

Guidelines to the Practice of Clinical Hyperbaric Medicine and Provision of Hyperbaric Oxygen Treatment 2015

As recommended by the
Canadian Undersea and Hyperbaric Medical Association (CUHMA)

First Edition

Approved January 15, 2015



Edited by: Dr. Kenneth M. LeDez

Members of the Standards of Practice and Patient Safety Committee of the
Canadian Undersea and Hyperbaric Medical Association

Ken LeDez (Chair)
Wayne Evans
Chris Wherrett
Paul Doherty
Jocelyn Boisvert
Bill Bateman
Ron Linden
David Harrison
Rita Katznelson

Other contributors:

Francois Burman
Tracey LeGros
Patrick Scott Murphy
Daniel 'Gericke

© Canadian Undersea and Hyperbaric Medical Association

The contents must not be copied or distributed without the permission of the Canadian Undersea and Hyperbaric Medical Association

This is the first edition of these Guidelines.

Physicians and other professionals involved in hyperbaric medicine and the provision of hyperbaric oxygen treatment are encouraged to participate and contribute to the development of these guidelines. Substantial contributions that are adopted will be acknowledged in the next edition of the Guidelines.

Please send suggestions for future revisions of these guidelines to the Editor, Dr. Ken LeDez. You may do so by clicking on the Standards of Practice links on the website of the Canadian Undersea and Hyperbaric Medical Association:

www.cuhma.ca

Please include your name and email address along with your detailed recommendations and suggestions. Where applicable please also provide references to any necessary documents.

Although developed initially for Canada it is hoped and anticipated that with increasing contributions and participation from other countries that these Guidelines will become international in scope and relevance.

Contents

Preamble

1. Introduction to the Guidelines

- a. Basic principles

2. General requirements

- a. Medical Hyperbaric Treatment Facilities
- b. General conditions and organization of hyperbaric medicine services
- c. Categories of Hyperbaric Facilities
- d. Emergency medical preparations
- e. Availability of emergency HBOT
- f. Quality Assurance
- g. Accreditation of Medical Hyperbaric Treatment Facilities
- h. Research and education

3. Hyperbaric Physicians

- a. Physician training and certification
- b. Physician credentials, privileges and practice
- c. Continuing professional development
- d. Professional and ethical responsibilities
- e. Medical coverage of diving operations

4. Medical Hyperbaric Treatment Facility staff

- a. General staffing requirements
- b. Staff roles
- c. Acceptable professions for MHTF staff
- d. Requirement for training and certification
- e. Recognition of training and experience in hyperbaric chamber operation and supervision
- f. Staff competencies
- g. Chamber Operator
- h. Inside Patient Attendant / Chamber Attendant (“inside tender”)
- i. Outside Patient Attendant (“outside tender”)
- j. Supervisors and Assistant Supervisors
- k. Minimal staffing requirements for multiplace and monoplace HBOT
- l. Staffing for critical care and operation of ventilators

5. Patient care

- a. Selection and assessment of patients
- b. Consent
- c. Clinical examination and monitoring equipment
- d. Administration of medications
- e. Emergency medical preparations
- f. Patient complexity considerations
- g. Wait times / urgency for HBOT
- h. Wound care
- i. Patient records

- j. Assessment for progress and complications
- k. Communication and follow up with patients, families and referring physicians

6. Hyperbaric chambers and related equipment

- a. General physical and operational requirements for MHTF hyperbaric chambers
- b. Specific requirements for Class A (multiplace) chambers
- c. Specific requirements for Class B (monoplace) chambers
- d. Monitoring and control of the chamber environment
- e. Purity and composition of compressed breathing gases
- f. Supply of compressed gases and pipeline systems
- g. Cleaning of hyperbaric chambers

7. Hyperbaric oxygen treatment

- a. General requirements and preparations for HBOT
- b. Hyperbaric Physician responsibilities for HBOT
- c. Prescription of HBOT
- d. General staffing requirements for HBOT
- e. Multiplace staffing requirements for HBOT
- f. Monoplace staffing requirements for HBOT
- g. Hyperbaric chamber occupancy limits
- h. Documentation
- i. Patients requiring mechanical ventilation, analgesia, sedation or general anesthesia
- j. Conduct of HBOT
- k. Pressures, oxygen concentrations, duration and air breaks used for HBOT
- l. Technical issues and problems occurring in the MHTF
- m. Medical problems and complications occurring in the MHTF
- n. The post-HBOT period
- o. Hyperbaric exposure limits and decompression of MHTF staff and accompanying persons

8. Appendices

- 1) Terminology
- 2) Approved medical conditions for HBOT
- 3) CUHMA position on the uses of Hyperbaric Oxygen Treatment and the role of physicians
- 4) Applicable standards, regulations and reference materials
- 5) Acceptable cleaning agents and procedures for hyperbaric chamber systems
- 6) List of expected policies and procedures for Medical Hyperbaric Treatment Facilities
- 7) Standardized HBOT schedules
- 8) Recommended patient investigations prior to HBOT
- 9) Patient triage for determining urgency of HBOT
- 10) Acceptable and target waiting periods for HBOT
- 11) Patient complexity and guidelines for determining staff requirements

- 12) Medical assessment and investigations of MHTF staff prior to hyperbaric exposures
- 13) Recommended Medications, Fluids, Medical Equipment and Supplies
- 14) Example checklists for use prior to HBOT

Preamble

The Canadian Chapter of the Undersea and Hyperbaric Medical Society (CUHMA) is registered as a federal not-for-profit corporation in Canada. In this document the organization is referred to either as the “CUHMA” or the “Corporation”. These guidelines were prepared by the Standing Committee on Standards of Practice and Patient Safety of the CUHMA and in this document are referred to as the “**Guidelines**”. The **Guidelines** are approved by the Board of Directors of the Corporation which reserves the right to determine their publication and distribution. The **Guidelines** are subject to revision on an annual or biannual basis and come into effect only after approval by the Board of Directors.

The CUHMA encourages all physicians practicing Hyperbaric Medicine in Canada and all hospitals, health authorities and other health care organizations with hyperbaric treatment facilities to be familiar with and endeavour to adhere to these guidelines but cannot guarantee any specific patient or staff outcome. It is anticipated that with increasing international contributions that the **Guidelines** will have broad applicability and relevance in many countries. As this is the first edition of these Guidelines it is expected that Medical Hyperbaric Treatment Facilities may not all be in compliance from the date of publication. Many facilities may require a period of time to meet all the recommendations and requirements. This will apply to future revisions also. Each facility is encouraged to develop a plan to implement the provisions in these Guidelines.

Each Hyperbaric Physician should exercise his or her own professional judgment in determining the proper course of action in any particular circumstance. The CUHMA assumes no responsibility or liability for any error or omission arising from the use of any information contained in its *Guidelines to the Practice of Clinical Hyperbaric Medicine and Provision of Hyperbaric Oxygen Treatment*.

The Canadian Provinces of Alberta, British Columbia and Quebec have requirements pertaining to hyperbaric chamber facilities and these guidelines add to but do not replace those requirements.

Hyperbaric medicine is a dynamic field of special competence practiced in Canada by physicians with varied training backgrounds including family practice, anesthesiology,

emergency medicine, internal medicine and surgery. The Royal College of Physicians and Surgeons of Canada (the agency that certifies all medical specialists in Canada) has approved an application to establish a Diploma in Hyperbaric Medicine in order to provide physician certification. These Guidelines envisage this becoming the recommended qualification for independent practice of hyperbaric medicine in Canada within 5 years of the commencement of the Diploma program.

It is a characteristic of the practice of hyperbaric medicine that there is close collaboration between the hyperbaric physician and other highly trained professionals who form an interdependent team responsible for the safety not just of the patient but also of each other. Safe hyperbaric treatment requires special equipment, specially trained physicians and other professionals, adequate infrastructure and detailed organizational arrangements, policies and operating procedures.

The purpose of these guidelines is to promote the provision of safe, high quality and appropriate hyperbaric medical care for patients with conditions likely to benefit from hyperbaric oxygen treatment. The **Guidelines** are intended to set forth the recommended standards for hyperbaric medicine and to assist Medical Hyperbaric Treatment Facilities to successfully achieve accreditation.

HBOT is approved for 14 different medical conditions by the UHMS / CUHMA and Health Canada and the costs of these services should be covered by provincial, territorial and federal health jurisdictions and other public agencies such as Workers Compensation Commissions. It is the responsibility of the various funding agencies to ensure reasonable access to **HBOT**.

The sections in the **Guidelines** present the key concepts and requirements. However, much of the detailed information needed to interpret and comply with the Guidelines is contained in the appendices.

In the text of these **Guidelines** terms that are shown in **bold** are explained or defined in the Abbreviations or Terminology sections below.

Scope

These guidelines are intended to apply only to the provision of hyperbaric health care services to human patients. Hyperbaric facilities that are used exclusively in the support of diving or caisson work, or for veterinary treatment are excluded.

Abbreviations used in these Guidelines

Abbreviation	Term
ATA	Atmospheres Absolute
CCFP	Canadian College of Family Physicians
CHRN	Certified Hyperbaric Registered Nurse
CHRT	Certified Hyperbaric Registered Respiratory Therapist
CHT	Certified Hyperbaric Technologist
CMA	Canadian Medical Association
CSA	Canadian Standards Association
CUHMA	Canadian Undersea and Hyperbaric Medical Association
DCBC	Diver Certification Board of Canada
DCIEM	Defence and Civil Institute for Environmental Medicine (now DRDC)
DMT	Diving Medical Technician
DRCPS	Diplomate of the Royal College of Physicians and Surgeons of Canada
DRDC	Defence Research and Development Canada (formerly DCIEM)
FPM	Feet per minute
FSS	Fire suppression system
fsw	feet of seawater
HBOT	Hyperbaric Oxygen Treatment
msw	metres of seawater
MHTF	Medical Hyperbaric Treatment Facility
NBDHMT	National Board of Diving and Hyperbaric Medical Technology
NFPA	National Fire Prevention Agency
No-D	No Decompression stop required
PER	Practice Eligibility Route (for Diploma in Hyperbaric Medicine)
RCPSC	Royal College of Physicians and Surgeons of Canada
UHMS	Undersea and Hyperbaric Medical Society

Terminology

The following terms, listed in alphabetical order, are used in the text and must be interpreted as explained below:

Accompanying person	An individual, other than a professional working at a MHTF, who accompanies a patient inside a hyperbaric chamber in order to assist with a particular patient, and who usually does not undergo HBOT. Most commonly this is the parent of a small child or a care attendant.

Accreditation	A formal process that involves a site visit by designated experts to hyperbaric facilities in order to assess compliance with expected published standards
Approved / accepted medical conditions	List of medical conditions (see appendix #1) published by the Undersea and Hyperbaric Medical Society. This list is used by Health Canada to determine licensing of hyperbaric chambers and is generally used by provincial and territorial government to determine reimbursement of physicians for provision of Hyperbaric Oxygen Treatment. All these treatments should be insured services in terms of the Canada Health Act and provincial health plans, Worker's Compensation or equivalent. Private or cosmetic uses and purposes that are not justified by available scientific evidence and are not covered by provincial or federal health organizations are not accepted as approved conditions.
Attending Hyperbaric Physician	The hyperbaric physician responsible for a particular treatment or patient
Certified Hyperbaric Technologist	At present there is no nationally recognized training or certification program in Canada for staff working at or inside Hyperbaric Treatment Centres. A number of health authorities and provinces recognize the CHT certification through the National Board of Diving and Hyperbaric Medical Technology (NBDHMT) in the USA. Local certification of hyperbaric training may be available in some jurisdictions. Training is available within Canada that meets the requirements of the CHT program or is equivalent to it. The CHT is recognized by the CUHMA as meeting the criteria for a Level 1 Hyperbaric Technologist.
Diving Physician	This term is used by the Canadian Standards Association to refer to different levels (1 – 4) of physicians with expertise in diving-related medical conditions. A diving physician may or may not meet the requirements as hyperbaric physician as set out in this document. See also the requirements for the Diploma in Hyperbaric Medicine (Sub-aquatic / diving medicine stream).
Dose	<i>Hyperbaric and oxygen exposure dose description</i> A full description of hyperbaric exposures must specify for each HBOT session the depth / pressure, duration, compression and decompression stages and breaks on air or other breathing gas. Units of pressure may be specified in fsw, msw, atmospheres, kPa, psi or

	mmHg. Any break less than 1 minute should be ignored.
Hyperbaric	Pressures that exceed ambient atmospheric pressure
Hyperbaric chamber	<p>A vessel designed for human occupancy that is used to provide hyperbaric pressures and is approved by Health Canada to be used as a medical device. All hyperbaric chambers shall be capable of operating at a pressure in excess of 103.4 kPa (15 psig).</p> <p>The two main types of hyperbaric chambers for HBOT as defined in CSA Z275.1-05 are as follows:</p>
Multi place	<p>A multiple-occupancy hyperbaric chamber permanently installed in a health care facility and fixed to a permanent foundation, this being the building in which it is housed, shall be known as a stationary chamber.</p> <p>These chambers shall have a minimum of two interconnected locks, one of which shall serve as an entrance lock. The main lock shall be of sufficient length and diameter to accommodate a recumbent person and an attendant.</p> <p>Multiplace chambers are characterized by</p> <ul style="list-style-type: none"> • The necessity for the presence of at least one attendant inside the chamber at all times for visual observation, monitoring, and medical or technical interventions in order to provide safe HBOT, and • The ability to accommodate two or more persons at the same time and for the attendant to provide hands-on care to a patient during HBOT.
Duo place	A hyperbaric chamber that may accommodate two patients or one patient and one attendant. This category of chamber is no longer recognized separately by the CSA standards but is in clinical use in Canada at the present time. Such chambers have particular capabilities and considerations and where appropriate are these are included in these guidelines.
Mono place	<p>A hyperbaric chamber that is normally intended for the treatment of one person and capable of oxygen or air pressurization to a depth not exceeding 20 m (66 ft) for the provision of hyperbaric oxygen therapy, normally for clinical applications only, and located in a health care facility.</p> <p>Monoplace chambers are characterized by the ability to:</p> <ul style="list-style-type: none"> • Undertake safe HBOT in a stable patient without an attendant

	<p>inside the chamber</p> <ul style="list-style-type: none"> • Directly and easily observe the patient from outside the chamber <p>With special procedures and equipment it is possible to care for critically ill patients inside a monoplace chamber, including patients requiring mechanical ventilation.</p>
Hyperbaric Medicine Service	An organized health care service that treats patients with approved medical conditions using hyperbaric oxygen. The service may also encompass other non-hyperbaric services such as wound care.
Hyperbaric Physician	A physician licensed to practice in a Canadian Province or Territory who has undertaken appropriate hyperbaric medicine training; and gained clinical expertise and experience treating patients with hyperbaric oxygen for a range of approved conditions; and who has been granted hyperbaric medicine privileges by a Canadian hospital or health authority.
Hyperbaric Technologist (Levels 1 – 4)	A technician qualified to operate a hyperbaric chamber.
Hyperbaric Oxygen Treatment (HBOT)	A medical treatment that consists of administering an inspired oxygen partial pressure that exceeds ambient atmospheric pressure and which requires the use of a hyperbaric chamber
Hyperbaric Oxygen Treatment Committee (HOTC)	The committee of the CUHMA that is responsible for reviewing the evidence concerning the risks and benefits of different indications for the use of HBOT and making recommendations to the Executive Board of the CUHMA.
Immediately available	<p>In the context of an attending hyperbaric physician being able to attend in person at the MHTF this means:</p> <ol style="list-style-type: none"> 1. Inside the MHTF, same building or adjoining building and 2. Not having any non-interruptible commitment to another patient or service outside the MHTF 3. Able to be present within several minutes and 4. Adhering to any other local policies of the MHTF in this regard <p>In the context of medical equipment, supplies or medications this means:</p>

	<ol style="list-style-type: none"> 1. Routinely present and checked within the MHTF or 2. Able to be present within no more than several minutes when ordered
Inside Patient Attendant (Inside Tender)	<p>Clinical professional staff member of a MHTF with a multiplace hyperbaric chamber with current medical fitness approval for hyperbaric work</p> <p>The attendant shall accompany the persons exposed to hyperbaric pressure in the chamber, ensure that the exposure is conducted safely and without harm to occupants, and shall be able to immediately intervene in an appropriate manner if necessary.</p>
No-D	No Decompression limit refers to the time beyond which, at any particular depth, that a decompression stop must be imposed prior to depressurizing
Period of risk	<p>The time period after a hyperbaric exposure during which it is reasonably foreseeable that a person who has undergone a hyperbaric exposure may develop symptoms or signs of decompression illness.</p> <p>The actual duration of this period should be specified in policies established at each HTF and will depend upon the details of the hyperbaric exposure.</p>
Proctor /Proctorship	<p>The situation where a physician (proctor) oversees another physician who is considered to be a trainee undertaking a period of proctorship. This supervision may not necessarily be direct. The degree of independence of the trainee is determined by the proctor.</p>
Treatment plan / program	A program for treatments that specifies the treatment protocol (pressure, times) and number of hyperbaric oxygen treatments that a patient will undergo
Treatment protocol	A detailed description of a standardized HBOT that specifies planned pressure, times, breathing gases and other parameters.
Required	This term is used in the context of this document to indicate that the guidelines cannot be met unless the particular item is adhered to.
Recommended	This term is used in the context of this document to indicate that the guidelines can best be met if the particular item is adhered to but that alternate approaches may also be satisfactory.

