



## Baromedical Nurses Association

The Baromedical Nurses Association (BNA) was established in June 1985 to provide registered nurses practicing in hyperbaric medicine a formal organization within which nurses can develop a network and provide professional support. This organization has grown and expanded outside the boundaries of the United States. Today, the BNA has members in Europe, Asia, South and Central America and the South Pacific. The BNA remains dedicated to offering educational opportunities, support of nursing research efforts, a presence on committees and boards of national organizations, to having a public voice in those issues which impact nursing, and to provide opportunities for networking and information exchange.

### Position Statement:

These hyperbaric oxygen (HBO) nursing guidelines represent best practice and evidence-based recommendations of the BNA on important issues relevant to the health, safety and well-being of patients receiving hyperbaric oxygen therapy (HBOT).

It is the intent of the BNA to provide these recommendations to guide nurses and facilities administering HBOT regarding minimum expectations related to Risk Factors, Psychosocial Factors, Pain Assessment and Management, Nutritional Factors, Safety and Education for every patient considering or receiving HBOT. Additional guidance is provided on specific conditions that may not apply to all individuals.

People are more likely to make the greatest gains when therapy and its related goals focus on activities that are meaningful to the patient and are believed to make a difference in their lives. While these guidelines are written as nursing diagnoses with interventions, each facility should partner with their patient to develop patient specific goals.

It is the position of the BNA that every facility providing HBOT has an HBO trained Registered Nurse to provide holistic, comprehensive care. This includes the responsibilities of assessment, development, and evaluation of the nursing plan of care, education, quality improvement and case management.

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## **Table of Contents**

### **Section One: MINIMUM EXPECTATIONS for EVERY facility providing HBOT**

I.	Risk Factors/Safety:	
	a. Risk of Injury related to fire.....	Page 3
	b. Risk of Injury (barotrauma) related to atmospheric pressure changes inside the HBO chamber.....	Page 4
	c. Risk of Injury related to oxygen toxicity secondary to administration of 100% oxygen at increased atmospheric pressure.....	Page 5
	d. Risk of Adverse Events related to hemodynamic changes secondary to HBOT.....	Page 6
	e. Risk of Vision Changes related to HBOT.....	Page 7
	f. Risk of Impaired Physical Mobility related to disease pathology and ambulation or offloading medical devices.....	Page 8
	g. Risk of Injury Within Hyperbaric Facility Related to transferring patient in/out of chamber.....	Page 9
	h. Risk of Ineffective Breathing Gas Delivery related to patient needs/limitations.....	Page 10
II.	Psychosocial Factors:	
	a. Knowledge Deficit related to HBOT and treatment procedures.....	Page 11
	b. Risk of Ineffective Individual Coping related to stresses of illness and/or poor psychosocial support system.....	Page 12
	c. Risk of Anxiety related to HBOT and their understanding of other medical procedures.....	Page 13
III.	Pain:	
	a. Risk of Pain related to HBOT and patients associated medical problem.....	Page 14
	b. Risk of Discomfort related to humidity changes.....	Page 15
IV.	Nutrition:	
	a. Risk of Imbalanced Nutrition less than body requirements related to intake of nutrients insufficient to meet metabolic needs.....	Page 16

### **SECTION TWO: Condition Specific Hyperbaric Nursing Diagnoses**

I.	Anxiety related to HBOT and treatment procedures.....	Page 17
II.	Risk of Ineffective Breathing Gas Delivery related to patient's critical care needs.....	Page 18
III.	Altered Tissue Perfusion related to carbon monoxide poisoning, decompression sickness, arterial gas embolism and other neurologic conditions.....	Pages 19-20
IV.	Imbalanced Nutrition Less Than Body Requirements related to intake of nutrients insufficient to meet metabolic needs.....	Page 21
V.	Risk of Unstable Blood Glucose level related to HBOT and disease pathology.....	Page 22
VI.	Risk of Impaired Communication related to language barriers, aphasia, hearing loss, visual loss, medical interventions i.e. surgical or radiation, and literacy.....	Page 23
VII.	Ineffective Tissue Perfusion related to disease pathology (diabetic foot wound, non-healing wound) or medical treatments (radiation therapy).....	Page 24

## SECTION ONE - I Risk Factors

a. Risk of injury related to fire

**Rationale:** HBO is intrinsically dangerous with significantly lower energy requirements to initiate and sustain combustion. Many inorganic and organic materials, including the patient's tissue, become easily combustible under hyperoxic conditions. They will similarly be significantly difficult to extinguish thus increasing the relative risk. Per National Fire Prevention Association (NFPA) guidelines, linen within the HBO chamber must be at least 50% cotton.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Staff will conduct and document a safety check/time out prior to each treatment to ensure fire safety precautions are met		x		
Grounding will be checked in all types of chambers according to NFPA and facility guidelines before operating the HBO chambers		x		
Materials not on the Approved/Go List will have an individual risk assessment completed by the Safety Director and Medical Director.		x		

