

# Certified Hyperbaric Technologist

## Approved Training Course Standard



**National Board of Diving & Hyperbaric Medical Technology**

Last reviewed October 2018

## Training and Competency Standards

This document describes content, training and competency requirements for NBDHMT approved introductory courses in hyperbaric medicine. These requirements must be incorporated into a 40-hour time frame. Additional related content may be added at the course director's discretion but must be provided in addition to the 40-hours.

### Minimum Content/Topic Time Frames

Recommended minimum time frames serve to allow adequate topic concentration, and are consistent with the make up of the certification question bank. The additional five hours necessary to complete the 40 hour course requirement are allocated at the discretion of the respective course director, with individual sections adjusted upwards accordingly.

**Section 1.** 2.0 hours **Section 2.** 1.5 hours **Section 3.** 5.0 hours **Section 4.** 3.0 hours **Section 5.** 4.0 hours **Section 6.** 4.0 hours **Section 7.** 5.0 hours **Section 8.** 1.0 hour **Section 9.** 0.5 hour **Section 10.** 6.0 hours **Section 11.** 1.0 hour **Section 12.** 2.0 hours

### Minimum Content/Topic Requirements

1. Physics of hyperbaric and hypobaric exposures
    - a. Applicable gas laws, to include
      - i. Boyle's Law, Dalton's Law, Gay-Lussac's Law, Charles' Law, Henry's Law, General Gas Law
    - b. Common physical units associated with diving and hyperbaric practice
    - c. Calculations for the conversion of common units used in diving and hyperbaric operations
  2. Air decompression procedures
    - a. Decompression theory fundamentals
    - b. Decompression procedures, per U.S. Navy Diving Manual
      - i. No-Decompression Tables
      - ii. Decompression Tables
      - iii. Repetitive Diving Tables
    - c. Inside attendant decompression procedures
  3. Food Drug Administration approved/Undersea and Hyperbaric Medical Society recommended indications for hyperbaric oxygen (HBO) therapy
    - a. Mechanisms of action that constitute the basis for approved/recommended indications
    - b. Hyperbaric medicine's indications
    - c. Fundamentals of clinical management and dosing guidelines
    - d. UHMS utilization review
  4. Patient assessment and management
    - a. Plan of care/treatment considerations
    - b. Pre- and post-treatment assessments
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- c. Patient scheduling
  - d. Patient charting and related documentation
  - e. Special issues related to diabetic patients
  - 5. Risk factors, side effects and contraindications
    - a. Central nervous system and pulmonary oxygen toxicity
    - b. Absolute and relative contraindications
    - c. Management of complications
    - d. Adverse effects of pressure change (barotrauma)
      - i. Ears
      - ii. Sinus spaces
      - iii. Teeth
      - iv. Lungs
      - v. Gastrointestinal tract
      - vi. Implanted device considerations
  - 6. Hyperbaric chamber and supportive systems
    - a. Fundamentals of multiplace and monoplace chambers
    - b. Operating policies and procedures
    - c. Pressurization gas systems
    - d. Breathing gas systems
    - e. Safe handling of high pressure gas cylinders
    - f. Biomedical support equipment
    - g. Environmental systems
    - h. Acrylic viewport/window inspection and care
  - 7. Hyperbaric safety
    - a. Hyperbaric Safety Director roles and responsibilities
    - b. Hyperbaric chamber fires and lessons learnt
    - c. Emergency procedures
    - d. Applicable codes and standards
    - e. Operational checklists
    - f. Mechanical and electrical considerations
    - g. Approved and prohibited items
  - 8. Administration and management
    - a. Hyperbaric chamber staffing
      - i. Inside attendant fitness-to-work in pressurized settings
    - b. Professional societies and organizations
    - c. Hyperbaric personnel certification
    - d. Hyperbaric facility accreditation
    - e. Operational, technical and safety resources
    - f. Familiarity with the role of Food and Drug Administration (FDA); Centers for Medicare and Medicaid Services (CMS); Occupational, Safety and Health
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Administration (OSHA); Centers for Disease Control and Prevention (CDC); National Fire Protection Association (NFPA); American Society of Mechanical Engineers' Committee on Pressure Vessels for Human Occupancy (ASME-PVHO); The Joint Commission (JC); De Norske Veritas (DNV); The Undersea and Hyperbaric Medical Society (UHMS)