Strongly recommended	This term is used in the context of this document to indicate that the guidelines may be difficult to meet unless the particular item is adhered to and that preparations should be made for such adherence in a timely fashion.
Supervisor (physician)	
tcpO2 TCOM	Transcutaneous oxygen measurement

Section 1: Introduction to the Guidelines

Basic principles

The purpose of these guidelines is to set forth the framework necessary to achieve high quality clinical hyperbaric medical care in Canada in order to fulfill the key principles of the Canadian Undersea and Hyperbaric Medical Association. These Guidelines are intended to provide for:

1. Safe use of **HBOT** for patients with approved medical conditions
2. Prior hyperbaric physician assessment to determine:
 - a. Appropriateness of **HBOT**
 - b. Patient fitness for **HBOT**
3. Ethical conduct of hyperbaric physicians and all hyperbaric personnel
4. Proper policies, procedures and organization in Medical Hyperbaric Treatment Facilities (**MHTFs**)
5. Appropriate documentation and record keeping
6. Availability of necessary equipment, supplies and personnel
7. Use of hyperbaric chambers meeting all required standards

8. Use of standardized pressure-time-oxygen concentration profiles that provide acceptable HBOT protocols
9. Compliance with applicable published standards and safety requirements
10. Preparation for emergency situations
11. Transparency of **MHTF**s regarding capabilities and treatments provided
12. Hyperbaric physicians with approved training, experience and credentials being required for:
 - a. Prescription of **HBOT** including treatment schedules and oxygen dose
 - b. Immediate availability and oversight during **HBOT**
13. Suitable training, experience, expertise and certification of clinical and technical personnel
14. Cooperation with ethical scientific research related to **HBOT**
15. Implementation of quality assurance programs
16. Participation in specific **MHTF** accreditation process

Section 2: General requirements

- Basic requirements for designation as a **MHTF**
- General organization
- Categories of hyperbaric facilities
- General facility requirements
- Responsibilities of the Medical Director
- Responsibilities of the Safety Director / Technical Director
- Referrals, consultations and assessments
- Minimum chamber requirements
- Quality Assurance / Quality Improvement program
- Prevention of cross contamination and cross-infection
- Accreditation, inspection and recognition of hyperbaric facilities

Basic requirements for designation as a **MHTF**

In order to be designated as a **MHTF** a hyperbaric facility shall comply with ALL of the following conditions:

1. Meet the criteria required for designation as a Level 1 – 5 facility as outlined below
2. Meet all applicable CSA standards
3. Hyperbaric chamber(s) must be approved by Health Canada
4. Has a Medical Director
5. Has a Safety / Technical Director

6. All **HBOT** must be prescribed and overseen by a **Hyperbaric Physician** as defined in Section 3 and under Terminology
7. A Hyperbaric Physician must be onsite and immediately available to attend all patients during HBOT
8. The primary focus and uses of **HBOT** shall be the treatment of UHMS / CUHMA and Health Canada **Approved** medical conditions
9. Any hyperbaric facility that primarily treats patients other than those with **Approved** medical conditions (or unapproved medical conditions as part of research approved by a public ethical review committee) is ineligible for the designation as a **MHTF**
10. Complies with Appendix #2, “CUHMA position on the uses of Hyperbaric Oxygen Treatment and the role of physicians”
11. Adherence to these guidelines (the need for any deviations should be documented and made available during accreditation)
12. Must provide information about the availability of specific capabilities during treatment including:
 - a. Maximum pressure capability
 - b. Pediatric capabilities
 - c. Hands on care
 - d. Critical care
 - e. Intravenous infusions and medications
 - f. Mechanical ventilation
 - g. Hours of operation and emergency coverage and any limitations to 24-hour continuous coverage
13. Disclosure of conditions treated
14. Disclosure of staffing

General organization

Hyperbaric medicine programs should be organized in a manner that is comparable to other services provided by the hospital, within the health authority or in other medical clinics or facilities. The Hyperbaric Medicine Service must be properly organized and staffed. The Medical Director of the **MHTF** must be a hyperbaric physician currently involved in the provision of hyperbaric medical services and should be recognized by the health authority in the same way as other clinical department chiefs or directors.

MHTFs may be located in hospitals, in close proximity to and associated with a hospital, or in a freestanding clinic. When emergency cases are treated the **MHTF** should normally be located in an accredited hospital or be closely associated with a hospital. Facilities must provide a suitable therapeutic supportive environment that protects the needs and rights of patients, their families and of staff. While it is acceptable to use hyperbaric chambers in such facilities for research and equipment testing, any non-therapeutic uses must not impede or interfere with patient care. Each **MHTF** should hold regular meetings of staff and strive to maintain a respectful, cooperative and collegial work environment.

The following general requirements apply to all **MHTFs**:

1. Referrals, consultations and assessment

- a. The process for referring a patient for hyperbaric medicine consultation should be similar to that used elsewhere within the hospital or health authority. The report of the consultation must be provided to the referring physicians.
- b. If self-referral by patients is permitted facility policies must require communication with other physicians involved in the care of the patient.
- c. The hyperbaric physician must be able to consult other specialists within the hospital, health authority, region or elsewhere as necessary.
- d. The use of a standardized referral and triage forms is recommended to facilitate management of wait times, prioritization and encourage similar access to and standards of care across Canada.

2. Availability of emergency HBOT

- a. Each **MHTF** must ensure that hospitals, emergency departments, patients and relevant health authorities are provided with reasonable notice regarding availability or interruptions in availability of emergency hyperbaric medicine services
- b. Any **MHTF** that utilizes a multiplace chamber (including a “duoplace” chamber) with an inside chamber attendant is required to provide continuous availability of emergency hyperbaric services at least until such time as the **period of risk** to staff or patients related to HBOT has passed.

3. On-call system

- a. Each **MHTF** that provides continuous emergency HBOT coverage is required to have an on-call duty roster for hyperbaric physicians that must be published and distributed appropriately, including to the hospital or health authority switchboard and emergency departments in the same manner as for other on-call physicians.
- b. Each **MHTF** that provides emergency on-call services is expected to have at least a minimum team of other hyperbaric personnel available to respond to an emergency. A formal on-call system is preferred but it is recognized that this is not always possible for practical or financial reasons.
- c. The on-call hyperbaric physician must carry a mobile telephone, pager or be contactable promptly by other means.
- d. Each **MHTF** should have policies regarding expected response times for on-call physicians and other hyperbaric personnel.

4. Policies and procedures

- a. Each **MHTF** is expected to maintain a set of policies and procedures specific to the unit and these should be available to all staff (see **Appendix #5** for a sample list of policies). Policies should be reviewed regularly and amended as needed.

5. Medications, fluids, medical supplies, medical equipment

- a. Maintain a list of necessary medications, medical supplies and medical equipment and establish a regular procedure to ensure that all these items are available within the unit and not out-dated.
- b. It is strongly recommended that each **MHTF** with a multiplace chamber maintain containers (“*chamber kits*”) stocked with equipment and supplies for specific tasks that can be rapidly sent into the chamber through the medical lock.

6. Quality Assurance Program

- a. Each MHTF is expected to systematically monitor the quality of care provided and adopt a comprehensive quality assurance program
- b. Specific hyperbaric policies and procedures are required related to documentation, mitigation, debriefing and future prevention of events that have been associated with actual or potential harm to patients or staff. These policies and procedures should be reviewed regularly and amended as needed.
- c. When the Hyperbaric Medicine Service is located in a hospital or under the auspices of a health authority, cooperation with relevant policies and quality assurance systems of the hospital or health authority is required

7. Prevention of cross-contamination and cross-infection

- a. Policies and procedures must be implemented to reduce and prevent cross-contamination and cross-infection between different patients and between patients and staff
- b. Hospital or health authority policies on infectious precautions must be adhered to
- c. In multiplace chambers it is recommended that patients that have tested positive to resistant organisms (such as MRSA) are not treated at the same time as patients who are negative for such tests unless adequate separation and avoidance of cross-contamination is assured. In an emergency or when this is not practical, patients should as far as possible be segregated within the chamber from other patients.
- d. Each MHTF must have a policy regarding testing for resistant organisms.
- e. Detailed recommendations for the prevention of cross-infection and for the cleaning of hyperbaric chambers are provided in **Appendix #4**.

8. Staff meetings

- a. Regular / periodic staff meetings and educational events are essential
 - i. Part-time staff, who may have other positions in the hospital or health authority, should be expected to attend whenever possible
- b. Emergency procedures should be practiced and appropriately documented
- c. Policies and procedures for emergency situations should be reviewed periodically
- d. Information relevant to the operations of the hyperbaric medicine service should be distributed to all relevant staff

9. Documentation

- a. Comprehensive records are required for patient care and technical matters
- b. Records of every hyperbaric exposure must be maintained for an indefinite period

10. Liaison with Emergency Department

- a. Communications must be established with appropriate hospital emergency rooms to facilitate referral of patients in each direction.

11. Cardio-pulmonary resuscitation (CPR) and critical events

- a. The health care facility and the **MHTF** are required to ensure that all personnel who may be called upon to respond as part of a resuscitation team are familiar with the location of the hyperbaric chamber. The **Hyperbaric Physician** must be present to explain and assist with any special considerations that may apply to the resuscitation of the particular patient in the **MHTF**.
- b. In **MHTFs** that are separate from hospitals this normally means establishing contacts with ambulance services and the nearest Emergency Department.

12. Emergency and disaster planning

- a. The **MHTF** is required to plan systematically both for the management of emergency situations and for the appropriate training of staff.
- b. Critical events arising in patients undergoing treatment in the **MHTF** are relatively uncommon. For this reason hyperbaric staff may not have experience of a particular type of emergency when one arises.
- c. The use of a human patient simulator to assist with such training should be considered and is recommended.
- d. Each **MHTF** should participate in those aspects of disaster planning by the hospital or health authority that are relevant to or may require actions involving the hyperbaric chamber.

13. Accreditation

- a. Each **MHTF** is required to participate in a specific accreditation process for medical hyperbaric treatment facilities. (Although hospitals and health authorities undergo accreditation, this process generally lacks the specific expertise needed to assess **MHTFs**)
- b. It is **strongly recommended** that Canadian **MHTFs** participate in the accreditation process provided by the CUHMA
- c. The requirements for accreditation include:
 - i. Initial accreditation for Hyperbaric Treatment Facilities operational in 2014 should commence no later than 2020
 - ii. New Hyperbaric Facilities are required to participate in accreditation within two years of commencing operation
 - iii. The accreditation process must be conducted by agencies or persons external to the hyperbaric facility
 - iv. The interval between successive accreditation assessments must not exceed five years
 - v. In preparing for accreditation each **MHTF** is expected to use the most recent revision of these Guidelines and appropriate references found in Appendix #3

14. Safety management

- a. The following basic safety requirements apply:

- i. Accurate (calibrated according to CSA or other applicable standard) measurement and control of chamber pressures (“depths”)
- ii. Accurate time pieces and time keeping
- iii. Periodic testing to ensure the purity and composition of compressed breathing gases (as required by CSA or other applicable standards)
- iv. Control and monitoring of chamber environmental conditions
- v. Expert understanding of dive tables
- vi. Reliable equipment

Categories of hyperbaric facilities

1. Medical hyperbaric facilities are categorized by these Guidelines according to the nature of the services provided, the technical facilities available and the nature and complexity of patients treated.
2. Hyperbaric facilities are categorized using a Level number and a Descriptor (see CSA Z275 1-11)
 - a. The Level number (1-7) denotes the type of service and activities provided
 - b. The Descriptor denotes the type of hyperbaric chamber(s) available

Descriptor	Description of hyperbaric facility
Multi	Facility has a multiplace chamber
Mono	Facility has one or more monoplace chamber(s)
Multi & Mono	Facility has both multiplace and monoplace chamber(s)
Transport	Facility has a portable or transportable chamber
Level No.	Description of hyperbaric facility
1	MHTF in a tertiary care or major regional centre that provides emergency and elective treatments for both stable and unstable or complex patients, and has capabilities of mechanical ventilation and invasive monitoring
2	MHTF that provides emergency and elective treatments but generally not located in a tertiary care center and not generally for unstable or complex patients, although these may be treated on occasion.
3	MHTF that provides only elective treatments for generally stable patients that do not require complex care during HBOT. Patients may nevertheless have multiple chronic medical conditions. These facilities generally do not provide continuous emergency coverage or treat emergencies.
4	MHTF that provides generally only emergency treatments and may comprise only a portable or transportable chamber. Such facilities may provide elective treatments except that transportable or collapsible chambers must not be used for elective treatments.
5	MHTF that is a military or other special facility and may be involved in only emergency treatments or periodic medical treatments.
6	Non-clinical facilities that do not meet the requirements for designation as a MHTF and are largely engaged in research or equipment testing rather than medical treatments.