SAFETY	EDUCATION
<ul style="list-style-type: none"> <li>▪ HBOT involves a fuel source (the patient, linen, equipment, dressing supplies, etc.) in an oxygen enriched environment in an HBO chamber</li> <li>▪ The fire triad is made up of fuel, oxygen, and an ignition source. To complete the fire triad in the HBO environment, an ignition or heat source is necessary. This can occur from a spark in the chamber</li> <li>▪ Follow fire prevention procedures per facility established policy and procedures for Class A and Class B chambers:                         <ul style="list-style-type: none"> <li>○ Oxygen levels shall be continuously monitored in Class A chambers in accordance with NFPA guidelines; ensuring chamber oxygen concentration does not exceed 23.5%</li> </ul> </li> <li>▪ Prohibited items are not allowed in the chamber. The Safety Director, in collaboration with the Medical Director, will determine the medical necessity of normally prohibited items, complete a risk analysis and institute additional safety measures as indicated</li> <li>▪ Facilities are encouraged to conduct fire drills monthly or at least quarterly.</li> <li>▪ A timed worst-case scenario fire drill shall be completed at least annually, to ensure preparedness in accordance with NFPA and industry standards</li> <li>▪ Splints and casts must be allowed to cure before going into an oxygen enriched atmosphere</li> </ul>	<ul style="list-style-type: none"> <li>▪ HBOT teaching and consent of the patient will include the risks of fire in the HBO environment</li> <li>▪ Provide the patient/family with written instructions that provides information concerning prohibited materials in the HBO environment to reduce the potential for fire</li> <li>▪ Education should be documented in patient's clinical record</li> </ul>

*Baromedical Nurses Association*  
*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

**b. Risk of Injury (barotrauma) related to changes in atmospheric pressure inside the HBO chamber**

**Rationale:** HBO conditions are known to be intrinsically dangerous in excess of 3 fsw or 1.5 psi. The variety of body tissues adversely affected by pressure changes (i.e., middle ear, sinuses, teeth, lungs, low viscosity fluid compartments) merit increased risk mitigation.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Assess patient's and inside attendant's knowledge of ear clearing techniques and ability to equalize pressure	X	X	X	
Assess tympanic membrane (TM) prior to first HBOT, after any suspected barotrauma and as needed. Describe and document observations including color and visibility of TM, presence of wax, blood/fluid/air, and any hearing deficits	X	X		X
Assess for nonverbal signs that the patient may be unable to equalize pressure including pulling on ear or applying pressure to tragus			X	X
Assess for signs and symptoms (s/s) of sinus or tooth squeeze on compression and decompression		X	X	X
Assess for adverse blood pressure elevation due to concomitant use of sympathomimetic medications and HBOT.		X		
Assess for s/s of sinus or tooth squeeze on compression and decompression				
Assess for symptoms of gastrointestinal (GI) barotrauma i.e., feeling of pain, discomfort, fullness or bloating in the abdomen			X	X
Assess patients for a greater risk for development of pneumothorax e.g., recent invasive procedure of the chest, history of pulmonary blebs, history of spontaneous pneumothorax, chronic obstructive pulmonary disease (COPD)	X	X		
Assess for sudden cardiopulmonary decompensation during decompression as this may indicate a tension pneumothorax				X
Assess for symptoms of tension pneumothorax i.e., sudden, sharp chest pain; difficulty breathing, rapid breathing, shortness of breath, rapid heart rate, cough, tracheal shift, abnormal chest movements on the affected side, cyanosis			X	X

SAFETY	EDUCATION
<ul style="list-style-type: none"> <li>▪ Ensure supplies for emergent needle decompression are available and ready</li> <li>▪ Do NOT decompress chamber until preparations are made for emergency management of pneumothorax and authorized by attending physician OR</li> <li>▪ Until chest needle decompression is performed in a multi-place chamber</li> <li>▪ Follow facility emergency procedures</li> </ul>	Provide education on: <ul style="list-style-type: none"> <li>▪ Potential for barotrauma: otic, sinus or tooth, gastrointestinal, pulmonary</li> <li>▪ Methods to equalize pressure in middle ear during treatment: yawning, swallowing, jaw thrust, head tilt, Valsalva, Toynbee, Roydhouse maneuver, Frenzel etc.</li> <li>▪ Notify chamber operator immediately when pressure or fullness is felt in the middle ear</li> <li>▪ Notify chamber operator immediately if develop sudden, sharp chest pain, difficulty or rapid breathing, or shortness of breath</li> <li>▪ Educates patient to rub affected area for tooth squeeze</li> </ul>

*Baromedical Nurses Association*  
*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

c. Risk of Injury related to oxygen toxicity secondary to 100% oxygen at increased atmospheric pressure

