DMT certification examination.

Sample Questions:

1. Rubber stopped vials:
    - **A. Require venting prior to compression**
    - B. Are unaffected by pressure changes
    - C. Should not be used under hyperbaric conditions
    - D. May explode upon compression
2. Which type of blood pressure device can be used safely under hyperbaric pressures?
    - A. Mercury
    - **B. Aneroid**
    - C. Either mercury or aneroid
    - D. Neither mercury or aneroid – electronic is the only suitable type

APPENDIX I

IN-CHAMBER CLINICAL SKILLS REQUIREMENTS

It is expected that DMT student in-chamber training will combine evaluation and management aspects with sham treatment scenarios.

1. Physical examination
   - Equipment requirements: stethoscope, blood pressure cuff, penlight thermometer; otoscope/ophthalmoscope

2. Neurological examination
   - Equipment requirements: 4-in-1 neurological hammer, penlight, tuning fork

3. Invasive skills
   a. Peripheral intravenous infusion – manikin
   b. IV/IM injections – manikin
   c. Foley catherization – manikin
      - with sterile field set up

4. Sham treatment
   - Scenario as per instructor preference

APPENDIX II

ESSENTIAL INVASIVE TRAINING SKILLS *(**Required** for DMT certification)*

1. Intravenous access
    a. Fluid infusions
    b. Drug administration
    c. Blood draws
2. Intramuscular injection
3. Subcutaneous injection
4. Insertion of urinary catheter
5. Insertion of nasogastric/orogastric tube
6. Manual or battery powered oropharynx/orogastric suction
7. Airway control; one or more of the following:
    a. Double lumen tube
    b. Pharyngeal-tracheal lumen
    c. Endotracheal intubation
    d. Needle cricothyroidotomy
8. Chest decompression capability; one or both of the following:
    a. Pneumothorax needle
    b. Chest tube

VALUABLE ADDITIONAL SKILLS *(**Not required** for DMT certification)*

1. Ability to use the 'Easy IO Drill'
2. Simple suture repairs or alternate of wound closure option, eg;
    a. Dermagel / Dermabond
    b. Quickclot
    c. Celox gauze
3. Splinting of simple dislocations and fractures
4. Basic Life Support
5. Advanced Cardiac Life Support
6. CO2 scrubber installation for chamber under pressure
7. Operation of a CO2 analyzer