General facility requirements

The following are required for each Level 1-5 **MHTF**:

1. Compliance with all applicable CSA standards for clinical hyperbaric facilities (Z275 1-11)
2. General conformance with Hyperbaric Facilities Design Guidelines published by the Undersea and Hyperbaric Medical Society
3. Appropriate reference and adherence to NFPA requirements for hyperbaric facilities, modified to meet CSA or other applicable standards in the jurisdiction
4. Adequate office and administration space
5. A minimum of two telephone lines
6. Secure storage for medical records
7. Secure storage for medications and supplies
8. Changing facilities
9. Examination facilities
10. A patient treatment area
11. Washroom facilities
12. Ability to provide oxygen and suction outside of the hyperbaric chamber
13. Secure password-protected encrypted computers and access to the internet and health facility network where available
14. Clean static-free clothing for use inside the chamber (laundered separately from any items not intended for use inside a hyperbaric chamber)
15. A stretcher (preferably tilting) for resuscitation
16. Suitable equipment for firefighting and protection including fire extinguishers, smoke hoods, breathing apparatus, fire alarm and sprinkler systems as mandated by the jurisdiction (see NFPA, CSA, applicable health facility requirements)
17. Functioning systems for communication with occupants inside the hyperbaric chamber(s)
18. Refrigerator for medications or ready access to a nearby refrigerator in the healthcare facility
19. Adequate policies and procedures readily available to all staff that cover a range of patient care and safety matters
20. Medical equipment and supplies appropriate for routine and emergency patient care

Requirements and Responsibilities for the Medical Director

1. Each **MHTF** shall have a **Medical Director**, who is:
 - a. Currently practicing hyperbaric medicine in the **MHTF**
 - b. Certified at a minimum as a Diplomate in Hyperbaric Medicine (or equivalent)
 - c. Suitable by virtue of experience and training to fulfill the leadership roles of Medical Director as defined in these guidelines and local health facility policies
 - d. Appointed by the healthcare facility

2. The responsibilities of the Medical Director shall include:
 - a. To be familiar with current CUHMA Guidelines to the Practice of Hyperbaric Medicine in Canada, the requirements of the provincial licensing authority and hospital credentials committee as they relate to hyperbaric medicine and the requirements of the Canadian Council on Health Services Accreditation.
 - b. To ensure that the **MHTF** complies with the CUHMA guidelines.
 - c. To be familiar with current CSA standards (or those in the applicable jurisdiction) related to clinical hyperbaric facilities
 - d. To ensure that written medical policies with respect to hyperbaric treatments are established and followed.
 - e. To develop and / or approve hyperbaric and other treatment protocols for use in the **MHTF**
 - f. To evaluate the qualifications, abilities and performance of physicians providing hyperbaric medicine services and of other professionals and personnel working with the hyperbaric medicine program. This includes (but is not restricted to) the recommendations of clinical privileges for hyperbaric physicians and their annual review.
 - g. To ensure compliance with all other aspects of section 3 of these guidelines related to hyperbaric physicians.
 - h. To monitor systematically the quality of hyperbaric care provided in the **MHTF** and its interactions with the hospital or health region. This should include chart reviews, internal audits or more detailed reviews when indicated.
 - i. To ensure that records are kept related to all hyperbaric treatments and assessments.
 - j. To carry out such other duties as the governing body of the hospital or health authority may delegate to ensure safe hyperbaric care.
 - k. To promote institutional compliance with applicable CUHMA guidelines and CSA Standards.
 - l. To determine the fitness of any hyperbaric staff working inside the hyperbaric chamber for such work and establish policies in this regard
 - m. To provide leadership and participate in strategic planning and development of the hyperbaric medicine service
 - n. To determine and advise on the suitability and qualifications of MHTF staff including the Safety Director
 - o. To work jointly with the Safety Director to determine appropriate staff qualifications and numbers according to the number and type of hyperbaric chambers in use, the maximum treatment capacity, the complexity of patients and the types of hyperbaric treatment provided (see Appendix # 7)

Requirements, Responsibilities and Training for the Safety Director

1. Every **MHTF** shall have a Safety Director as required by CSA Z275.1-05 and NFPA99.

2. The **MHTF** may optionally have a separate Technical Director (or similar designation) that has expertise in technical operations of hyperbaric facilities, to whom some technical aspects may be delegated, and who works closely with the Safety Director.
3. As specified in CSA Z275.1-05, the Safety Director shall be knowledgeable, by training or experience, in the operation, maintenance, and repair of all the mechanical, electrical, liquid, and gas systems comprising the hyperbaric facility and shall be acceptable to the regulatory authority.
4. The Safety Director must meet the requirements for a Level 2 or higher Hyperbaric Technologist (see Appendix # 8)
5. The responsibilities of the Safety Director shall include:
 - a. Overseeing safety and operational aspects of the **MHTF**
 - b. Inspection and maintenance of the hyperbaric chamber facility and associated infrastructure, including development and review of a maintenance plan for the **MHTF**
 - c. Establishing and maintaining safe operating and emergency procedures
 - d. Ensuring that standard operating procedures, such as for start-up and shutdown, are followed and all applicable checklists are completed
 - e. Ensuring all personnel operating hyperbaric equipment in the **MHTF** are appropriately qualified and safely performing their duties, and advising the Medical Director and healthcare facility accordingly
 - f. Working closely with and advising the Medical Director on technical matters and issues related to the safety of staff and patients
 - g. Assisting the Medical Director with the Quality Assurance and Performance Improvement program of the **MHTF**
 - h. Advising the healthcare facility on technical matters and issues related to the safety of staff and patients
 - i. Ensuring adequate technical record-keeping related to the hyperbaric facility
 - j. Familiarity with the details of all applicable CSA Standards and other standards related to hyperbaric chambers and operations
 - k. Authority to restrict or remove any potentially hazardous item or equipment from the hyperbaric chamber or facility and ensuring compliance with CSA, NFPA99 or other applicable requirements in this regard
 - l. Familiarity with the details of all routine and non-routine treatment schedules and dive tables that may be used at the **MHTF**.
 - m. To work jointly with the Medical Director to determine appropriate staff qualifications and numbers according to the number and type of hyperbaric chambers in use, the maximum treatment capacity, the complexity of patients and the types of hyperbaric treatment provided (see Appendix # 7)
 - n. Ensuring that Hyperbaric Technologists are safely operating hyperbaric chambers and following the appropriate treatment tables or protocols
 - o. Assisting with the training and oversight of Level 1 - 2 Hyperbaric Technologists

- p. Assisting with developing fire safety plans and advise and work with fire protection, firefighting and other personnel to ensure fire safety in the **MHTF**
- q. To participate in the occupational safety committee of the health facility where appropriate

Research and education

1. Each MHTF is required to provide a suitable learning environment for any trainees working in or rotating through the facility
2. The applicable ethical review committee must approve any research conducted in the MHTF
3. It is recommended that all MHTFs promote and cooperate with approved research protocols related to HBOT

Section 3: Hyperbaric Physicians

- Physician training and certification
- Physician credentials, privileges and practice
- Continuing professional development
- Professional and ethical responsibilities
- Medical coverage of diving operations

Physician training and certification

1. Hyperbaric physicians must have appropriate education, training, experience and certification in Hyperbaric Medicine.
 - a. The training requirements are those required for the DRCPS
2. Training and experience in HBOT must include:
 - a. Elective and emergency monoplace treatments for providing monoplace HBOT
 - b. Elective and emergency multiplace treatments for providing multiplace HBOT
 - c. Adequate knowledge and experience of decompression illness and decompression treatment tables. Although some MHTFs seldom treat decompression illness, Inside Patient Attendants in multiplace chambers are exposed to the risk of decompression sickness. In addition, this may occur in a monoplace chamber pressurized on air.

3. The pre-requisites for certification as a Diplomate in Hyperbaric Medicine include prior certification in a clinical area of medical practice (by the RCPSC or the CCFP).
4. Oversight of HBOT by alternate, non-physician, health care providers is not permitted under these guidelines
5. The following are recommended for all hyperbaric physicians:
 - a. Ability to manage the airway and resuscitate an unstable patient until any additional needed assistance arrives
 - b. Current ACLS certification (Advance Cardiac Life Support)
6. It is recommended that **Hyperbaric Physicians** currently in practice, and those entering hyperbaric medicine, should attain DRCPS (or equivalent) certification within 5 years
7. Regardless of the category of MHTF all hyperbaric physicians must have experience of emergency HBOT in a MHTF that provides 24-hour emergency coverage (category 1 or 2 MHTF) prior to providing HBOT without supervision or proctorship.

Physician credentials, privileges and practice

1. The following categories of hyperbaric medicine practice are recognized:
 - a. Independent practice
 - b. Trainee practice
 - c. Supervised / Proctored practice
2. For **independent practice** hyperbaric physicians must:
 - a. Have certification as a Diplomate of the Royal College of Physicians and Surgeons of Canada (DRCPS) in Hyperbaric Medicine or training and experience that is recognized as equivalent (the CUHMA may advise on equivalency) or acceptable to local health authorities
 - b. Be a licensed physician in the applicable Canadian province or territory
 - c. Have privileges in Hyperbaric Medicine awarded by an accredited hospital or health authority that specify for each physician whether approvals apply to:
 - i. Monoplace HBOT
 - ii. Multiplace HBOT
 - iii. Critically ill or complex patients
 - iv. Intravenous sedation or anesthesia during HBOT
 - v. Mechanically ventilated patients
 - vi. Adult and / or pediatric patients
 - vii. Decompression illness and arterial gas embolism
 - d. It is recommended that hyperbaric physicians working in MHTFs that are not in a hospital or associated with a health authority undergo a similar credentials process and that the above categories of privileges be specified
 - e. Satisfy the minimum requirements for continued professional development

- f. Comply with the professional and ethical responsibilities as set forth in these Guidelines
- 3. For **supervised / proctored** hyperbaric medicine practice physicians must:
 - a. Have certification by the Royal College of Physicians and Surgeons of Canada or the Canadian College of Family Physicians
 - b. Be a licensed physician in the applicable Canadian province or territory
 - c. Have successfully completed a UHMS or CUHMA approved introductory course in hyperbaric medicine of at least 40 hours duration (80 is recommended)
 - d. Have restricted privileges in hyperbaric medicine that specify the supervision arrangements and applicable restrictions
 - e. Comply with all the restrictions and terms of supervision
 - f. Be enrolled in a training program for the Diplomate in Hyperbaric Medicine, be an applicant for certification for the Diploma or be seeking recognition by the Practice Eligibility Route (PER) for the Diploma in Hyperbaric Medicine (once this program is available)
 - g. “Supervision” requires that an experienced hyperbaric physician who satisfies the requirements for the DRCPSC is directly observing or is promptly available and that all restrictions of privileges are adhered to
 - h. “Proctorship” requires that an experienced hyperbaric physician who satisfies the requirements for the DRCPS is available to advise and review the practice of the physician but not necessarily present in the building or nearby and that all restrictions of privileges are adhered to
- 4. For **trainee practice** the physician must:
 - a. Have at least an educational license as a physician in the applicable Canadian province
 - b. Have at least educational privileges in the health care facility where the MHTF is located
 - c. Work under the supervision and direction of an experienced hyperbaric physician with certification as a Diplomate of Hyperbaric Medicine (or equivalent) in a MHTF approved as a training site
 - d. Be enrolled in an approved training program (or an applicant for the Practice Eligibility Route - PER) for the Diploma of Hyperbaric Medicine or in a residency training program approved by the Royal College of Physicians and Surgeons of Canada or the Canadian College of Family Physicians
- 5. Hyperbaric Physicians must have their credentials reviewed and be granted privileges in Hyperbaric Medicine by the hospital or health authority according to the same process used for credentialing other physicians.

6. In the situation of a freestanding **MHTF** it is essential that physician credentials be reviewed and determined to be satisfactory. It is recommended that physicians at such facilities request a review of credentials by a hospital with a MHTF.
7. The Credentials and Certification Committee of the CUHMA may assist by undertaking reviews and providing advice regarding the training and experience of physicians seeking recognition in hyperbaric medicine by health authorities and other agencies.
8. All physicians applying for Hyperbaric Medicine privileges should demonstrate knowledge, skills and satisfactory completion of appropriate training and clinical experience under the supervision of recognized hyperbaric physician(s).
9. It is helpful if at least one Hyperbaric Physicians providing emergency HBOT has hospital admitting privileges.
10. Hyperbaric physicians must have maintain membership in the Canadian Medical Protective Association (CMPA) or demonstrate other acceptable professional liability insurance.
11. The hyperbaric Physician must inform the CMPA or other insurer regarding participation in provision of hyperbaric medicine services.
12. The Hyperbaric Physician must inform the licensing authority (usually the College of Physicians and Surgeons in the applicable jurisdiction) about provision of hyperbaric medicine services.
13. A physician undergoing a period of proctorship as required in these guidelines may provide HBOT for patients without the presence of an experienced hyperbaric physician provided that:
 - a. It is approved by the health facility, and
 - b. The proctorship is part of formal arrangement for the purposes of building experience and training in hyperbaric medicine
 - c. The physician complies with any practice restrictions required by the health facility and these guidelines
 - i. Such restrictions may relate to the nature of patients treated, the HBOT schedules used, the chamber and other equipment used, and the availability of assistance from another hyperbaric physician
 - d. A certified / recognized hyperbaric physician with at least three years' hyperbaric medicine experience is promptly available to render advice

Continuing professional development

1. All hyperbaric physicians must participate in educational programs suitable for maintenance of competence / certification directly related to hyperbaric medicine and the care of patients undergoing HBOT (including wound care) in order to comply with these guidelines.
2. This must include participation in the Maintenance of Competence programs of the Royal College of Physicians and Surgeons of Canada, the Canadian College of Family Physicians, the CUHMA, or equivalent program or system for documenting on-going professional education.
3. The minimum requirements for continuing education are:

- a. At least:
 - i. 16 hours each year, or
 - ii. 32 hours over two years, or
 - iii. 48 hours every three years
- b. The hours of education above may be satisfied by in-person, on-line or personal reading projects
- c. Each hyperbaric physician is required to attend at least one national or international level meeting related to hyperbaric medicine in any given 5-year period
- d. Educational activities must comply with the requirements of the Royal College of Physicians and Surgeons of Canada for Diplomates in Hyperbaric Medicine

Professional and ethical responsibilities

1. The hyperbaric physician responsible for a particular HBOT must remain onsite and immediately available to attend to a patient or staff member in the MHTF.
2. The hyperbaric physician must respond promptly to all critical events and is responsible for supervising and coordinating management with the critical events or cardiac arrest teams.
3. It is a requirement of these guidelines that procedures must exist at each MHTF to specify which hyperbaric physician is responsible for each patient and each HBOT, and for any period of risk for a staff member or accompanying person after hyperbaric exposure, and how that physician may be promptly contacted.
4. Professional responsibilities include:
 - a. Ethical conduct as set out in published guidelines such as the CMA Code of Ethics
 - b. Protecting patient privacy in accordance with legislation and local policies
 - c. Maintenance of competence and continuing medical education in hyperbaric medicine
 - d. Taking precautions to prevent the transfer of potentially infectious materials to patients in accordance with local policies
 - e. Following infection prevention and control policies of hospital or health facility and provincial ministry of health
 - f. Familiarity with all equipment and supplies that are utilized
 - g. Cooperating with research conducted in accordance with the ethical requirements of the Tri-council Policy Statement on Ethical Conduct for Research Involving Humans
 - h. Respectful interactions with physician colleagues, trainees and other health care staff and refraining from conduct that could be considered harassment
 - i. Appropriate supervision of trainees
 - j. Responsible and efficient use of resources
 - k. Due attention to the roles published by the Royal College of Physicians and Surgeons of Canada (CanMeds 2005)
 - l. Carrying medical liability insurance

- m. A duty to consider personal fitness so that safe patient care is not compromised by impairment due to intoxicating substances, medication, illness or fatigue.