**Rationale:** Elemental oxygen, given as a drug, is subject to under-dosing or overdosing similar to administration of other elemental drugs (i.e., calcium, potassium, magnesium, sodium). As with any medication, individualization of dose to response and tolerance is required as affected by endogenous patient response to Henry's and Fick's gas laws. Hyperoxia is a known risk to central nervous system (CNS) and pulmonary tissue meriting increased surveillance of toxicity.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Assess patient prior to HBOT for increased risk factors such as: <ul style="list-style-type: none"> <li>▪ Elevated core temperature</li> <li>▪ Neurologic: history of seizures, history of brain injury/surgery</li> <li>▪ Acute carbon monoxide (CO) poisoning</li> <li>▪ Use of medications that may lower the seizure threshold</li> <li>▪ Metabolic changes: metabolic acidosis, dehydration, hypoglycemia</li> <li>▪ History of inhaled cannabis</li> </ul>	x	x		
Assess patient for and document s/s of CNS oxygen toxicity including V-E-N-T-I-D-C-C or V-E-N-T-I-D-S-H-H <ul style="list-style-type: none"> <li>▪ <u>V</u>isual changes (acute): tunnel or blurred</li> <li>▪ <u>E</u>ars: auditory hallucinations, ringing or roaring in the ears</li> <li>▪ <u>N</u>ausea, numbness</li> <li>▪ <u>I</u>witching of muscles (usually facial), tingling of extremities</li> <li>▪ <u>I</u>rritability: Restlessness or personality changes</li> <li>▪ Neurological changes: <u>D</u>izziness or vertigo, <u>C</u>onvulsions/seizure activity, <u>C</u>hange in affect</li> <li>▪ Respiratory changes: <u>S</u>hortness of breath, <u>H</u>iccups</li> <li>▪ <u>H</u>ear rate increased</li> </ul>			x	
Assess for and document symptoms of oxygen toxicity during HBOT <ul style="list-style-type: none"> <li>▪ Respiratory changes: dry, hacking cough, air hunger/shortness of breath (SOB), difficulty inhaling a full breath, dyspnea on exertion</li> <li>▪ Substernal irritation or burning</li> <li>▪ History of high FiO<sub>2</sub></li> <li>▪ Tightness in the chest/substernal burning</li> </ul>			x	

SAFETY	EDUCATION
<ul style="list-style-type: none"> <li>▪ If any symptoms occur including seizure, follow the facility emergency guidelines</li> <li>▪ Remove built in breathing system (BIBS) mask/hood</li> <li>▪ Instruct patient to apply air break mask</li> <li>▪ Follow seizure procedure                             <ul style="list-style-type: none"> <li>○ <u>Class B – Monoplace Chamber</u>: Do NOT decompress patient during seizure, wait for spontaneous respirations to return and then decompress</li> <li>○ <u>Class A – Multiplace Chamber</u>: Collaborate with the practitioner to use established guidelines e.g., the U.S. Navy, for treating CNS oxygen toxicity or follow provider orders</li> </ul> </li> <li>▪ Notify physician if s/s of pulmonary oxygen toxicity appear</li> <li>▪ Add humidity to oxygen as needed to reduce chest discomfort</li> </ul>	<ul style="list-style-type: none"> <li>▪ Educate patient and/or family about risks of oxygen toxicity</li> <li>▪ Educate patient and/or family on the s/s of CNS oxygen toxicity</li> <li>▪ Educate the patient on the importance of notifying the chamber operator if they feel different or funny in the chamber</li> <li>▪ Educate regarding increased risk of pneumothorax and ground glass opacity with inhaled cannabis</li> <li>▪ Educate patient and/or family on the risks and side effects of pulmonary oxygen toxicity</li> </ul>

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*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

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d. Risk of Adverse Events related to hemodynamic changes secondary to HBOT

**Rationale:** A combination of hyperbaric and hyperoxic conditions affect pulmonary stress and systemic vascular resistance. In the presence of congestive heart failure (CHF), these can cause CHF exacerbation and/or fulminant pulmonary edema.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Medical history assessments to include history of CHF and exacerbations: <ul style="list-style-type: none"> <li>▪ HBO practitioner will evaluate individual risk, weigh the risk against potential benefits of HBOT and re-assess throughout treatment</li> </ul>	x			
Assess/Assess for: <ul style="list-style-type: none"> <li>▪ Dry cough that begins during treatment</li> <li>▪ Jugular vein distention</li> <li>▪ Adventitious heart sounds</li> <li>▪ S/S of fluid accumulation in the lungs and lower extremities</li> <li>▪ Fluid and electrolyte balance per provider order</li> <li>▪ Vital signs as indicated</li> <li>▪ Daily weights as indicated</li> </ul>	x	x	x	x
Assess patient according to facility heart failure guidelines	x	x		x
Cardiopulmonary assessment	x	x		x
Keep suction equipment nearby and ready to use		x	x	x

SAFETY	EDUCATION
<ul style="list-style-type: none"> <li>▪ Whelan and Kindwall (2017) states "baseline left ventricular ejection fraction (EF) is not a predictor of CHF outcomes. The EF percentage ought not to be used as a criterion for inclusion or exclusion from HBO."</li> </ul>	<ul style="list-style-type: none"> <li>▪ Educate on s/s to report</li> </ul>

*Baromedical Nurses Association*  
*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

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e. Risk of Vision Changes related to HBOT

**Rationale:** Patients should receive a pre-treatment visual acuity prior to starting HBOT. Patients (especially with a history of myopia or presbyopia) may experience transient vision acuity changes during HBOT with pre-treatment levels returning within 6-10 weeks after treatments have been completed.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Assess vision pretreatment using a standard vision measurement tool, e.g., the Snellen or Jaeger (handheld) eye charts. If the patient wears glasses or contacts, make sure they are wearing them during testing. Note: Patients may state increased reading ability and that glasses are no longer needed.	x	Assess for visual changes throughout course of treatments. Any ocular symptoms should be promptly evaluated, repeat visual acuity, documented, and referred for further evaluation when indicated.		
Assess for pre-existing acute angle glaucoma, cataracts or optic neuritis as more frequent visual assessments may be necessary Note: Patients with diabetes, history of head/neck radiation or systemic steroids are at increased risk for developing cataracts.	x			