9. Infection prevention
  - a. Universal precautions
  - b. Use of approved disinfectants for chamber and related equipment; risks associated with in-chamber chemical off-gassing
  - c. Hand washing
  - d. Personal protective equipment (PPE)
10. Practical orientation; may be direct observation, hands-on, or combination
  - a. Hyperbaric chamber operations
  - b. Compression and breathing gas systems
  - c. Ancillary equipment
  - d. Emergency drills examples; to include:
    - i. In-chamber fire
    - ii. In-facility/nearby fire
    - iii. Suspected patient pneumothorax
    - iv. Emergency decompression (cardiac arrest, etc.)
    - v. Timed egress
  - e. Patient pre- and post-treatment assessments
  - f. Documentation
    - i. Patient charting; examples to include:
      - a. Patient history
      - b. Patient assessment
      - c. Education checklist
      - d. Prohibited items authorization
      - e. Treatment record/progress notes
      - f. Treatment consent
      - g. Photography consent
    - ii. Equipment check lists
    - iii. Facility check lists
11. Evaluation
  - a. Written examination (paper or online)
  - b. Course and faculty critiques (paper or online)
12. Transcutaneous oxygen monitoring (TCOM)

## **Transcutaneous Oxygen Monitoring (TCOM) Module**

### **Background**

During initial screening and case management of wound healing referrals, CHT's may be called

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upon to conduct transcutaneous oxygen testing. This procedure represents a non-invasive and quantitative assessment of tissue oxygenation states, commonly involving lower extremity sites. Used in an algorithmic manner, transcutaneous oxygen testing:

- Identifies whether local hypoxia is a factor in healing compromise
- Determines capacity to respond locally (wound) to centrally (lungs) delivered increases in oxygen
- Provides early indication of therapeutic response
- Helps identify a therapeutic endpoint

### **Purpose**

This Module is designed to ensure that CHT's are provided with sufficient knowledge and skill to effectively conduct transcutaneous oxygen testing and data recording. It contains both learning objectives and methods to demonstrate proficiency.

### **Disclaimer**

It is not the intent of this module to provide CHT's with certification in transcutaneous oxygen testing.

### **Learning Objectives**

The trainee is expected to be able to demonstrate a working knowledge of:

- I. Transcutaneous oxygen (tcpO<sub>2</sub>) technology
  - A. General principals
  - B. Common applications
- II. The transcutaneous oxygen monitor and related supplies
  - A. Operating functions
  - B. Calibration procedure and verification
  - C. Sensor electrode care and maintenance
  - D. Membrane replacement
  - E. Monitor care
  - F. Trouble-shooting fundamentals
- III. The transcutaneous oxygen testing procedure
  - A. Patient informed consent
  - B. Fundamentals of site selection
  - C. Site preparation
  - D. Anticipated normal values; chest and lower extremities
  - E. Effects of testing at altitude
  - F. Control/reference sites
  - G. Normobaric air breathing
  - H. Normobaric oxygen breathing
  - I. Hyperbaric oxygen breathing
  - J. Testing documentation and data recording
  - K. Regional perfusion index (RPI) computation
  - L. Common testing errors