Medical coverage of diving operations

1. Physicians certified in the Diving Medicine stream of the DRCPSC may provide diving medicine physician services according to Level 2 or 3 as set forth in CSA Z275.2
2. Physicians must have satisfactorily completed a specific course for assessing medical fitness to dive (approved by the CUHMA or the UHMS) within the preceding 4 years (or otherwise as required by the applicable jurisdiction or authorities) to function as a Level 1 diving physician as set forth in CSA Z275.2
3. Physicians must undertake additional specialized training beyond the Diving Medicine stream of the DRCPSC to meet the requirements for medical coverage of saturation diving (Level 4 as set forth in CSA Z275.2)
4. Additional approvals may be required by international, national and provincial authorities

Section 4: Medical Hyperbaric Treatment Facility staffing

- General staffing requirements
- Staff roles
- Acceptable professions for MHTF staff
- General requirements for training and certification
- Hyperbaric Technologists
- Chamber Operator(s)
- Inside Patient Attendant
- Accompanying Person
- Outside Patient Attendant
- Minimal staffing requirements for multiplace and monoplace HBOT
- Staffing for critical care and operation of ventilators

General staffing requirements

1. Each MHTF must have suitable technical, clinical and administrative personnel in order to provide safe HBOT
2. The number and qualifications of staff required for the hyperbaric team in the health care facility must be determined according to:
 - a. The number of patients treated simultaneously and per day
 - b. The complexity of the patients treated

- c. The types and complexity of hyperbaric chambers used in the MHTF (monoplace or multiplace)
- 3. The MHTF must have a Safety Director as outlined above.
- 4. Each MHTF should have policies related to Accompanying Persons

Staff roles

- 1. The role of MHTF professional staff (see CSA Z275.1-1) may be:
 - a. Technical only (or combined with administrative)
 - b. Clinical only (or combined with administrative)
 - c. Technical and clinical (for example CHT) (or combined with administrative)
 - d. Administrative only
- 2. Each MHTF must have appropriate professional staff for the different roles required in the hyperbaric medicine service and this may include, as appropriate:
 - a. Hyperbaric Technologist (Hyperbaric Chamber Operator)
 - b. Safety Director
 - c. Patient Care Coordinator
 - d. Registered Nurse (with acceptable hyperbaric training)
 - e. Registered Respiratory Therapist (with acceptable hyperbaric training)
 - f. Inside and outside Patient Attendant for multiplace operations
- 3. Each MHTF must have clear job descriptions for personnel that define the necessary qualifications and roles of each position

Acceptable professions for MHTF professional staff

- 1. Staff must have suitable professional training, certification and experience prior to working in the MHTF and this may include (but is not restricted to):
 - a. Respiratory therapists
 - b. Nurses
 - c. Nurse practitioners
 - d. Paramedics
 - e. Licensed practical nurses
 - f. Physician assistants
 - g. Biomedical technologists
 - h. Diving supervisors
 - i. Commercial diving personnel
 - j. Military corpsmen
 - k. Military diving personnel
 - l. Diving Medical Technician (DMT)
- 2. Technical personnel are not required to have a clinical background and clinical personnel are not required to have a technical background

General requirements for training and certification

1. The training, qualifications and certifications expected for non-physicians working in **MHTFs** is not standardized and it is recognized that considerable variation exists across Canada (and other jurisdictions) at this time. Specific training and certification is not presently available in Canada for all levels or categories of hyperbaric personnel.
2. All professional staff working at the hyperbaric facility, whether outside or inside the hyperbaric chamber must have satisfactorily completed specialized hyperbaric training for this purpose.
 - a. This training must be acceptable to the **Medical Director** of the **MHTF**
 - b. Outside Patient Attendants may be exempted from this requirement depending upon local policies
 - c. When Canadian hyperbaric certification is available for nurses, respiratory therapists, paramedics or other categories of clinical personnel, current clinical personnel are expected to attain this within 5 years and all new entrants will be expected to attain certification within 2 years
3. The Certified Hyperbaric Technologist (CHT) certification available from the National Board of Diving and Hyperbaric Medical Technology (NBDHMT) in the USA is recognized as a Level 1 Hyperbaric Technologist and these personnel may perform a mixture of technical and clinical duties
4. Hyperbaric technical personnel working in a **MHTF** are not required to be certified in diving-related occupations as set forth in CSA standards (Z 275 series). However, these CSA standards provide valuable guidance and, in general, personnel working in technical roles should meet comparable criteria for experience and training.
5. Technical personnel who are not eligible for certification as a CHT are not required to have this certification but must demonstrate equivalent or greater experience and competence.
6. Technical and clinical staff must be approved by and have suitable orientation to the hospital or health facility, and be covered by any facility practice insurance where applicable
7. Each **MHTF** should have a range of professionals appropriate to both the facility and the nature of the patients treated.

Hyperbaric Technologists

1. Detailed recommendations regarding the recognition, training and roles of Level 1 – 4 Hyperbaric Technologists are provided in Appendix #8
2. The Safety Director of the MHTF must have sufficient authority over technical operations and personnel to ensure safety in the facility.
3. **MHTF** technical duties, including chamber operations, shall be undertaken only by personnel recognized as a Hyperbaric Technologist (see Appendix # 8) or by a trainee for Level 1 that is directly supervised by a Level 2 or higher Hyperbaric Technologist.
4. Chamber operators must not remain in a training capacity indefinitely, and must attain recognition as a Level 1 Hyperbaric Technologist within a maximum of 2

- years. The intention of this requirement is to ensure that hyperbaric chambers are operated only by individuals who are competent as a Hyperbaric Technologist by completion of approved training and experience
5. Each MHTF must have policies regarding the number and level of Hyperbaric Technologists required for HBOT and these policies must take account of the types of the hyperbaric chambers and the nature of patients and treatments provided.
 6. As specified in CSA Z275.1-05, during the operation of the chamber(s), one person shall be designated as the chamber operator.
 7. The chamber operator shall be responsible for the safe operation of the chamber according to established operating procedures and be familiar with the maintenance and repair of the various mechanical, electrical, liquid, and gas systems comprising the hyperbaric facility.
 8. The chamber operator must have training and experience with the specific type(s) of chamber for which they are responsible
 9. The chamber operator must have training, competency and experience that is acceptable to the Medical Director of the MHTF
 10. The Credentials Committee of the CUHMA may provide advice regarding equivalency and appropriate qualifications for Hyperbaric Technologists
 11. The chamber operator shall ensure the completion of records required in section 7 of these Guidelines

Inside Patient Attendant

1. The Inside Patient Attendant shall be medically fit (CSA Z275.1-05, CSA Z275.2-04) for hyperbaric chamber exposures and trained to attend persons in a chamber.
2. All persons who undergo hyperbaric exposure at a **MHTF** must be assessed by a physician for fitness to undergo such exposures
 - a. The physician must have successfully completed training for assessing fitness to dive and be recognized for performing fitness assessments for occupational divers (CSA Level 1 diving medicine physician)
 - b. In an emergency, the Attending Hyperbaric Physician may waive the requirement for investigations and determine fitness for hyperbaric exposure
3. The final decision on suitability for hyperbaric exposure rests with the Medical Director of the **MHTF**
4. Each MHTF should have policies regarding the investigations recommended for staff to work inside a hyperbaric chamber. The requirement for diagnostic investigations for staff or accompanying persons may be waived or varied by the hyperbaric physician in an emergency.
5. Each MHTF should use a standardized assessment and documentation for medical evaluation of fitness to work inside a hyperbaric chamber.
6. The **MHTF** shall have policies that require staff that work inside the hyperbaric chamber to inform the hyperbaric physician or medical director of any circumstances that could have the potential to affect fitness including:

- a. Pregnancy
 - b. New onset of a significant medical condition or medical treatment
 - c. Change or exacerbation of a pre-existing medical condition
 - d. Recent surgical and other medical procedures
 - e. Significant injuries
 - f. Hospitalizations
 - g. Use of prescription or non-prescription medications
7. The responsibilities and training required for personnel attending patients inside hyperbaric chambers must be appropriate to the medical condition of patients that are treated. Each MHTF must have detailed policies in this regard (see Appendix # 8 and also section 5 below on patient care).
 8. Current BLS certification is strongly recommended.
 9. Inside Patient Attendants must have training to work in the hyperbaric environment and also health care certification as one of the following:
 - a. Licensed physician
 - b. Registered nurse
 - c. Nurse practitioner
 - d. Registered Respiratory Therapist
 - e. Paramedic
 - f. Licensed Practical Nurse
 - g. Licensed Physician Assistant
 - h. Military corpsmen
 - i. Diving Medical Technician (DMT)

Accompanying Person

1. It is acceptable for an Accompanying Person (parents of children, other responsible person) to accompany patients inside the hyperbaric chamber in special circumstances if the **Attending Hyperbaric Physician** determines this is necessary to enable hyperbaric treatment of a patient.
2. Accompanying persons must be medically fit for hyperbaric exposure and sign a consent form prior to such exposure.
3. Prior to any hyperbaric exposure Accompanying Persons must be assessed by a Hyperbaric Physician
4. The final decision on suitability for hyperbaric exposure rests with the Medical Director of the **MHTF** or other Hyperbaric Physician.
5. The investigations recommended for Accompanying Persons may be determined by each MHTF but should be comparable to those for hyperbaric patients. The requirement for diagnostic investigations for staff or Accompanying Persons may be waived or varied by the hyperbaric physician in an emergency.

Outside Patient Attendant

The Attending Hyperbaric Physician or the Medical Director of the MHTF may determine:

1. That additional personnel or other persons are needed in the MHTF but outside of the chamber to assist with patient care in particular cases or types of cases
2. The appropriate qualifications or requirements for such persons
3. Outside attendants may not necessarily be required to have hyperbaric training and may be selected for particular clinical purposes such as pediatric experience or to assist with managing critically ill patients

Minimal staffing requirements for multiplace and monoplace HBOT

1. For multiplace chamber HBOT the minimum staffing required is:
 - a. A Hyperbaric Technologist Level 2 or 3 acting in a supervisory role that fulfills the competency requirements of applicable CSA standards
 - b. A Level 1 Hyperbaric Technologist functioning as chamber operator
 - i. An individual who is in training for Level 1 Hyperbaric Technologist may operate the chamber under the direct observation of Level 2 or higher Hyperbaric Technologist
 - c. An inside Patient Attendant
 - d. A hyperbaric physician, who may also function as the Outside Patient Attendant
 - e. The minimum number, including the hyperbaric physician, is therefore 4 (four) hyperbaric professionals
 - f. In an emergency situation the hyperbaric physician may enter the hyperbaric chamber or function as an Inside Patient Attendant if necessary to enable HBOT to commence, resulting in a hyperbaric team of only 3 (three) persons. However, as soon as possible an Outside Attendant should be made available and the physician replaced with another Inside Patient Attendant. If it is necessary for the hyperbaric physician to remain inside the chamber with the patient it is strongly recommended that another hyperbaric physician be available outside the chamber.
2. For monoplace chamber HBOT the minimum staffing required is:
 - a. A Level 2 or higher Hyperbaric Technologist
 - b. Alternately, a Level 1 Hyperbaric Technologist provided that they have been approved by the Medical Director, the health care facility, the Safety Director / Technical Director for working independently and that a Level 2 or higher Hyperbaric Technologist is contactable for advice or assistance.
 - c. A hyperbaric physician who must be capable of safely depressurizing the hyperbaric chamber(s) and present next to the chamber at all times if only one Hyperbaric Technologist is present. If two Hyperbaric Technologists are available the physician need not remain next to the chamber but must be immediately available in the hyperbaric facility

- d. The absolute minimum number, including the hyperbaric physician, is therefore 2 (two) hyperbaric professionals. As set out in section 7 below, one Hyperbaric Technologist must not operate more than three (3) monoplace chambers simultaneously.
- e. It is reasonable to proceed with the minimum number of personnel rather than cancel treatment(s) but this minimum staffing is not optimal, especially on a regular day-to-day basis. An additional chamber operator is preferred particularly for emergencies or patients with complex medical conditions. It is recommended that an Outside Patient Attendant or another responsible person be available to assist with other tasks when practical and this may be another chamber operator.

Staffing for critical care and operation of ventilators

1. MHTFs that treat critically ill or ventilated patients must:
 - a. Be a Level 1 or Level 2 facility or a Level 5 military facility authorized and equipped for this purpose
 - b. Have policies regarding staffing and management of critically or ventilated patients
2. When critically ill patients are treated with HBOT then hyperbaric personnel are required to have training, experience and certification in the care of such patients under hyperbaric conditions and be approved for this purpose by the hospital or health authority
3. When ventilators are used under hyperbaric conditions a staff member must be dedicated to the respiratory care of the patient during HBOT and this individual (normally a Respiratory Therapist) must:
 - a. Have specific approval by the hospital for operation of a hyperbaric ventilator
 - b. Have training and certification in the use of ventilators
 - c. Have experience with the particular ventilator under hyperbaric conditions
 - d. Be approved for this purpose by the Medical Director of the MHTF
 - e. Be competent to maintain the airway and manually ventilate the patient and preferably able to intubate the patient if needed

Section 5: Patient care

- Selection and assessment of patients
- Consent
- Clinical examination and monitoring equipment
- Administration of medications
- Emergency medical preparations
- Patient complexity considerations
- Wait times / urgency for HBOT

- Wound care
- Patient records
- Assessment for progress and complications
- Communication and follow up with patients, families and referring physicians

Selection and assessment of patients

1. The hyperbaric physician is required to assess and advise each patient prior to commencing a program of HBOT to ensure that:
 - a. The patient has an approved medical condition that is likely to benefit from HBOT
 - b. There are no absolute contra-indications to HBOT and that any relative contra-indications have been considered and appropriately managed
 - c. The patient's medical conditions are optimized to the best practical extent
 - d. Other anticipated or potential risks are considered and a plan is in place to ameliorate these if necessary
 - e. The likely benefits exceed the risks.
 - f. The patient or substitute decision-maker has given written informed consent
2. The hyperbaric physician should be familiar and comply with Appendix #2, CUHMA position on the uses of Hyperbaric Oxygen Treatment and the role of physicians
3. The hyperbaric physician is responsible for ensuring adequate documentation of the disorder for which HBOT is prescribed, including before commencing HBOT, periodically during a course of HBOT and after completion of HBOT (Patient records below).
4. Each MHTF should have policies regarding recommended patient investigations prior to HBOT. The **Attending Hyperbaric Physician** may accept the results of recent investigations performed depending on any local policies. In addition, the Attending Hyperbaric Physician may waive the requirements for certain investigations if they are unavailable, if waiting to obtain investigations would delay the provision of emergency HBOT or if they are contra-indicated or considered inappropriate in a particular patient.

Consent

1. HBOT requires prior written consent and this should conform to hospital / health authority policies and should include discussion of the risks, benefits and procedures involved in HBOT. Standardized specific hyperbaric consent forms are recommended.
2. In the event that it is not possible to obtain consent in an emergency then HBOT may proceed in accordance with hospital / health authority / provincial policies and regulations.

3. It is **strongly recommended** that all patients receive printed information regarding the risks, benefits and procedures of HBOT (specific instructions on accessing on-line information are acceptable).
4. Separate consent should be obtained for photography when this is part of the care of the patient

Clinical examination and monitoring equipment

1. The following are required to be present and immediately available to all **MHTFs**
 - a. Examination table or stretcher
 - b. Stethoscope
 - c. Sphygmomanometer
 - d. Otoscope
 - e. Ophthalmoscope
 - f. Pulse oximeter
 - g. Eye charts for visual acuity testing
 - h. ECG monitor (may be shared with another department nearby)
 - i. Suction (manual, electric or medical vacuum)
 - j. Laryngoscope(s)
 - k. Self-inflating breathing bag
 - l. Defibrillator / AED (may be shared with another department nearby or otherwise available promptly)
 - m. Glucometer
2. The following are recommended:
 - a. Non-invasive automated blood pressure
 - b. Transcutaneous oxygen partial pressure monitor
 - c. Laser Doppler (Skin perfusion pressure) monitor
 - d. Capability for invasive pressure monitoring (**MHTFs** providing emergency and critical care services)

Administration of medications

1. The hyperbaric physician must prescribe any medication administered in the MHTF
2. Each MHTF must have policies regarding which staff may administer what medications (MDs, RNs, RTs or Paramedics)
3. To ensure patient safety adequate checks are required prior to administration of any medications in the MHTF including:
 - a. Identity of the medication
 - b. Dose
 - c. Appropriateness for the patient
 - d. Allergies
 - e. Correct patient

Emergency medical preparations

1. Each **MHTF** must systematically plan for the management of emergency medical situations that may arise and have suitable equipment and supplies immediately available for this purpose, including:
 - a. Suction, including apparatus to suction the airway that does not rely upon the chamber pressure must be immediately available.
 - b. Equipment, medications and supplies for treating:
 - i. Pneumothorax
 - ii. Anaphylaxis
 - iii. Cardiac arrest
 - iv. Respiratory arrest
 - v. Hypotension
 - vi. Hypertension
 - vii. Cardiac arrhythmia
2. Each **MHTF** is required to have specific policies and procedures related to emergency situations (see Appendix #5 for examples)
3. The following are required to be present or immediately available at **MHTFs** that treat critically ill or unstable patients:
 - a. Invasive pressure monitoring
 - b. Exhaled carbon dioxide monitor or detector
 - c. Spirometry (ventilated / intubated patients)
 - d. Intravenous infusion pump(s) suitable for and tested under hyperbaric conditions
 - e. Microdrip intravenous infusion apparatus
 - f. Ventilator suitable for and tested under hyperbaric conditions

Patient complexity considerations

1. The Medical Director and hyperbaric physicians at each **MHTF** must give careful consideration as to whether, at any particular time, complex or unstable patients can undergo HBOT with an acceptable degree of safety
2. Critically ill or unstable patients shall only be treated in a hospital-based or hospital-associated Level 1 or Level 2 **MHTF**.
3. Each **MHTF** must give consideration to and have policies regarding staffing and level of care required for patients undergoing HBOT including:
 - a. Number of simultaneous patients
 - b. Complexity of those patients
 - c. Artificial devices (such as pumps, patches and pacemakers)
4. Many scoring systems exist to describe patient status, but none is adequately developed for HBOT.
 - a. The complexity assessment system in Appendix #7 may serve as a guide but it has not been evaluated or validated.