SAFETY	EDUCATION
<ul style="list-style-type: none"> <li>▪ If vision declines to threshold for state Department of Motor Vehicle (DMV) guidelines, consider referral for optometrist and arrange for alternative transportation</li> <li>▪ Ophthalmic risks include glaucoma or ocular surgery</li> <li>▪ High risk patients (history of optic neuritis, progressive cataracts, diabetic retinopathy) should undergo a fundoscopic exam and an ophthalmology consult.</li> <li>▪ NOTE: Visual changes can be easily dismissed if the patient complains of decreased vision. If reading ability is compromised, hold HBOT and obtain ophthalmologic evaluation.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Educate patient to:               <ul style="list-style-type: none"> <li>○ Wait 6-10 weeks post HBOT to obtain new prescription for corrective lenses and</li> <li>○ Communicate to provider that they have recently received HBOT</li> </ul> </li> <li>▪ Discuss the risk of transient myopia, presbyopia and existing lenticular cataracts</li> </ul>

*Baromedical Nurses Association*  
*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

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f. Risk for Impaired Physical Mobility related to disease pathology and medical ambulation of offloading devices

**Rationale:** Patients may have impaired mobility due to disease pathology, decreased muscle strength, energy level and range of motion. Patient safety and effective use of offloading devices should be routinely evaluated for potential complications (increased injury, balance, decreased mobility) from the use of these devices. Patient requirements for needing assistance by one or more people to ambulate safely should be an ongoing evaluation.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Assess physical mobility and the use of assistive devices	x	x		x
Observe for statements indicating non-compliance and/or unsafe use at home	x	x	x	x
Consider referral to community resources as indicated	x			x
Consider referral to occupational therapy/physical therapy as indicated	x	x	x	x

<b>SAFETY</b>	<b>EDUCATION</b>
<ul style="list-style-type: none"> <li>▪ All removable devices will be removed prior to HBOT treatments per chamber safety policy</li> <li>▪ Consider "Even Up" or similar product to raise contralateral limb</li> <li>▪ Assess competence of patient or caregiver with facilitating activities of daily living (ADLs) or instrumental activities of daily living (IADLs)</li> <li>▪ Prosthetics, diabetic shoes, orthotic boots and total contact cast all impact range of motion and ability for population that may already have balance and gait issues</li> <li>▪ If a new device, there may not be sufficient accommodation at home, in their car, or with their employment to maintain baseline ADLs</li> <li>▪ Advise ordering physician of ineffective treatment, if indicated</li> </ul>	<ul style="list-style-type: none"> <li>▪ Provide education/re-education regarding safe use of assistive devices</li> </ul>



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*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

**g. Risk for Injury Within HBO Facility related to transferring patient in/out of chamber**

**Rationale:** The HBO chamber and equipment are inspected/monitored/secured (including monitoring equipment, drainage tubes/bags) per facility policy to decrease the potential for injury for the patient transferring into/out of the chamber. Patient assessment for fall risk/prevention is ongoing as well as assessing the need for increased personnel and equipment for patient transfers in/out of chamber.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Assess for risk of falls or impaired mobility	x	x		x
Assess for increased need of equipment and/or personnel to transfer patient into and out of the chamber		x		X
If utilizing lift equipment, comply with facility policy		x		x

SAFETY	EDUCATION
<ul style="list-style-type: none"> <li>▪ Comply with facility fall risk/prevention policy</li> <li>▪ Assess patient's potential risks for falls</li> <li>▪ Discuss safety measures and apply precautions as appropriate</li> <li>▪ Provide patient assistance with transfers according to patient needs and facility policy:                             <ul style="list-style-type: none"> <li>○ 1-2 person assist, as necessary</li> <li>○ Use of gait belt, as necessary</li> <li>○ Use of footstool and/or lower stretcher to load patient</li> <li>○ Use of slide board, or other transfer equipment as necessary, ensuring all equipment is removed prior to HBOT</li> <li>○ Use of side rails on stretcher as appropriate</li> <li>○ Use facility approved mechanical lift equipment and transfer devices when indicated, assuring all materials used is removed prior to HBOT</li> </ul> </li> <li>▪ Follow Safety Time Out/Pause (STOP) procedure prior to beginning any HBOT</li> <li>▪ Equipment located in the HBO room should only include items necessary to provide patient care and stored appropriately</li> <li>▪ All patient care equipment in the facility should be always in good working order and inspected per facility policy</li> <li>▪ It is the responsibility of all staff operating HBO equipment to be knowledgeable of any potential hazards</li> </ul>	<ul style="list-style-type: none"> <li>▪ Communicate plan with patient and staff involved prior to taking action.</li> <li>▪ Provide patient education regarding safety precautions</li> </ul>

*Baromedical Nurses Association*  
*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