### **TCOM MODULE TRAINING OUTLINE**

- I. Trainee will demonstrate a working knowledge of the transcutaneous monitor's technology, specifically:
    - A. Principles of testing, to include:
      - i. Monitor set up
      - ii. Function of the sensor electrode
      - iii. Physiological effect of the sensor electrode heating
      - iv. Potential patient risks
    - B. Common indications for testing
      - i. Small and large vessel arterial screening
      - ii. Wound hypoxia definition
      - iii. Values suitable to undergo HBO therapy
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- iv. Evidence of therapeutic response
- v. Determination of therapeutic
- vi. Skin flap assessment
- C. Describe the operating function of the monitor, including settings and adjustments
- D. Describe calibration verification procedures, and on what frequency
- E. Describe technique for changing sensor membranes
- F. Describe how sensor electrode is cleaned and disinfected
- II. Trainee will demonstrate a working knowledge of the testing procedure.
  - A. Describe related anatomy of common testing sites
    - i. Arterial vascular supply
    - ii. Issues related to bones, tendons and pulse sites
  - B. Describe how the testing sites are commonly selected
    - i. Anatomic characteristics
    - ii. Skin characteristics
    - iii. Indication-specific issues
  - C. List steps involved in site preparation
    - i. Removal of any hair
    - ii. Removal of oils and dirt
    - iii. Removal of loose outer skin (stratum corneum)
  - D. Describe testing process
    - i. Baseline air breathing test procedure
    - ii. Provocative challenges
      - a. Normobaric 100% oxygen at ambient pressure
      - b. Hyperbaric oxygen challenge
  - E. Explain why patient-specific control/reference sites are employed and provide examples
    - i. To allow each patient to serve as their own control
    - ii. To determine differences in degree of 'central' (chest) vs. 'local' (extremity or wound) tissue oxygenation
    - iii. Example sites include chest (left second intracostal space, mid-clavicular), tricep, where the chest is not suitable (large amount of fatty tissue; previous history of therapeutic radiation; CABG surgery with mammary artery diversion)
  - F. List anticipated tcpO<sub>2</sub> values or range of normal values for both 1.0 ATA air testing and effect of elevated altitudes
    - i. Chest reference site 60-95mmHg
    - ii. Lower extremity; normal > 50mmHg adequate for oxygen-dependent wound healing; > 40mmHg
  - G. Describe trouble shooting procedure for
    - i. Alarms
    - ii. Error Codes
- III. Trainee should be able to demonstrate knowledge of a tcpO<sub>2</sub> test that is consistent with best practice standards.
  - B. Calculate Regional Perfusion Index (RPI)
    - i. Completed during air breathing only
    - ii. Divide wound value by chest control value
  - C. Explain the effects of common testing errors on tcpO<sub>2</sub> values obtained
    - i. Positioning of patient
    - ii. Patient animated
    - iii. Ambient room temperature variance
    - iv. Inconsistent electrode temperature with serial readings
    - v. Inconsistent electrode placement with serial readings
    - vi. Inadequate time for electrode equilibration
    - vii. Inadequate oxygen flow during oxygen challenge
    - viii. Inadequate/faulty fixation ring adhesion

- D. Trainee should be able to describe informed consent procedure
  - i. Explain planned procedure and why it is necessary
  - ii. Explain risks involved
  - iii. Summarize its potential value
- E. Trainee should be able to inspect and verify completeness of equipment required to conduct a tcpO<sub>2</sub> study
  - i. Monitor
  - ii. Electrode(s)
  - iii. Ancillary Equipment
    - a. Oxygen source
    - b. Patient oxygen delivery device (non-rebreather mask or hood)
    - c. Calibration gas (if applicable)
- F. Trainee should be able to conduct a tcpO<sub>2</sub> test consistent with best practice standards
  - i. Set up the monitor
    - a. Sensor temperature setting
    - b. pO<sub>2</sub> calibration
    - c. pCO<sub>2</sub> setting (if available)
    - d. Re-membrane electrode
  - ii. Prepare patient
    - a. Brief patient
    - b. Obtain patient's consent
    - c. Position patient
  - iii. Prepare site(s)
    - a. Prepare the selected site(s)
    - b. Attach fixation ring and connect sensor electrode
  - iv. Collect data
    - a. Baseline tcpO<sub>2</sub> on normobaric air
    - b. Physiologic challenge (either of c. or d.)
    - c. Normobaric oxygen challenge on 100% oxygen
    - d. Hyperbaric oxygen challenge with 100% oxygen
  - v. Record data
    - a. Complete data sheet or input information to computer
    - b. Calculate RPI
  - vi. Remove electrode
    - a. Remove adhesive device
    - b. Clean/decontaminate electrode
    - c. Store monitor