5. The hyperbaric physician must consider for each individual case the staffing required and the safety of treating each individual case taking into consideration staffing and patient complexity
6. The table below indicates some factors that increase complexity of HBOT

Table: Some factors that may increase complexity of HBOT

Airway factors	Neurologic / psychiatric
Tracheostomy	Seizure disorder
Intubated / artificial airway	Unconscious, neurologic deficit
Airway abnormalities	Cognitive impairment
Sleep apnea or anticipated airway difficulty	Severe / chronic pain
Breathing factors	Profound anxiety / requirement for sedation
Mechanical ventilation	Behaviour disturbances
PEEP / CPAP requirement	Psychosis
COPD / asthma / pneumonia	Profound sedation or general anesthesia
Pneumothorax / chest tube	Organ dysfunction / systemic disease
Circulatory factors	Diabetes
Cardiac arrhythmia	Critically ill patients / ICU / CCU
Hypotension, hypertension	Continuous bladder irrigation
Congestive heart failure, poor contractility	Burns or extensive wounds
Severe / unstable ischemic heart disease	Patient characteristics
Inotropic or vasoactive medications	Multiple concurrent medical conditions
Invasive monitoring (arterial, CVP, PA)	Emergency cases
Intravenous fluids	Infants and small children
Other	Elderly
Anaphylaxis, latex allergy	Morbid obesity
Drug-resistant organisms (MRSA, etc.)	Recent or impending major surgery
Pumps, patches and pacemakers	

Wait times for HBOT / urgency of treatment

1. Each **MHTF** should endeavour to treat patients in a timely manner according to the urgency determined by the hyperbaric physician.
2. The policies of the **MHTF** must ensure that the date a patient is assessed is recorded and wait times are monitored.
3. If there is a delay to commencing treatment the facility should continue to communicate with the patient and periodically reassess the condition of the patient and urgency of treatment.

4. Each **MHTF** should have policies that require the urgency of treatment to be determined when the patient is first seen in consultation and this should be reviewed at intervals as appropriate.
5. Target wait times
 - a. Emergency treatments: as quickly as possible (< 4 hours)
 - b. Urgent treatments: within 1 – 4 days (as determined by hyperbaric physician)
 - c. Elective treatments: within 2 – 16 weeks

Wound care and other interventions

1. If the MHTF provides wound care or other interventions there should be policies regarding the personnel approved for each intervention and the documentation required
2. Each MHTF should ensure that any wound dressings are compatible with hyperbaric exposures

Patient records

1. Each **MHTF** is required to:
 - a. Have policies on patient records
 - b. Maintain adequate records for each patient.
2. These records may be paper, electronic or both
3. The patient medical records must contain:
 - a. Written consent for HBOT
 - b. Date of each HBOT, patient visit and assessments
 - c. Names of hyperbaric personnel involved in treating the patient
 - d. Prescription for HBOT and medications administered by the MHTF
 - e. Daily treatment records
 - f. Time of pressurization, depressurization and start and end time of each pressure step
 - g. Treatment pressures
 - h. Oxygen exposure and air breaks
 - i. Events or incidents
 - j. Approved indication for HBOT
 - k. Contact information
 - l. Consultation and examinations
 - m. Wound care or other interventions
 - n. Wound dressings
 - o. Dates and records of vascular assessments (TCOM, Laser Doppler) where applicable
 - p. Dates, images and records of photography and wound area analysis
 - q. Summary records of HBOT
 - r. Progress and reassessment records

- s. A physician note, confirmation, electronic signature or similar for every HBOT where required by local policies
- t. Endoscopic photography where this is available and appropriate to the patient's condition
- u. Diagnostic imaging studies
- v. Blood glucose and other blood tests where indicated
- 4. MHTF patient records must comply with:
 - a. Applicable hospital or health authority policies
 - b. Guidelines and requirements of Provincial Colleges of Physicians and Surgeons
 - c. Canadian Medical Association guidelines
 - d. Federal, provincial and Territorial legislation and regulations on privacy and protection of personal information
- 5. Chamber logbooks must be maintained in addition to separate patient records.

Assessment for progress and complications

- 1. Assessment and documentation of progress and any complications or changes of each patient's medical conditions is mandatory
 - a. Each MHTF should establish policies in this regard

Communication and follow up with patients, families and referring physicians

- 1. Communications with patients and their families must meet the ethical requirements of the CMA and applicable legislation, regulations and policies of the health authority
- 2. Each MHTF should have a website and printed materials for the purpose of providing information to patients and referring physicians
- 3. Each MHTF should periodically contact patients waiting for HBOT in order to:
 - Provide information about the timing of availability of HBOT
 - a. Determine whether reassessment is needed to determine whether urgency of HBOT has changed
- 4. Telephone and secure electronic communications are recommended
- 5. Each MHTF must have policies that ensure adequate follow up with patients after HBOT
 - a. It is recommended that each MHTF provide patients with written information after completion of HBOT
- 6. Hyperbaric physicians and the MHTF should inform referring physician(s) and family physicians:
 - a. That the patient been accepted for HBOT
 - b. The patient has commenced HBOT
 - c. The patient has completed HBOT
 - d. The number and nature of treatments
 - e. About the outcome of treatment and any complications
 - f. About any future recommendations and follow up

Section 6: Hyperbaric chambers and related equipment

- General physical and operational requirements for MHTF hyperbaric chambers
- Specific requirements for multiplace chambers
- Specific requirements for monoplace chambers
- Monitoring and control of the chamber environment
- Purity and composition of compressed breathing gases
- Supply of compressed gases and pipeline systems
- Cleaning of hyperbaric chambers

General physical and operational requirements for MHTF hyperbaric chambers

1. All hyperbaric chambers in each MHTF must:
 - a. Be approved and licensed by Health Canada for HBOT
 - b. Be used according to requirements of Health Canada for approved medical conditions
 - c. Undergo all inspections and testing as required by Federal, Provincial or Territorial legislation and regulations
 - d. Have an operating pressure capability of 3 ATA or greater
 - e. Comply with CSA Z275.1-05
 - f. Comply with NFPA standards for hyperbaric facilities
 - g. Be specifically designed for, or modified and equipped for medical HBOT
 - i. Chambers specifically designed for clinical HBOT are recommended
 - h. To be equipped with the means to provide alternative sources and composition of breathing gas, to provide, for example, 100% oxygen or for an “air break”.
 - i. Have pressure gauges or electronic pressure measurement devices that are calibrated and approved either at a certified test facility or onsite by a certified test facility at least once in every 12-month period (see CSA Z 275.1-05)
 - j. Have communications equipment
2. Hyperbaric chambers for elective HBOT shall be of rigid construction
 - a. Inflatable, collapsible or portable chambers are unacceptable for elective HBOT
 - b. Inflatable, collapsible or portable chambers are acceptable for emergency HBOT, particularly in remote locations
3. Each MHTF should ensure that hyperbaric chambers and associated systems are adequately maintained up to date with applicable CSA and medical standards and are not of such an age or condition that this is difficult or impossible to achieve.
4. Acrylic ports and chamber components must be maintained and replaced according to manufacturer directions and applicable standards.

Specific requirements for multiplace chambers

1. Multiplace chambers shall comply with CSA Z275
2. There shall be a minimum of two interconnected chambers (“locks”):
 - a. At least one shall serve as an entrance lock
 - b. At least one shall serve as a treatment lock
3. The entrance lock shall:
 - a. Be of sufficient length and diameter to accommodate a recumbent person and an attendant and shall be operated without altering the pressure of the treatment chamber.
 - b. Be capable of being compressed to 60 fsw within 5 minutes (US NAVY dive tables require 20 FPM minimum)
4. There shall be a medical lock
 - a. It must be capable of being cycled between chamber pressure and atmospheric pressure within one minute and without altering the chamber pressure by more than 1 fsw
 - b. The purpose is to enable food, medical supplies, and other small articles to be passed into and out of the chamber while its occupants remain under pressure.
 - c. The entrance lock may be used as the medical lock provided that it can be cycled between chamber and atmospheric pressure within one minute
5. Each MHTF multiplace chamber must have:
 - a. Breathing equipment for all occupants plus one spare
 - b. A Fire Suppression System including a hand held hose inside the chambers
 - c. At least two independent communication systems
 - d. A reserve / back up / alternate supply of air and oxygen
 - e. An emergency / back up supply of electricity and lighting

Specific requirements for monoplace chambers

1. Pressurization with either oxygen or air is acceptable
2. Pressurization with oxygen necessitates special precautions with respect to prevention of fire and explosions
3. The MHTF must generally comply with the NFPA 99 Chapter on Hyperbaric Facilities
4. The MHTF must have policies and procedures specific to monoplace hyperbaric operations

Monitoring and control of the chamber environment

1. The internal environment of multiplace hyperbaric chambers utilized for patient treatments must be continuously and accurately monitored for:

- a. Oxygen concentration
 - b. Carbon dioxide concentration
 - c. Humidity
 - d. Temperature
 - e. Pressure
2. The equipment used for these measurements must be periodically calibrated according to the manufacturer's recommendations and the requirements of CSA Z275.1-05.
3. The internal oxygen concentration of monoplace chambers must be continuously monitored.

Purity and composition of compressed breathing gases

1. Compressed breathing gases must comply with CSA standards Z275.2-04
2. Breathing air produced by compressors must be tested at least every six months (CSA Z275) by a testing laboratory accredited by the Standards Council of Canada according to ISO 17025.
3. It is strongly recommended that oil-free compressors are used
4. The air intake for any compressor used for hyperbaric chamber operations must be located so as to minimize the potential for air contamination; policies and programs should be in place to prevent and monitor for carbon monoxide contamination
5. HBOT must utilize Medical Grade "100%" oxygen for HBOT (this is required to be > 99% oxygen, with impurities mostly being argon) unless special gases are used for pressures greater than 3 ATA or for research purposes
6. The use of an oxygen concentrator to provide oxygen inside the hyperbaric chamber is:
 - a. Generally unacceptable for a multiplace chamber where MHTF staff or accompanying persons must be provided with "100%" oxygen in accordance with decompression protocols
 - b. Acceptable for a monoplace chamber operations in locations where reliable supplies of liquid oxygen (LOX) or cylinders of medical oxygen are not available, provided the oxygen concentration supplied is at least 93% and meets applicable CSA and ISO standards
 - i. The hyperbaric physician must be aware of the actual gas composition used
 - c. Generally unacceptable for emergency treatment of decompression sickness or arterial gas embolism, or decompression of hyperbaric staff inside a multiplace chamber
 - d. Generally acceptable where the concentrator is certified to produce an oxygen concentration > 99%.
7. In remote locations or under circumstances of inadequate availability of 100% oxygen from a liquid oxygen (LOX) supply or cylinder bank then oxygen produced from a concentrator may be utilized provided that:
 - a. Accurate measurement of the oxygen concentration is available and this information is available to the hyperbaric physician

- b. Calibration of oxygen measurement equipment must utilize medical oxygen (99% oxygen).
 - c. The concentration of major impurities (usually argon) is known
- 8. The use of air or oxygen enriched air as the therapeutic gas in routine HBOT is unacceptable

Supply of compressed gases and pipeline systems

1. The compressed gas supplies for a MHTF may be:
 - a. Segregated and completely separate from a health facility medical gas pipeline system
 - b. Provided entirely by a health facility medical gas pipeline system
 - c. Partially integrated or interconnected to, and partially segregated from a health facility medical gas pipeline system
 - d. Provided by pipelines that transit through a health facility but which are not connected to the health facility medical gas pipeline system
2. The applicable CSA standards for these compressed gas supply options are different:
 - a. For the segregated system the applicable standard is found in CSA 275 - Compressed Breathing Air and Systems
 - b. For a MHTF supplied by a health facility the applicable standard is CSA Z7396.1-09 - Medical Gas Pipeline Systems, Part I
 - i. However, the purity requirements are different and CSA standards in Z275 apply
 - c. For the partially interconnected arrangement, both the Compressed Breathing Air Systems and the Medical Gas Pipeline Systems standards apply but the latter standard specifies a “demarcation point” between the health facility and the MHTF.
 - d. Where pipelines transit a health facility the Medical Gas Pipeline standard applies
 - i. Considerably higher pressures (75 – 150 psi) are required for ventilators used inside hyperbaric chambers but CSA Z7396.1-09 does not currently recognize pipelines with pressures considerably higher than the 50 psi that is utilized in the standard
3. CAN/CSA-Z9170-1-11 - Terminal units for medical gas pipeline systems - Part 1: Terminal units for use with compressed medical gases, vacuum, and anaesthetic gas scavenging systems currently applies to any terminations of the medical gas pipeline system in the MHTF but this standard does not include connections for higher pressures
4. Requirements for oxygen concentrator supply systems for connection to the oxygen pipeline distribution systems described in this Standard are provided in CAN/CSA-Z10083
5. In Canada, Oxygen 99, Oxygen 93, and Oxygen 90+% may all be supplied by a medical gas pipeline as oxygen. The hyperbaric physician and all hyperbaric staff must be aware of the concentration of oxygen used in the MHTF

Cleaning of hyperbaric chambers

1. Each MHTF must have policies and procedures related to the cleaning of hyperbaric chambers and the room(s) enclosing the chambers.
2. The inside and outside of hyperbaric chambers must be cleaned only by MHTF staff who have been trained and approved for this purpose.
3. Only staff with specific training and knowledge appropriate to the particular chamber(s) must be permitted to clean the room(s) within the MHTF enclosing the hyperbaric chamber(s).
4. Only approved cleaning agents may be used for hyperbaric chambers
5. Approved cleaning agents and other information related to prevention of cross-infection are provided in **Appendix #4**.