**h. Risk for Ineffective Breathing Gas Delivery related to patient needs/limitations**

**Rationale:** Patients should have a lung assessment including history (asthma, COPD, fibrosis, spontaneous pneumothorax, chest trauma), conditions, needs and limitations per facility policy prior to starting HBOT to determine the best suited gas delivery system. S/S of inadequate oxygen delivery should be continuously monitored during HBOT to be recognized and reported promptly.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Assess the patient's condition, needs and limitations for the best suited gas delivery system	x	x	x	
Monitor the patient's response to the oxygen delivery system, including their ability to tolerate chosen system			x	
Assist the HBO technician with the delivery system, as appropriate		x	x	
MULTIPLACE CHAMBER: Oxygen Treatment Hood <ul style="list-style-type: none"> <li>▪ Assist patient with application and removal of neck seal and hood</li> <li>▪ Ensure the oxygen flow is sufficient to ventilate the treatment hood and maximize FiO<sub>2</sub></li> <li>▪ After assembly, check for leaks</li> <li>▪ Observe patients for signs of inadequate treatment hood ventilation such as CO<sub>2</sub> buildup, fogging, restlessness, anxiety and overt symptoms of oxygen toxicity</li> </ul>	x	x	x	
MONOPLACE CHAMBER: face mask / mouthpiece <ul style="list-style-type: none"> <li>▪ Coaching patient with mask application and removal, and reposition mask/mouthpiece as needed</li> <li>▪ Check for leaks, continuity of seal against patient's face, keep tight fit around mouthpiece</li> <li>▪ If using a Built-In-Breathing System (BIBS) mask, ensure that the straps are adjusted for patient comfort and a tight seal</li> </ul>	x	x	x	

SAFETY	EDUCATION
<ul style="list-style-type: none"> <li>▪ Ensure air break tubing is not pinched in the monoplace chamber door</li> </ul>	<ul style="list-style-type: none"> <li>▪ Educate patient on use of gas delivery system</li> </ul>

## SECTION ONE – II: Psychosocial Factors

a. Knowledge Deficit related to HBOT and treatment procedures

**Rationale:** Thorough orientation of the patient and family to HBO treatments may reduce anxiety, increase compliance, and reinforce the importance of safety. Reinforcement of education is needed with every treatment as the patient could be overwhelmed with information on the first treatment. Always continue re-educating on every treatment with return demonstration of understanding.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Assess and document patient and/or family's understanding of purpose and goals of HBOT, procedures involved and potential hazards of HBOT.	x	x	x	
Identify and address barriers to learning: <ul style="list-style-type: none"> <li>• Involve interpreter, if indicated</li> <li>• Apply age-specific teaching</li> <li>• Consider cultural/religious factors</li> <li>• Readiness to learn</li> <li>• Patient's expectations of treatment</li> </ul>	x	x		
Assess and document patient/family teaching and their understanding of instructions and any return demonstration	x	x		x

SAFETY	EDUCATION
	<ul style="list-style-type: none"> <li>▪ Educate on:                             <ul style="list-style-type: none"> <li>▪ Disease process for which referred to HBOT in language and manner which patient learns best</li> <li>▪ Purpose and goals of HBOT</li> <li>▪ Procedures involved</li> <li>▪ Potential hazards of HBOT</li> <li>▪ Sequence of treatment procedures and what to expect e.g., pressure, temperature, noises, and wound care</li> <li>▪ The HBO environment including:                                     <ul style="list-style-type: none"> <li>▪ chamber orientation</li> <li>▪ middle ear pressure equalization</li> <li>▪ fire hazards</li> <li>▪ safety policy and procedures</li> <li>▪ risk and benefits of HBOT</li> <li>▪ provide patient and/or family with written education on HBOT</li> <li>▪ provide written discharge instructions per facility guidelines</li> </ul> </li> </ul> </li> </ul>

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*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

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b. Risk for Ineffective Individual Coping related to stresses of illness and/or poor psychosocial support system

**Rationale:** It is important to recognize not only the medical status but also the psychosocial status of the patient to understand unspoken gestures of communication and recognize triggers that may create an unsafe environment for you and your clinic. Be prepared for the unknown as the current literature supports HBOT may subject patients to repressed painful or uncomfortable thoughts and memories causing them to react during the 15-20<sup>th</sup> treatment.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Assist patient/family to identify coping skills, available support systems, cultural and spiritual values	x	x	x	x
Assess for and offer other support services as needed and as available in the facility	x	x		x
Provide emotional support, including active listening and acknowledgement of concerns	x	x	x	x
Assess for depression and suicidal/homicidal ideation	x	x	x	x
Assess for post-traumatic stress disorder (PTSD) history	x	x	x	x
Reassess treatment outcome goals	Per patient request, and/or per facility guidelines			

SAFETY	EDUCATION
<ul style="list-style-type: none"> <li>▪ Risk assessment of environment should be completed/reviewed at least annually and a plan to mitigate risks established.</li> <li>▪ Depression screening should be completed on all patients receiving HBOT upon initial consult and as needed or per facility guidelines.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Educate on potential for PTSD, repressed memories etc. to resurface at approximately 15-20 treatments, but generally improves in approximately 5 treatments.</li> </ul>

*Baromedical Nurses Association*  
*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

c. Risk of Anxiety related to HBOT and their understanding of other medical procedures