# SAMPLE TCOM COMPETENCY SKILLS CHECKLIST

## Technical Knowledge of Transcutaneous Oxygen Monitoring System

Name \_\_\_\_\_ Auditor/Instructor \_\_\_\_\_  
as it appears on government issued I.D.

### Demonstrate knowledge of the following

<input type="checkbox"/>	Principles of transcutaneous oximetry
<input type="checkbox"/>	Common indications for tcpO <sub>2</sub> testing
<input type="checkbox"/>	Operating functions of the monitor
<input type="checkbox"/>	Settings
<input type="checkbox"/>	Adjustments
<input type="checkbox"/>	Calibration procedures
<input type="checkbox"/>	Procedure for maintaining membrane & electrode
<input type="checkbox"/>	Troubleshooting procedures for alarms and error codes
<input type="checkbox"/>	Arterial anatomy related to common tcpO <sub>2</sub> testing sites
<input type="checkbox"/>	Fundamentals of site selection
<input type="checkbox"/>	How to prepare tcpO <sub>2</sub> testing sites
<input type="checkbox"/>	How to perform a tcpO <sub>2</sub> study
<input type="checkbox"/>	Why reference information is obtained
<input type="checkbox"/>	Anticipated normal lower extremity tcpO <sub>2</sub> values
<input type="checkbox"/>	How to calculate regional perfusion index (RPI)
<input type="checkbox"/>	Common testing errors and their effect on tcpO <sub>2</sub>
<input type="checkbox"/>	How to obtain informed consent for tcpO <sub>2</sub> testing

### Demonstrate procedure for inspection of the equipment

	Monitor
<input type="checkbox"/>	Monitor temperature setting
<input type="checkbox"/>	pO <sub>2</sub> setting
<input type="checkbox"/>	pCO <sub>2</sub> (if applicable)
<input type="checkbox"/>	O <sub>2</sub> alarm limits
<input type="checkbox"/>	CO <sub>2</sub> alarm limits (if applicable)
	Sensor electrode
<input type="checkbox"/>	Cable intact/undamaged
<input type="checkbox"/>	Membrane change
<input type="checkbox"/>	Frequency of changes
	Ancillary Equipment
<input type="checkbox"/>	O <sub>2</sub> source (HP cylinder; wall O <sub>2</sub> )
<input type="checkbox"/>	O <sub>2</sub> delivery (non-rebreather mask or hood assembly)
<input type="checkbox"/>	Calibration gas (if applicable)



### Demonstrate test procedure

<b>Conduct tcpO<sub>2</sub> Study (3 patients/subjects)</b>	<b>1</b>	<b>2</b>	<b>3</b>
Set up oxygen monitor			
Set temperature			
Set pO <sub>2</sub> (pCO <sub>2</sub> if applicable)			
Re-membrane electrode (once)			
Calibrate monitor (if applicable)			
Prepare the patient/subject			
Brief the patient/subject			
Obtain consent (where necessary)			
Position patient/subject for test			
Prepare the site(s)			
Sites selected by hyperbaric physician			
Shave any hair and strip off loose skin			
Clean the site			
Attach fixation ring(s)			
Collect data			
Baseline tcpO <sub>2</sub> air			
NBO challenge			
HBO challenge (if equipment available)			
Record data			
Data sheet or computer program			
Calculate RPI			
Remove electrode(s)			
Remove fixation ring(s)			
Clean and secure electrode			

Preceptor Signature: \_\_\_\_\_ Date: \_\_\_\_\_