Section 7: Hyperbaric oxygen treatment (HBOT)

- General requirements and preparations for HBOT
- Hyperbaric Physician responsibilities for HBOT
- Prescription of HBOT
- General staffing requirements for HBOT
- Multiplace staffing requirements for HBOT
- Monoplace staffing requirements for HBOT
- Hyperbaric chamber occupancy limits
- Documentation
- Patients requiring mechanical ventilation, analgesia, sedation or general anesthesia
- Conduct of HBOT
- Pressures, oxygen concentrations, duration and air breaks used for HBOT
- Technical issues and problems occurring in the MHTF
- Medical problems and complications occurring in the MHTF
- The post-HBOT period
- Hyperbaric exposure limits and decompression of **MHTF** staff and accompanying persons

General requirements and preparations for HBOT

1. Each **MHTF** is required to implement checklists prior to commencing HBOT that are specific to its own equipment, circumstances, staffing and patients.
2. Each **MHTF** must have policies regarding the materials that are permitted to be taken into the hyperbaric chamber(s)

3. As a minimum the checklists or any “time out” prior to the start of any HBOT must confirm:
 - a. The identity of all patients
 - b. That all patients are wearing only clothing approved for hyperbaric oxygen environments
 - c. That no prohibited materials, including those carried or worn by the patient, are in the hyperbaric chamber prior to pressurization
 - d. The availability of the Hyperbaric Physician and other required hyperbaric personnel
 - e. The availability of gas supplies sufficient to complete the HBOT and subsequent treatment of a staff person with decompression illness (multiplace chamber)
 - f. The availability of any required medical supplies
 - g. That the patient has received any decongestant, anxiolytic or other premedication prescribed for HBOT
 - h. Any technical, environmental or other restrictions or issues related to safe conduct of HBOT
 - i. That any patient in a monoplace chamber is properly grounded before closing the chamber door
4. Each patient should be reviewed periodically (weekly is suggested) to:
 - a. Determine progress of the condition being treated
 - b. Confirm or modify the treatment plan
 - c. Consider the implications of any patient medical conditions for HBOT
 - d. Confirm any allergies, medications, recent or upcoming investigations or medical interventions
 - e. Patient treatment limitations
 - f. Emergency patients should be assessed before and after every HBOT
5. It is strongly recommended that latex be excluded from the hyperbaric chamber and the **MHTF** at all times.

Hyperbaric physician responsibilities for HBOT

1. The **Attending Hyperbaric Physician** is required to:
 - a. Prescribe all HBOT
 - b. Confirm the medical condition of each patient before HBOT
 - c. Ensure that appropriate notes are made in each patient’s record for every treatment and that each note is verified and signed by the physician either manually or electronically
 - d. Remain onsite and immediately available at all times during HBOT to attend the patient
 - e. Assess and manage any patient complications or medical problems that occur before, during or after each HBOT
 - f. Provide medical oversight of each patient during every HBOT

Prescription of HBOT

1. The treatment protocol for each patient must be selected, prescribed or modified on the written / electronic order of the Hyperbaric Physician
2. Each prescription must use standard medication prescription forms in use at the facility, a special HBOT prescription form, or electronic equivalents
3. The prescription shall specify the depth / pressure and time, breathing gas and air breaks of each treatment (or a named standardized schedule in routine use at the MHTF) and the number of treatments planned.
4. Any changes to this plan must be documented
5. Each MHTF is required to establish routine treatment protocols and familiarize hyperbaric personnel with these
 - a. When staff are exposed to hyperbaric pressures these protocols must be based upon published diving tables
 - b. The use of elective schedules based upon DCIEM / DRDC tables is strongly recommended.
 - c. Emergency protocols must utilize published treatment tables
6. Each **MHTF** is recommended to select a standardized treatment protocol (examples are in appendix #6)
 - a. The use of standard schedules facilitates research and comparisons between **MHTFs** and the provision of equivalent care in different MHTFs and helps to prevent errors and mishaps by ensuring that all personnel are familiar with the HBOT schedule
7. Each **MHTF** is required to make its treatment schedules available, upon request, to other centres and as part of accreditation
8. The routine elective use for HBOT of the following is unacceptable:
 - a. HBOT utilizing pressure less than 1.5 ATA or oxygen concentrations less than 100% except as part of an approved research protocol
 - i. Special breathing gas mixtures are permitted when appropriate in certain diving operations, emergency treatments and for research purposes but not for routine elective HBOT
 - ii. Requirements related to breathing gas composition and oxygen concentrators are included in section 6 of these guidelines
 - b. Treatment times less than 30 minutes with the exception of:
 - i. A “test of pressure” to assist in diagnosis of decompression illness
 - ii. A “test pressurization” to determine whether the patient is able to equalize ear and sinus pressures prior to scheduling HBOT or whether myringotomies and ear tubes will be required
 - iii. A “test pressurization” to assess special procedures needed for a particular patient or patient tolerance in terms of anxiety, psychological responses or medical factors
 - iv. Performance of TCOM or other investigations under hyperbaric conditions

General staffing requirements for HBOT

1. The number and type of staff required for the safe conduct of HBOT must be determined by:
 - a. The design, configuration and operational characteristics of the hyperbaric chamber(s) and the MHTF
 - b. The number of simultaneous patients
 - c. The medical conditions and complexity of each patient to be treated
 - d. Whether monitoring (visual, audio, physiologic parameters) and communication with each patient is possible from a single operator location
 - e. Whether all chamber parameters and systems required for safe operation may be monitored and controlled from a single location without creating a hazard or potential hazard
2. Each **MHTF** is required to have staffing policies related to these criteria that specify the numbers and qualifications of staff that must be present inside the hyperbaric chamber and within the **MHTF** during treatments.
 - a. The person(s) observing the condition of each patient must be qualified to determine whether there is a medical or technical need to inform the hyperbaric physician or take corrective actions
3. The matrix in Appendix #7 provides general guidance on staffing

Multiplace staffing requirements

1. Each **MHTF** operating a multiplace chamber must have policies regarding:
 - a. The numbers of patients and staff permitted and required both inside and outside the chamber
2. In general, it is recommended that there should be a minimum of one Inside Patient Attendant for up to six (6) patients
 - a. The local particulars of hyperbaric staff, equipment or patients may necessitate a smaller number of patients for one Inside Attendant for safe treatment
3. Local policies may permit a single Inside Patient Attendant to care for up to eight patients (8) provided that:
 - a. Most of the patients require only minimal assistance with hyperbaric procedures
 - b. The facility has can demonstrate the ability to safely provide simultaneous care to 8 patients
 - c. A **Hyperbaric Physician** or an additional Inside Patient Attendant is able to promptly lock into the chamber if required
 - d. There is sufficient space and breathing apparatus available for at least one (1) additional Inside Patient Attendants in the event an emergency arises
 - e. Detailed policies are in place to ensure the safety of all occupants
4. It is recognized that hyperbaric chamber technology, hyperbaric medicine practices and standards are continuing to develop and this may lead to changes to recommended staffing requirements.
 - a. When developments at a particular MHTF may lead to staffing that does not comply with these guidelines it is strongly recommended that formal

- advice be obtained by experts external to that MHTF and be subject to inspection and approval by a specific MHTF accreditation process
- b. It is recognized that CSA standards now classify all hyperbaric chambers that may accommodate more than a single occupant as a multiplace hyperbaric chamber
 - c. It is recognized that there are hyperbaric chambers approved by Health Canada that are designed to accommodate two patients at one time (“duoplace” chamber) and these are acceptable for hyperbaric treatments without an Inside Patient Attendant.
 - d. Technological advances not addressed in these guidelines must be subject to prior approval by relevant regulatory, standards and accreditation agencies and may be considered in future revisions of these Guidelines.
5. For unstable patients there must be at least one Inside Patient Attendant per patient.
 6. For patients requiring mechanical ventilation an additional Inside Patient Attendant competent and certified to operate the ventilator and manage the airway under hyperbaric conditions is strongly recommended.
 7. If an Accompanying Person is present inside the chamber they must not replace any required Inside Patient Attendant and the number of staff inside the chamber should be determined as if the Accompanying Person is a stable patient.

Monoplace staffing requirements

1. Each **MHTF** operating monoplace chambers must have policies regarding:
 - a. The permitted number of simultaneous patient treatments
 - b. The number of operators required
 - c. A chamber operator should normally not be responsible for more than three (3) simultaneous treatments
2. At least one additional staff member in addition to the chamber operator must be present in the MHTF during treatments
 - a. The hyperbaric physician may fulfill this role.
3. When providing HBOT to critically ill or unstable patients at least one staff member approved for such care must be continuously present with each such patient in addition to the chamber operator
4. When providing HBOT to a patient requiring mechanical ventilation an additional staff member with training and certification in the operation of ventilators must also be present or immediately available
 - a. This will normally be a Registered Respiratory Therapist
 - b. This staff person must be familiar with the operation of the specific ventilator for HBOT

Hyperbaric chamber occupancy limits for HBOT

1. Each **MHTF** is required to have policies related to the number of patients and other occupants permitted inside the hyperbaric chamber(s) depending on:
 - a. Equipment

- b. Staffing
 - c. Patient complexity
 - d. Operational factors
- 2. If necessary (as determined by the hyperbaric physician) it is acceptable for an Inside Patient Attendant or an Accompanying person, such as the parent of a small child, to accompany a patient inside a monoplace chamber.

Documentation

Each **MHTF** is required to maintain records of every hyperbaric exposure for an indefinite time period. These records must include:

1. All information required in CSA standards
2. The names and roles of all persons exposed
3. The timing of the previous hyperbaric exposure if within 48 hours
4. The purpose of the hyperbaric exposure for each individual
5. The pressure-time profiles of the exposures
6. The duration of the hyperbaric exposure
7. Time to reach maximum pressure and to depressurize to surface pressure
8. The pressure and time at each phase of a multi-step profile
9. The gas composition breathed by each person exposed including:
 - a. Oxygen concentration
 - b. The duration of oxygen breathing of each occupant at each pressure
 - c. The timing and duration of any interruptions to oxygen breathing (“air breaks”)
 - d. Inert gas identity and concentration
10. The equipment used to deliver breathing gas to each chamber occupant
11. Names of HTF personnel including:
 - a. The hyperbaric physician responsible
 - b. Chamber operator
 - c. Technical director or supervisor
 - d. Personnel inside the chamber
 - e. Other personnel outside the chamber
12. The planned treatment schedule
13. Any deviations from the planned schedule and the reason for the deviation
14. All significant events or complications arising to persons inside or outside the chamber
15. Any significant intervention required
16. Any technical problems or equipment failures that arise and corrective actions
17. Pre-, during and post-treatment assessments of each patient as required by MHTF policies
18. Information about multi-place chamber environmental conditions should be recorded at least every 15 minutes including:
 - a. Oxygen concentration
 - b. Carbon dioxide concentration
 - c. Humidity
 - d. Temperature

19. Video recording of HBOT is recommended and should be retained for at least 24 hours.
20. Electronic documentation of chamber pressures and times is recommended. A permanent log of the above information is required. This may be a signed (manual or digital) copy of a computer record.
21. Standardized terminology in these guidelines to describe and document HBOT and hyperbaric exposures.

Patients requiring mechanical ventilation, analgesia, sedation or general anesthesia

1. When patients require potent oral, transcutaneous or intravenous narcotic analgesics, staff with training and experience of these medications must be present and profound caution is warranted when:
 - a. The patient is not mechanically ventilated
 - b. During monoplace HBOT, particularly when the patient is not accustomed to these medications
2. Oral and sublingual anxiolytic medications are acceptable for elective and emergency HBOT provided that:
 - a. The medication is prescribed by the attending Hyperbaric Physician
 - b. The medication is administered by personnel that have approval from the hospital or health authority for this task or by the patient according to a prescription by the hyperbaric physician
 - c. Patient respirations are observed frequently or continuously during HBOT
 - d. The patient is assessed after HBOT to ensure fitness to leave the MHTF, or when applicable fitness to drive, according to any local policies
 - e. The patient is accompanied by a responsible adult when leaving the MHTF if any impairment continues or as required by local policies
 - f. The patient may take any routine psychotropic medications with which they are accustomed
3. Repeated intravenous sedation or anesthesia for elective HBOT is generally inappropriate and should not be considered except in exceptional circumstances
4. It is acceptable for patients requiring emergency or urgent HBOT to administer intravenous sedation or general anesthesia with muscle relaxants to enable safe HBOT when a patient:
 - a. Is critically ill
 - b. Requires mechanical ventilation
 - c. Is profoundly anxious
 - d. Has a psychiatric or behaviour disorder that limits cooperation or potentially endangers themselves or others inside the chamber
5. The administration of intravenous sedative, narcotic or anesthetic medications may lead to apnea, airway obstruction, and cardiovascular instability, loss of consciousness or altered behaviour and should only be considered in a hospital-based MHTF (except if needed to treat seizures).

6. Patients who require general anesthesia or profound sedation should normally be intubated and mechanically ventilated to ensure airway patency and adequate ventilation.
7. Whenever intravenous sedatives or anesthetics are administered to a patient inside the hyperbaric chamber or within the MHTF the following apply:
 - a. Equipment and supplies for intubation and ventilation must be present with the patient at all times, including inside the multiplace hyperbaric chamber
 - b. Profound sedation is unacceptable in a monoplace chamber unless the patient is intubated and ventilated
 - c. Personnel must be present with the patient at all times who are capable of initial airway management
 - d. The Attending Hyperbaric Physician must remain within the MHTF
 - e. ECG monitoring is mandatory
 - f. Measurement of tidal and minute ventilation in intubated or mechanically ventilated patients is required
 - g. Measurement of exhaled or transcutaneous carbon dioxide is strongly recommended
 - h. Arterial blood gas (ABG) analysis is strongly recommended and should be considered essential during HBOT in mechanically ventilated patients to confirm adequacy of ventilation unless exhaled or transcutaneous monitoring is utilized or unless ABG analysis is not available (such as in many monoplace chambers)
 - i. Suction equipment must be available at all times
 - j. The MHTF must have specific policies related to the use of intravenous sedatives and anesthetics
 - k. When patients require the continuous infusion of sedative or anesthetic medications in order to undergo emergent or urgent HBOT a staff member with specific training and who is approved by the hospital to control such infusions must be present with the patient at all times.
 - l. The use of accurate electronic pumps approved and tested for hyperbaric chamber use should be considered essential.
 - m. Micro-drip manually controlled infusions are not the preferred option but may be used in the event that a pump suitable for safe use in the particular chamber is not available.
 - n. The Hyperbaric Physician must be familiar with the use of the sedative or anesthetic infusion at the doses required and approved for this purpose by the hospital.
 - i. If this is not possible then another physician with such approval (Anesthesiology, Intensive Care or Emergency Medicine) must be present or consulted and immediately available.
 - o. General Anesthesia is only acceptable when undertaken by those with certification and privileges in anesthesiology approved by the hospital, acting in accordance with the “Guidelines to the Practice of Anesthesiology” published by the Canadian Anesthesiologists Society.

- p. Emergency Physicians who are experienced and approved to administer sedation may do so provided that applicable emergency physician sedation policies of the health facility, and these guidelines are adhered to
- 8. The use of inhaled anesthetic agents inside a hyperbaric chamber is strongly discouraged due to the potential for contamination of the chamber environment.