**Rationale:** On the first visit/impression, patients view the chamber as a confined area. It is important to discuss this prior to even walking into the treatment room to alleviate their fears and reduce the amount of anxiety of the unknown. Prepare the patient for a 2-hour treatment and be aware that treatment cannot stop quickly. The better prepared the patient is, the lower the anxiety level. Never leave a patient unattended. Watch for signs of anxiety in body language and words and let the patient know you are there watching them for their safety.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Assess patient for history of confinement anxiety or claustrophobia	x			
Monitor for s/s of anxiety before and during HBOT: <ul style="list-style-type: none"> <li>▪ Patient verbal admission of anxiety</li> <li>▪ Clenching fists</li> <li>▪ Flushed face</li> <li>▪ Complaint of nausea or diarrhea</li> <li>▪ Sudden complaint of pain or discomfort</li> <li>▪ Feelings of being smothered or suffocated</li> <li>▪ Urgency to empty bladder</li> <li>▪ Defensive attitude</li> <li>▪ Hyperventilation</li> <li>▪ Profuse diaphoresis</li> <li>▪ Flat affect</li> <li>▪ Tachycardia/reports of heart palpitations (Note: this may also be a sign of oxygen toxicity)</li> <li>▪ Restlessness</li> <li>▪ Sudden complaint of feeling warm/hot during treatment</li> </ul>	x	x	x	x
Encourage use of restroom prior to HBOT. For males, send urinal for use during HBOT		x	x	
Allow for adequate preparation time		x		

SAFETY	EDUCATION
<ul style="list-style-type: none"> <li>▪ Rings, jewelry (remove)</li> <li>▪ Ligature risk assessment – remove items as able/plan</li> <li>▪ De-escalation strategies</li> <li>▪ Communicate in language patient uses</li> </ul>	<ul style="list-style-type: none"> <li>▪ Educate patient on what expect from the treatment</li> <li>▪ Confinement anxiety vs claustrophobia</li> <li>▪ Procedures</li> <li>▪ How to communicate with staff</li> <li>▪ How long it will take to get patient out of chamber</li> <li>▪ Right to refuse care</li> </ul>

## SECTION ONE – III: Pain

a. Risk of Pain related to HBOT and patient's associated medical conditions.

**Rationale:** National regulators recommend documented pain assessments must be completed to ensure the patients tolerable level of pain is met comfortable prior, during and post HBO Treatment. It is important to know which type of pain relief items the patient uses as some of the medications can cause drowsiness and reduce communication during the treatment. It is strongly advised to review current literature and perform a risk assessment on topical medicated patches to determine if there is an increased fire risk or alterations in absorption rate. Pain assessment is required post any intervention per facility guidelines.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Assess pain level and document according to facility guidelines	x	x	x	x
Address patient's needs related to pain	x	x	x	
Assess patient's experience of pain and whether pain is increased during HBOT			x	x
Provide non-pharmacological pain interventions: <ul style="list-style-type: none"> <li>▪ Relaxation techniques</li> <li>▪ Distraction</li> <li>▪ Repositioning / Positioning</li> <li>▪ Family present at chamber side as appropriate</li> </ul>		x	x	
Assess for need and administer pharmacological pain medication as ordered		x	x	x
Assess and document effectiveness of pain reducing interventions		x	x	x

SAFETY	EDUCATION
<ul style="list-style-type: none"> <li>▪ Avoid intramuscular (IM) medications immediately prior to treatment due to vasoconstriction affect from HBOT</li> <li>▪ Assess for topical patches. Safety Director and Medical Director to perform risk assessment and review facility policy to determine if needs to be removed for HBOT. (Add to Go/No Go list as appropriate)</li> <li>▪ Over-sedation</li> <li>▪ Avoid overuse of linens/pillows etc.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Educate on non-pharmacological pain reducing interventions</li> <li>▪ Pharmacological pain reducing interventions</li> </ul>

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*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

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b. Risk of Discomfort related to humidity changes within the HBO chamber

**Rationale:** Pressure changes during movement in the HBO environment cause a change in both temperature and humidity/condensation. Pressurization causes the chamber temperature to rise due to compression of the air particles and when the chamber decompresses, the temperature decreases causing the air to be cooler and condensation to develop.  $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$  (Ideal Gas Law)

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Assess patient's comfort with temperature changes	x	x	x	x
Offer patient comfort measures, such as blankets, increasing ventilation in the chamber or use of environmental control system (MULTIPLACE)		x	x	

SAFETY	EDUCATION
<ul style="list-style-type: none"> <li>▪ Monitor room temperatures within the HBO suite according to NFPA 99 guidelines</li> <li>▪ Avoid overuse of linens as this could add to a fire risk</li> </ul>	<ul style="list-style-type: none"> <li>▪ Educate on temperature changes anticipated during HBOT</li> </ul>

## SECTION ONE – IV: Nutrition

- a. Risk for Imbalanced Nutrition Less Than Body Requirements related to intake of nutrients insufficient to meet metabolic needs.

**Rationale:** Individuals may be at risk for or develop imbalanced nutrition for a variety of reasons. Many times, for those receiving HBOT, it is a result of side effects from surgical and oncological treatments. Additional reasons may be from psychosocial or other physical factors. Facilities providing HBOT should assess and monitor nutritional status of individuals as it can greatly affect their clinical outcome.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Assess baseline nutrition status before initiating adjunctive HBOT	x			
Monitor/reassess nutrition status throughout the course of HBOT		x		x
Provide nutritional supplementation as ordered		x	x	
Monitor/reassess weight and nutrition status per facility guidelines	x	x		
Attempt to identify the factors contributing to impaired nutrition: clinical/medical, psychosocial, social, financial, etc.	x	x		x
Collaborate with appropriate interdisciplinary team to develop a plan to alleviate the contributing factors.	x			x

SAFETY	EDUCATION
	<ul style="list-style-type: none"> <li>▪ Educate patient/family related to nutritional needs and dietary preferences</li> </ul>



## SECTION TWO: Condition Specific Hyperbaric Nursing Diagnoses

### I. Anxiety related to HBOT and treatment procedures

**Rationale:** Anxiety related to HBOT can occur for a variety of reasons, confinement anxiety is common, but is generally manageable with education and a plan developed prior to initiating HBOT. Individuals may also have anxiety that is noted while the patient is receiving HBOT that is unrelated to HBOT but can affect their ability to comply with treatments.

These interventions are in addition to SECTION ONE – Psychosocial Risk of Anxiety

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Assess and monitor for s/s of anxiety.	x	x	x	x
<ul style="list-style-type: none"> <li>▪ Follow the recommended interactions to reduce anxiety during HBOT:                             <ul style="list-style-type: none"> <li>○ Stay in patient's visual field</li> <li>○ Address patient calmly</li> <li>○ Establish eye contact</li> <li>○ Reassure patient that he/she is safe</li> <li>○ Encourage relaxation techniques and offer diversional activities: TV, music, books on tape, family member at chamber side (as appropriate per HIPAA standards)</li> <li>○ Assure patient of HBO trained nurse presence throughout treatment</li> </ul> </li> </ul>	x	x	x	x
Notify provider of patient's response to anti-anxiety measures and ability to tolerate confinement	x	x	x	x
Assess need for, administer, and document anti-anxiety medications per provider order	x	x	x	x

SAFETY	EDUCATION
<ul style="list-style-type: none"> <li>▪ Provide a safe and calm environment for individuals that may be anxious</li> </ul>	<ul style="list-style-type: none"> <li>▪ Comprehensive informational visit explaining the purpose, risk factors, expected outcome, and procedure for HBOT allowing for time to ask and answer questions prior to initiating HBOT.</li> <li>▪ Educating individuals on their rights and responsibilities as a patient, including the right to refuse treatment.</li> <li>▪ Educate on the necessary length of time to safely bring someone out of the HBO chamber – PRIOR to HBO treatment, so they are aware that staff cannot open the door immediately.</li> </ul>

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*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

II. Potential for Ineffective Breathing Gas Delivery related to patient's critical care needs (Ventilator)

**Rationale:** Individuals that have critical care needs e.g., ventilator, while receiving HBOT have additional needs and are at increased risk for ineffective breathing and gas delivery concerns. It is imperative that those facilities providing emergent/critical care HBOT have appropriately trained critical care and HBO trained nursing staff.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Partner with Respiratory Therapy department per facility guidelines		x	x	x
Monitor and document patient's tidal volume per Wright's spirometer, respiratory rate and breath sounds prior to chamber pressurization, during and after chamber pressurization and then every 10-15 minutes, or as ordered		x	x	x
Monitor patient for respiratory distress and notify HBO provider if noted		x	x	x
Manually ventilate the patient with bag valve device, if necessary, during pressurization and depressurization of the chamber and as needed during treatment in a Class A chamber (Multiplace)			x	
Monitor TcPO <sub>2</sub> levels per transcutaneous monitor in monoplace chamber per facility protocol			x	
Check ET tube placement, placing NS in cuff pretreatment and replacing NS with air post treatment		x		x
Provide patient with adequate sedation/analgesia as the ventilators utilized for individuals in monoplace chambers are more restrictive than standard ventilators		x	x	x
Cover Velcro™ securing ET tube with tape, if applicable		x		
Replace restraints with cotton kerlix, or per facility protocol. Return to standard restraints at the end of each HBOT		x		x
Ensure vent tubing is not kinked or within patient reach while closing the chamber door		x		

SAFETY	PATIENT/FAMILY EDUCATION
<ul style="list-style-type: none"> <li>▪ Inflate the endotracheal tube (ET) or tracheostomy cuff with normal saline (NS) or sterile water prior to pressurization and replace the saline or sterile water with air after treatment, or per facility guidelines</li> <li>▪ Keep suction equipment nearby and ready to use</li> <li>▪ All HBO staff and RT staff that will utilize the HBO ventilator will receive training on the use of the HBO ventilator</li> <li>▪ Ensure immediate access to an advanced cardiac cart/crash cart and staff appropriately trained on advanced cardiac life support.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Educate family on the potential need to increase analgesia/sedation during HBOT.</li> </ul>

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*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

III. Altered Tissue Perfusion related to carbon monoxide poisoning, decompression sickness, gas embolism and other neurological conditions

**Rationale:** Carbon monoxide (CO) is a colorless, odorless and tasteless gas that is produced when something is burned. CO poisoning occurs when the gas is inhaled or transdermal chemical absorption. Decompression sickness (DCS) a.k.a. "the bends" is a condition in which nitrogen dissolved in the blood and tissues by high pressure forms bubbles as pressure decreases. Cerebral arterial gas embolism (AGE) occurs when gas bubbles block the flow or damage the lining of blood vessels that supply blood to the brain. Individuals suffering from CO poisoning, DCS, or AGE require immediate medical attention.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Perform standard psychometric assessment, such as: Halstead-Reitan Neuropsychological Test Battery (HRNTB) – this includes the Trail Making Test, Wechsler Adult Intelligent Scale (WAIS) – this includes the Block Design Test or other established facility screening tool to assess psychometric cognition prior to and after HBOT.	x	x		x
Assess and document patient's motor and sensory functioning as ordered	x	x		x
Monitor for signs of poor end organ perfusion per physician order i.e., laboratory values, e.g., liver and kidney function, shock, respiratory failure/adult respiratory distress syndrome (ARDS)	x	x		x
Collaborate with the provider to perform baseline neurological assessment prior to treatment	x	x		x
Perform neurological checks per established protocol and provider order	x	x		x
Provide reorientation and emotional support as needed	x	x		x
Notify provider of changes in patient status			x	x
Monitor for cardiac dysrhythmias	x	x	x	x
Consider need for myringotomies for patients that may not be able to follow directions for clearing their ears.		x		