Conduct of Hyperbaric Oxygen Treatments

1. Patient assessment, monitoring and documentation
 - a. A continuous visual and audio watch of each patient by a qualified person approved for this task must be maintained at all times during HBOT by:
 - i. An Inside Patient Attendant inside a multiplace chamber
 - ii. Direct or electronic observation of patient(s) in monoplace chamber(s).
 - b. Each patient must have their vital signs (blood pressure, pulse and respiratory rate) measured and recorded by a qualified person before every HBOT and:
 - i. During and after every multiplace HBOT when indicated by the condition of the patient, and is suggested periodically for most patients
 - ii. Before and after each monoplace HBOT when indicated by the condition of the patient and is suggested periodically for most patients
 - c. In diabetic patients, the blood glucose must be measured using a glucometer immediately preceding HBOT.
 - i. Levels below 7 mmol/L increase the risk of hypoglycaemia and grand mal seizure during HBOT.
 - ii. The risk of hypoglycemia is generally greater in patients requiring insulin and those with poor diabetic control
 - iii. It is recommended that blood glucose be at least 8.0 mmol/L in insulin dependent diabetics or those that are poorly controlled; and at least 7.0 mmol/L in non-insulin dependent diabetics immediately prior to HBOT
 - iv. In the event that glucometer measurements are less than these recommended levels HBOT should be delayed or deferred
 - v. Glucose, sugar containing drinks and / or glucagon must be available inside the hyperbaric chamber during HBOT when treating diabetic patients
 - vi. The MHTF must have policies and procedures for managing diabetic patients
 - d. MHTF policies on monitoring must be adhered to when treating unstable, critically ill and ventilated patients
 - e. Any problems, events or medications related to each patient must be documented
2. Airway and breathing equipment
 - a. Breathing equipment used to deliver oxygen or other treatment mixture must be approved for use with hyperbaric oxygen and provide a reliable gas-tight fit to ensure delivery of the intended gas composition.
 - b. Acceptable equipment includes:

- i. BIBS with aviator-type mask
 - ii. Head tent
 - iii. Endotracheal tube and ventilator breathing system
 - iv. Tracheostomy tube (cuffed) and ventilator breathing system
 - v. Laryngeal mask airways may be used for emergency airway management but should not be used routinely.
- c. Breathing equipment should be designated and clearly marked for individual patients or cleaned after each use in a manner that effectively eliminates the risk of cross contamination with drug-resistant organisms.
- 3. Basic sequence of HBOT
 - a. The basic sequence of HBOT must comprise:
 - i. Pressurization
 - ii. Holding at pressure
 - iii. Depressurization
 - b. Any deviations from this planned sequence and the reasons for the deviation must be approved by the hyperbaric physician and documented in patient records
- 4. Standard HBOT protocols
 - a. Elective HBOT must utilize a limited number of standardized and named protocols approved by the Medical Director of the MHTF
 - b. Deviations from standardized protocols should only be made in exceptional circumstances and must be documented in the patient record
 - c. Emergency HBOT protocols must also use standardized protocols but the condition of the patient or hyperbaric staff may require modifications within defined limits
 - d. In the event of special or emergency circumstances arising then whenever possible pre-determined emergency protocols should be implemented (a list of sample policies is found in Appendix #5)
 - e. MHTFs in Canada are strongly recommended to utilize the same standard HBOT protocols
- 5. Modification, abbreviation or early termination of HBOT
 - a. The hyperbaric physician is responsible for determining any modification, abbreviation or termination of the planned HBOT protocol when warranted by the medical condition of the patient or by technical or staffing issues.
 - b. These circumstances may include:
 - i. Prolonged time to compression due to difficulty equalizing ear and sinus pressures or for other causes
 - ii. Technical, environmental, staff conditions
 - iii. Distress, deteriorating medical condition of the patient, emergency or other situations as determined by the hyperbaric physician, Safety Director or other hyperbaric staff
 - c. Primary concern must be safety of the patient(s) and attendant(s)
 - d. Decisions should take account of the urgency of the treatment and the risks to chamber occupants
 - e. The reasons for alterations to the planned treatment protocol must be documented in a permanent log and the patient record

Pressures, oxygen concentrations, duration and air-breaks used for HBOT

1. Elective HBOT protocols must use pressures between 1.5 and 2.8 ATA (16.5 – 60 fsw)
 - a. Treatment pressures between 1.9 and 2.5 ATA (30 - 50 fsw) should be used in almost all cases for currently approved medical conditions
 - b. Routine use of HBOT pressures less than 1.5 ATA is unacceptable (except decompression stops for hyperbaric staff)
 - c. The hyperbaric physician may determine that, due to special circumstances, such as exceptional risk of seizure or cardiovascular complication in an individual patient with an approved medical indication for HBOT, treatment pressures between 1.5 – 1.9 ATA are appropriate
 - i. The physician must document the circumstances and prescribe the modified HBOT protocol
 - ii. Other patients lacking the exceptional risk should not be treated using the same modification for reasons of convenience
2. The oxygen administered during HBOT must comply with Section 6 of these guidelines
3. MHTF standard elective HBOT protocols should provide a minimum of 60 minutes and a maximum of 120 minutes of oxygen breathing
4. Each MHTF must implement policies and procedures to recognize and reduce the risk of oxygen seizure including “air breaks” and education of patients and staff

Medical technical and facility problems occurring in the MHTF

1. The safety of patients and staff must take priority over all other considerations
2. When medical concerns arise the following must be considered:
 - a. Cancellation of HBOT
 - b. Early termination of HBOT
 - c. Modification of HBOT protocol
 - d. Prompt medical interventions
 - e. Application of specific policies and procedures (such as for cardiac arrest)
 - f. Transfer of patient to Emergency Department or Intensive Care Unit
3. Problems and actions must be documented

The post-HBOT period

1. Complications of HBOT and vital signs should be recorded when indicated
2. Each MHTF must have policies to ensure:
 - a. That patients remain in the MHTF for a defined period in order to complete all post HBOT assessments
 - b. Patients or caregivers have information to indicate that hyperbaric exposure has occurred within the previous 24 hours and how to contact the MHTF or hyperbaric physician in case a medical emergency arises

3. Specific discharge criteria are recommended for patients receiving sedation

Hyperbaric exposure limits and decompression of MHTF staff and accompanying persons

1. It is recommended that **MHTF** personnel carry information indicating that a hyperbaric exposure has occurred and how to contact the hyperbaric physician on-call in the event that decompression sickness or unexplained emergency occurs
2. Each **MHTF** is required to have policies regarding how long after hyperbaric exposure that an Inside Patient Attendant or Accompanying Person must remain in the MHTF after hyperbaric exposures.
 - a. For routine elective treatments a period of 30 minutes is normally sufficient and the Hyperbaric Physician must remain available for this time or as stipulated in local policies
 - b. For longer treatment tables the **Attending Hyperbaric Physician** may require a longer period.
3. Each **MHTF** must have policies to limit the risks, frequency and duration of hyperbaric exposures for **Inside Patient Attendants and Accompanying Persons**:
 - a. Training is necessary to ensure awareness of decompression sickness symptoms and the importance of contacting the Hyperbaric Physician in the event that concern arises.
 - b. For routine elective HBOT (2.4 ATA or less) it is strongly recommended that oxygen be used for decompression. It is suggested that oxygen breathing commence at least 10 minutes prior to the time when the no-decompression limit of the dive table employed is exceeded. For other treatment schedules (such as those greater than 2.4 ATA or longer than 90 minutes total) it is strongly recommended that In-Water O₂ tables for decompression be considered and it is advisable to give extra O₂ time over the basic requirement as a precautionary measure. It is essential that the oxygen-breathing requirements of a particular treatment table be followed as a minimum.
 - c. The time from the end of one elective hyperbaric exposure to the beginning of another should normally be not less than 18 hours even when oxygen has been used for decompression.
 - d. In the event that further hyperbaric exposure within 18 hours is necessary for patient care
 - i. The Hyperbaric Physician must take account of the previous exposure by determining the Repetitive Factor (for DCIEM tables, or similar for other tables) and if necessary limit the time and pressure in order to minimize the risk of decompression sickness
 - ii. Oxygen must be utilized for decompression and should commence before the No-D limit is reached taking into account the previous exposure
 - iii. The Hyperbaric Physician and Hyperbaric Technologists must be familiar with the necessary decompression tables and procedures

- and remain contactable by telephone and available to treat if decompression sickness occurs
- e. For emergency HBOT involving longer times, pressures greater than 2.4 ATA, the need for decompression stops or slow ascent rates, particular caution is essential in managing decompression risks. In these circumstances:
 - i. The Hyperbaric Physician and Hyperbaric Technologists must have adequate training, familiarity and experience with applicable tables and procedures and remain contactable by telephone and available to treat if decompression sickness occurs
 - ii. Oxygen must be utilized for decompression and must commence when required by the table or preferably sooner
 - iii. Repeat hyperbaric exposure of an Inside Patient Attendant or Accompanying Persons must not occur within 18 hours without taking full account of the previous exposure and ensuring compliance with all the requirements of the tables used
 - iv. Repeat exposure within 18 hours should be avoided whenever possible
 - 4. Each MHTF is required to have policies regarding flying after hyperbaric exposures.

List of Appendices

1. Approved medical conditions for HBOT
2. CUHMA position on the uses of Hyperbaric Oxygen Treatment and the role of physicians
3. Applicable standards, regulations and reference materials
4. Recommendations for cleaning and prevention of cross-infection in Medical Hyperbaric Treatment Facilities
5. Sample list of useful policies and procedures
6. Examples of Standardized HBOT schedules
7. Patient complexity and example guidelines for determining staff requirements
8. Hyperbaric Technologists

Appendix 1: Approved medical conditions for HBOT

1. Air or Gas Embolism

2. Carbon Monoxide Poisoning
Carbon Monoxide Poisoning Complicated By Cyanide Poisoning
3. Clostridial Myositis and Myonecrosis (Gas Gangrene)
4. Crush Injury, Compartment Syndrome and Other Acute Traumatic Ischemias
5. Decompression Sickness
6. Arterial Insufficiencies:
 - Central Retinal Artery Occlusion
 - Enhancement of Healing In Selected Problem Wounds
7. Severe Anemia
8. Intracranial Abscess
9. Necrotizing Soft Tissue Infections
10. Osteomyelitis (Refractory)
11. Delayed Radiation Injury (Soft Tissue and Bony Necrosis)
12. Compromised Grafts and Flaps
13. Acute Thermal Burn Injury
14. Idiopathic Sudden Sensorineural Hearing Loss (approved on October 8, 2011 by the UHMS Board of Directors)

Appendix 2: CUHMA position on the clinical uses of Hyperbaric Oxygen Treatment and the role of physicians (2015)

Approved January 15, 2015

Physician role in provision of hyperbaric oxygen treatment

The Canadian Undersea and Hyperbaric Medical Association (CUHMA) asserts that Hyperbaric Oxygen Treatment (HBOT) is a Medical Act. As such it must be prescribed and supervised only by licensed medical doctors that have successfully completed appropriate training in hyperbaric medicine and have satisfied the requirements for experience, certification, credentialing and recognition as hyperbaric physicians. Provincial Colleges of Physicians and Surgeons (the agencies that license and regulate medical doctors) have an important role in ensuring responsible hyperbaric physician oversight of HBOT.

Appropriate uses of HBOT

The CUHMA endorses the list of “Hyperbaric Oxygen Therapy Indications” published by the Undersea and Hyperbaric Medical Society (UHMS) as the primary guide for appropriate medical uses of HBOT. The UHMS indications are the conditions for which Health Canada licenses the importation and sale of hyperbaric chambers. The applicability of approved uses to individual patients must be determined by the treating hyperbaric physician.

The practice of any particular hyperbaric facility or hyperbaric physician must be focussed on the treatment of approved conditions. There are exceptional circumstances where it may be difficult to determine whether a patient’s condition meets approved criteria for HBOT. Hyperbaric physicians must exercise caution in any decision to utilize HBOT for conditions not specifically approved. Before proceeding in such cases the hyperbaric physician must undertake and document the following steps:

1. Decisions to treat with HBOT must be based upon the best interests of the patient
2. There must be a scientific rationale to support the use of HBOT, and some related supportive scientific evidence.
3. The hyperbaric physician must determine that the potential benefits outweigh the risks of treatment.
4. The hyperbaric physicians should consider HBOT only when other treatments are insufficient, unsuccessful, or are not available, effective, safe or practical.
5. Patient care decisions based upon financial or other gain are unacceptable and great care must be taken to avoid any potential conflict of interest.
6. Prior approval for investigational uses must be obtained from a Research Ethics Board or health authority ethics committee for new applications of HBOT.
7. When multiple treatments are planned the use of HBOT must be supported by all the hyperbaric physicians who will be providing care to the patient.
8. In elective cases all the steps outlined above must be undertaken and documented.

9. In an emergency situation the hyperbaric physician must make a decision promptly based upon as many of these principles as possible and carefully document the reasons for the decision to use HBOT.

During the course of treatment the hyperbaric physician must monitor progress closely, and must terminate treatment if benefit is not demonstrated and documented, or if adverse effects occur. In addition, the number, nature and results of treatment of all conditions must be subject to disclosure and review by applicable regulatory authorities and a hyperbaric facility accreditation process. Routine administration of HBOT without the above process for unproven applications is unacceptable. The routine use of HBOT for disproven applications is unacceptable in any circumstance.

Protection of the public

The Health Canada regulatory framework related to the importation, distribution, sale, purchase and use of hyperbaric chambers in Canadian jurisdictions currently provides only limited public protections. Existing regulations do not prevent unsafe and hazardous practices and do not prevent the exposure of the public and vulnerable persons to unnecessary health risks and expenditures. These regulations need to be strengthened and enforced for hyperbaric chambers in all jurisdictions in Canada to ensure public safety. The sale or use of hyperbaric chambers for home “treatments” creates an unacceptable hazard that should be prohibited for both vendors and purchasers through prompt legislation and regulation to ensure permanent cessation.

The CUHMA is opposed to the routine use of HBOT for unapproved conditions or by persons who are not credentialed hyperbaric physicians. Safe provision of HBOT requires a hyperbaric physician that is able to determine appropriateness and fitness for HBOT and to recognize and treat any complications or medical problems that may arise. The CUHMA recommends that when accreditation of Canadian hyperbaric facilities is available that this be mandatory. In addition, the CUHMA recommends that when the Diploma in Hyperbaric Medicine from the Royal College of Physicians and Surgeons of Canada is available that all facilities providing HBOT have at least one physician with this certification and that this Diploma, or equivalent, be the preferred qualification for privileges in Hyperbaric Medicine.

Summary

The primary focus of the CUHMA and hyperbaric physicians is safe effective HBOT for approved medical conditions. As the principal source of clinical and scientific excellence in hyperbaric medicine in Canada, the CUHMA encourages healthcare licensing and regulatory authorities to engage in a responsible cooperative effort to address the serious issues relating to public safety and inappropriate use of HBOT. Such an effort will necessitate a review of criteria for professional licensure, introduction of comprehensive regulations pertaining to hyperbaric chambers, designation of HBOT as a Medical Act requiring physician prescription and supervision in all Canadian jurisdictions, and requirements for physician training and certification in hyperbaric medicine. New

research and clinical applications of HBOT must undergo ethical review and be published to guide future decisions.

Appendix 3: Applicable standards, regulations and reference materials

The following is a list of standards, regulations, documentation and manuals applicable to operations at a MHTF. Many of these are (or should be) used as reference material and for guidance to remain abreast of current trends, industry standards and developing applications in hyperbaric diving medicine and commercial diving operations.

Reference materials for Hyperbaric Facilities accreditation and operations:

1. Hyperbaric oxygen therapy indications (UHMS)
2. UHMS Guidelines for Hyperbaric Facilities Operations
3. Accreditation Manual (UHMS)
4. Risk Assessment Guide (François Burman) 5th edition
5. Canadian Forces Diving Manual by the Experimental Diving Unit of the Defence and Civil Institute of Environmental Medicine (DCIEM)
6. United States Navy Diving Manual (all revisions)
7. NOAA Diving Manual
8. CSA Z275.1-05 Hyperbaric Facilities
9. CSA Z275.4-04 Competency Standard for Diving Operations
10. CSA Z275.5-05 Occupational Diver Training
11. **CSA Z275.7-00 Compressed Breathing Air Systems**
12. CSA Z275.3-04 Occupational Safety Code for Construction Work in Compressed Air
13. CSA Z305.8-03 Medical gas supply
14. CSA Z7396.1-06 Medical gas pipeline systems
15. NFPA99 Health Care Facilities
16. Occupational Health and Safety Regulations (specific to each province or territory)
17. Canada Labour Code
18. PVHO 1 (2002) and PVHO 2 (2003) manual

Appendix 4: Recommendations for cleaning and prevention of cross-infection in Medical Hyperbaric Treatment Facilities

The prevention of cross-infection in the MHTF requires a comprehensive program that extends far beyond the cleaning of hyperbaric chambers. The components of such a program should include:

1. Documented adherence to infection control policies of the health care facility
2. Surveillance and testing for antibiotic resistant bacteria and by routinely sending patient swabs for culture and sensitivity tests
3. Hand hygiene requirements before and after hyperbaric treatments
 - a. Patients
 - b. Staff
4. Cleaning of washrooms and change rooms immediately after use by patients known to have antibiotic-resistant organisms and before these areas are used by other patients
5. Immediate cleaning and disinfection of obvious gross soiling of areas or equipment
6. Policies and procedures to help prevent gross contamination and soiling such as:
 - a. Appropriate management of ostomies, bladder catheters and patient drains
 - b. Avoid treatment of patients during episodes of nausea, vomiting or diarrhea when practical
 - c. Use of diapers, garments and drapes to reduce contamination of hyperbaric facilities
7. Adoption of policies requiring universal infectious precautions
8. Policies to eliminate or reduce physical contact between patients
9. Cleaning and disinfection of blood pressure cuffs and other equipment that comes into contact with patients
10. Appropriate treatment and cleaning of wounds
11. Periodic education of hyperbaric staff and patients about infection control
12. Safe disposal of potentially infectious materials and fluids
13. Appropriate use of gloves, gowns and other barriers to infection
14. Cleaning and disinfection of BIBS masks and head tents before reuse by another patient
15. Policies to ensure single-patient-use supplies such as oxygen masks are used only for one patient
16. Ensuring that any garments or bedding that is reused is stored and labeled separately for individual patients
17. Changing and laundering of linens and bedding
18. Segregation and isolation of patients
 - a. Where practical do not treat patients with resistant organisms in a multiplace chamber with other patients or ensure adequate separation between patients

19. Liaison with infectious disease specialists and participation in health facility infection prevention programs
20. Scheduling of patients with known infectious potential at the end of the day or before a planned complete cleaning and disinfection of the hyperbaric chambers
21. Monoplace chambers cleaning:
 - a. Must comply with the manufacturer's instructions
 - b. Use only approved cleaning agents (see below)
 - c. Surface disinfection of rails of stretchers between every case
 - d. Brief cleaning (< 5 minutes) after every patient
 - e. Comprehensive cleaning (30 minutes) at the end of each day and after all cases of resistant organisms or obvious contamination or soiling
22. Multiplace chambers
 - a. Cleaning procedures vary according to the design of the chamber such as:
 - i. Rounded chambers with removable floor board
 - ii. Rectangular chambers with flat non-removable floors
 - b. Disassembly or removal some of chamber components may be required for thorough cleaning and disinfection although this may also increase the risk of infections
 - c. Comprehensive cleaning and disinfection is required at least weekly, after treatment of contaminated patients and in the event of gross or obvious soiling or contamination
 - d. Use only approved cleaning agents (see below) and ensure removal of these or dissipation of any odors prior to pressurizing the chamber again

Approved cleaning agents

In selecting suitable cleaning and disinfecting agents, the following criteria should be considered:

1. Effectiveness against the expected spectrum of bacteria, viruses, fungi and other micro-organisms
2. Compatibility with chamber occupants (safe for human use)
3. Compatibility with chamber materials (non-corrosive & non-degrading)
4. Fire safety in terms of volatile compounds (no flammable vapors)
5. Residue to be harmless – non-toxic and non-flammable
6. Acceptable odor
7. Application requirements (ease of use)
8. Availability and price

The most common constituent of suitable hyperbaric cleaning and disinfecting agents is a quaternary ammonium compound, which is non-corrosive, suitable for use with plastics, acrylic materials, rubber and metals.

Multiplace chambers

It should be recommended by the manufacturer

It should not off gas while under pressure

It should not chemically react to any surface inside the chamber

Monoplace chambers

Sechrist

1. Quick Fill 920
2. Hi-Tor
3. Tor-HB
4. Stat-III TB
5. Beaucoup
6. Ascend
7. Matar
8. LpH-se

Perry Baromedical

1. Tor-HB
2. Coverage HB
3. Hibitaine
4. Ascend

Blanson Ltd

1. Trigene
2. Hi-Tor
3. Hibitaine
4. Expel

Appendix 5: Sample list of useful policies and procedures

Emergency and critical care policies and procedures

- 1) Patient / staff emergencies
- 2) Cardiac Arrest Abort Protocols (should have abort procedures for all treatment profiles that may be done)
- 3) 2.0/2.4 ATA Cardiac Arrest Abort Protocol
 - a. ATA Cardiac Arrest Abort Protocol (Intubated & Non-Intubated)
- 4) 3.0 ATA COP Cardiac Arrest Abort Protocol
 - a. ATA GG Cardiac Arrest Abort Protocol
- 5) Comex 30 Cardiac Arrest Abort Protocol
- 6) USN TT5 Cardiac Arrest Abort Protocol
- 7) USN TT6 Cardiac Arrest Abort Protocol
- 8) USN TT6A Cardiac Arrest Abort Protocol
- 9) DCS Table Progression Cardiac Arrest Protocol (USN TT6→Comex 30→USN TT6A)
- 10) Myringotomies for Emergency Patients
- 11) Seizures / oxygen toxicity
- 12) Cardiac arrest, arrhythmias, defibrillation
- 13) Respiratory arrest / airway obstruction
- 14) Respiratory distress / bronchospasm
- 15) Pneumothorax
- 16) Arterial gas embolism
- 17) Anaphylaxis and allergic reactions
- 18) Mechanical ventilation
- 19) Pulmonary oxygen toxicity
- 20) Hypoglycemia
- 21) Vomiting
- 22) Loss of consciousness
- 23) Severe claustrophobia
- 24) Aggressive / uncooperative conduct of persons within the **MHTF**

Technical / environmental emergency policies and procedures

- 1) Impending Natural Disaster or Mechanical Failure
- 2) Management of Fire or smoke in or in close proximity to the hyperbaric facility
- 3) Power failure
- 4) Equipment failures
- 5) Failure of / inadequate gas supplies

- 6) Hyperbaric chamber electrical failure
- 7) Environmental contamination
- 8) Contamination of chamber or chamber gases
- 9) Chamber malfunction or failure (including activation of the deluge system)
- 10) Errors in dive profiles
- 11) Detaching Scott Masks below 66 fsw (3.0 ATA)
- 12) Equipment Approval for Use In The Chamber
- 13) Housekeeping (Chamber)

Routine operational policies and procedures

General policies and procedures

- 1) Privacy and confidentiality
- 2) Confirmation of patient identity and treatment (“time out”)
- 3) Coordination of elective and emergency cases
- 4) Diversion Plan
- 5) Goals & Objectives
- 6) Visiting by Patients’ Relatives
- 7) Working Conditions in the Hyperbaric Unit

Patient care policies

- 1) Ear Squeeze Protocol
- 2) Other barotraumas (sinuses, lung, teeth, intestinal)
- 3) Early Termination of Treatments
- 4) Elective Patients Outside of Regular Hours
- 5) Dentures in the Chamber
- 6) Hearing Aids in the Chamber
- 7) Hyperbaric Identification Bracelets
- 8) MRSA/VRE Positive Patients in the HBU
- 9) Patient Information
- 10) Patients With Congestive Heart Failure
- 11) Patients With URI
- 12) Patients with diabetes
- 13) Continuous bladder irrigation
- 14) The first hyperbaric treatment for any particular patient
- 15) Assessment of patients prior to hyperbaric treatment
- 16) Administration of oral, nasal or injection medications
- 17) Control of intravenous fluid administration
- 18) Care of patients with arterial, central venous and pulmonary artery catheters

- 19) Patients who are intubated or who have a tracheostomy
- 20) Pediatric patients
- 21) Patients requiring mechanical ventilation
- 22) Critically ill patients
- 23) Administration of cardiac and respiratory medications
- 24) Clinical procedures

Physician policies

- 1) Medical Coverage of Critically Ill Patients
- 2) Availability of the on-call Hyperbaric Physician

Staff-related policies

- 1) Physician as the Only Circulating Tender
- 2) Pre/Post Dive Operator Requirements for start-up and shut-down of chamber
- 3) Presence of HBU MD in the Unit
- 4) Repetitive Dive
- 5) Reporting Structure of Management Committee
- 6) Return to Work after Emergency Treatments
- 7) Safety Stops on Non-Decompression Dives
- 8) Scott Mask Checks Pre-Dive
- 9) Staff Diving Accident or Incident
- 10) Staffing for Emergency Cases
- 11) Standby Diving RT/RN/MD
- 12) TCOM
- 13) Chamber Operator's Absence from Console
- 14) Chamber Operator/Back-Up Operators
- 15) Dress Code for Diving Personnel
- 16) Exercise After Working As An Inside Tender
- 17) Medical Evaluation of Inside Tenders
- 18) Operator Monitoring of Audible Alarms
- 19) Operator Staffing
- 20) Inside Tender Oxygen Requirements for TT5, 6, 6A, Comex 30 & DCS Progression
- 21) Travel to Elevation After Pressurization
- 22) Needle stick / exposure to potentially infectious fluids
- 23) Decompression illness
- 24) Occupational injury / disease

Appendix 6: Examples of Standardized HBOT schedules

Disclaimer statement

Monoplace protocols

Multiplace protocols

Appendix 7: Patient complexity and example guidelines for determining staff requirements

The information in this appendix has not been validated in any clinical study and is offered as an example for guidance only. The hyperbaric physician and team is responsible for determining the care of individual patients. This section is intended to guide consideration of staffing issues. The hyperbaric physician should consider whether emergency treatments outside routine hours necessitates a larger number or different qualifications of staff.

Patient complexity level	Description and examples
1	Stable self-ambulatory outpatient: <ul style="list-style-type: none"> Needs minimal or no assistance with procedures for HBOT Any medical conditions are well-controlled
2	Stable self-ambulatory outpatient that requires: <ul style="list-style-type: none"> Wheelchair or other device for mobility Oral or sublingual anxiolytics Assistance with chronic conditions that are generally well-controlled
3	Patient (in-patient or outpatient) that requires <ul style="list-style-type: none"> Additional professional assistance at the beginning, end and during HBOT, but not frequent or continuously Pacemaker or implanted defibrillator Airway device such as tracheostomy tube
4	Hospital in-patient that requires <ul style="list-style-type: none"> Level 1 or 2 MHTF Frequent, continuous or almost continuous attention of a health care professional Oral or intravenous fluids or medications during HBOT Continuous bladder irrigation during HBOT
5	Hospital ICU patient is profoundly unstable requiring any or all of the following: <ul style="list-style-type: none"> Level 1 (or Level 2) MHTF Continuous monitoring Continuous infusions of inotropic, vasoactive or other medications to maintain satisfactory blood pressure, cardiac rhythm, coronary perfusion Mechanical ventilation or repeated respiratory assistance, tracheal suctioning Intermittent or continuous intravenous sedative, anesthetic or analgesic medications

Staffing matrix for monoplace HBOT

Monoplace chamber(s)	Monoplace chamber(s)	Monoplace chamber(s)	Monoplace chamber(s)	Monoplace chamber(s)
Patient Characteristics	Stable	Intermediate	Complex	Critical
Patient complexity level	1 - 2	2 - 3	4	5
HBOT type	Elective	Elective / urgent / emergency	Elective / urgent / emergency	Emergency / urgent
Comments			Caution in treating 2 or more complex patients	Elective HBOT contraindicated
MHTF level	1 - 3	1 - 3	1 - 2	1 - 2
MHTF staff:				
Hyperbaric technologist Level 1 (Chamber operator)	1 operator for a maximum of 3 simultaneous chambers with staggered start / stop times	1 operator for a maximum of 3 simultaneous chambers with staggered start / stop times	1 operator for a maximum of 2 simultaneous chambers, if both patients complex	1 operator for each chamber and patient
Hyperbaric technologist Level 2 - 4				
Safety director	1 for the facility, need not be present unless acting as supervisor	1 for the facility, need not be present unless acting as supervisor	1 for the facility, need not be present unless acting as supervisor	1 for the facility, need not be present unless acting as supervisor
Patient Inside Attendant	N / A	N / A	N / A	N / A
Patient Outside Attendant	Not required	Not required	1 recommended	1 required 2 recommended for ventilated patients
HBOT physician	1	1	1	1
Total personnel including physician				

Staffing matrix for multiplace HBOT

Multiplace chamber	Multiplace chamber	Multiplace chamber	Multiplace chamber	Multiplace chamber
Patient Characteristics	Stable	Intermediate	Complex	Critical
Patient complexity level	1 - 2	2 - 3	4	5
HBOT type	Elective	Elective / urgent / emergency	Elective / urgent / emergency	Emergency / urgent
Comments			Caution in treating 4 or more complex patients simultaneously	Elective HBOT contraindicated
MHTF level	1 - 3	1 - 3	1 - 2	1 - 2
MHTF staff:				
Hyperbaric technologist Level 1 (Chamber operator)	1	1	1	1
Hyperbaric technologist Level 2 - 4	1 must be present, meeting CSA criteria			
Safety Director	1 for the facility, need not be present unless acting as supervisor	1 for the facility, need not be present unless acting as supervisor	1 for the facility, need not be present unless acting as supervisor	1 for the facility, need not be present unless acting as supervisor
Inside Patient Attendant	1 for a maximum of 8 stable patients			
Outside Patient Attendant	1 required, but may be the hyperbaric physician	1 required, but may be the hyperbaric physician	1 required	1 required, additional personnel recommended
HBOT physician	1 present, may act as outside attendant	1 present, may act as outside attendant	1 present	1 (consider additional physician if needed inside chamber but not mandatory)
Totals				

Appendix 8: Hyperbaric Technologists

The following table describes the concepts for recognition of hyperbaric technologists. Certification is not currently available in Canadian healthcare for levels 1b, 2, 3 or 4. The table represents the consensus of experts in hyperbaric technology regarding the categories that should apply. The text of the main Guidelines document explains the appropriate roles for these levels in MHTFs.

Level	Entry requirements	Role	Responsibilities, training, experience and competency requirements
1a	CHT prerequisites (health care background)	Mixed clinical and technical	<ul style="list-style-type: none"> CHT training course (www.nbdhmt.org) Basic monoplace or multiplace chamber operations Oversight generally required by a higher level technologist May be approved for limited independent operations providing advice available from a higher level technologist
1b	Diving Military Biomedical Other (non-healthcare background)	Technical	<ul style="list-style-type: none"> CHT training course, DCBC certification or equivalent Basic monoplace or multiplace chamber operations Oversight generally required by a higher level technologist May be approved for limited independent operations providing advice available from a higher level technologist
2	Level 1	Technical	<ul style="list-style-type: none"> Generally at least 5 years of experience of hyperbaric chamber operations, including at least 3 years in a clinical facility Advanced operation of monoplace and / or multiplace chambers and oversight of Level 1 personnel Knowledge of decompression tables Quality assurance and safety training
3	Level 2	Technical	<ul style="list-style-type: none"> Multiplace chamber expertise required, including maintenance Oversight and training of Level 1 and 2 personnel Widely recognized or consulted on technical aspects of hyperbaric chamber operations in clinical facilities Expert knowledge of decompression tables, chamber systems Extensive training, certification and experience in safety, supervision, quality assurance and administrative aspects of hyperbaric technologies in clinical facilities Expertise in hyperbaric standards for clinical facilities and able to advise hyperbaric physician on technical matters
4	Level 3 in a clinical facility or offshore saturation diving	Technical	<ul style="list-style-type: none"> Extensive experience and expertise of multiplace hyperbaric mixed gas saturation operations Advanced knowledge of saturation decompression procedures and hyperbaric life support technologies