SAFETY	EDUCATION
<ul style="list-style-type: none"> <li>▪ Hemolytic anemia patients (i.e., sickle cell) and smokers may run a 10% or greater carboxyhemoglobin levels as their normal baseline</li> <li>▪ Pulse oximetry cannot be used to establish adequate oxygenation in CO victims</li> <li>▪ Fetal carboxyhemoglobin levels rise more slowly than maternal levels but usually peak higher due to the delayed off-gassing</li> <li>▪ If possible, determine the source of the CO and provide resources to assist with the mitigation of the poisoning</li> </ul> <p>DCS</p> <ul style="list-style-type: none"> <li>• Arises from the formation of gas bubbles in tissue or blood in volumes sufficient to interfere with function of an organ or to cause alteration in sensation</li> <li>• Type I – musculoskeletal pain</li> <li>• Type II – aching pain in a limb after diving               <ul style="list-style-type: none"> <li>o Can occur alone or in combination with musculoskeletal pain</li> <li>o Primary targets</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ Provide written post HBOT instructions including s/s to watch for, and report, follow up and resources (for all of these conditions)</li> <li>▪ Educate patient/family on potential for delayed neurologic sequelae following carbon monoxide poisoning</li> <li>▪ Educate patient/family on potential s/s of delayed sequelae including headache, irritability, personality changes, loss of memory cognitive changes, psychomotor changes, and parkinsonian appearance</li> <li>▪ Educate patient/family to not return to the source of the poisoning until the source has been mitigated</li> <li>▪ Instruct patient to rest, avoid caffeine and alcohol, encourage fluids and adequate diet, avoid strenuous activity, and avoid hot bath or shower for 24 hours after completion of HBOT</li> <li>▪ Contact the HBO department or Diver's Alert Network (DAN) if any symptoms return</li> <li>▪ Avoid altitude exposure for 72 hours or underwater diving per physician recommendations</li> <li>▪ Reinforce the importance of follow-up after discharge</li> </ul>

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*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

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<ul style="list-style-type: none"><li>▪ Pulmonary</li><li>▪ Vestibular</li><li>▪ Nervous systems</li></ul> <p>Cerebral AGE</p> <ul style="list-style-type: none"><li>• The possibility of AGE during decompression is high if the patient has suspected<ul style="list-style-type: none"><li>o Pneumothorax</li><li>o Subcutaneous emphysema</li><li>o Arterial gas</li></ul></li></ul>	
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*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

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IV. Imbalanced Nutrition Less Than Body Requirements related to intake of nutrients insufficient to meet metabolic needs

**Rationale:** Many of the patients that receive HBOT are at risk for imbalanced nutrition, and they should be assessed for and monitored throughout the course of therapy. For those individuals that have an actual imbalance of nutrition, collaboration with the HBO team, nutritional support and the patient's primary care team should recommend a comprehensive nutrition plan to assist patient with healing. Imbalanced nutrition will slow down or prevent wound healing.

These interventions are in addition to those in SECTION ONE - Nutrition

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Advise coordinating HBO physician of nutritional status	x	x		x
Coordinate nutritional supplementation with primary care physician and/or service referring to HBO	x	x		x
Consider referral to nutritional and/or diabetes educator for further education and assistance with developing a nutritional plan	x	x		x
Notify provider of ineffective treatment plan		x		x
<b>SAFETY</b>		<b>EDUCATION</b>		
		<ul style="list-style-type: none"> <li>▪ Educate patient/family related to nutritional needs and dietary preferences</li> </ul>		

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*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

V. Potential for Unstable Blood Glucose Level related to HBOT and disease pathology

**Rationale:** It is a known risk factor that HBOT can create unstable blood glucose levels, specifically hypoglycemia, which can be life threatening. Additionally, poorly controlled blood glucose (>180mg/dL) will affect the ability for wounds to heal and may predispose a patient for seizures. It is imperative that individuals with diabetes are closely monitored before, during and after treatments. Each facility should have a designated policy/protocol on the management of diabetic patients receiving HBOT.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Assess patient's knowledge level related to diabetes	x	x		x
Assess recent hypoglycemic events and patient specific symptoms of hypoglycemia prior to HBOT	x	x		
Consider timing of short and long-acting glycemic control medication when scheduling HBOT to avoid peak action time while at depth in the chamber	x	x		x
Assess HgbA1C, as ordered.	x			
Assess peripheral blood glucose prior to each HBOT to ensure level is at least 100-150mg/dL or within facility guidelines	x	x		x
Follow facility policy and protocol guidelines for glucose control during HBOT	x	x	x	x
Monitor for s/s of hypoglycemia		x	x	x
Perform medication reconciliation to determine medications that may affect glucose levels (e.g., steroids, oral hypoglycemic agents, insulins etc.)	x	x		

SAFETY	EDUCATION
<ul style="list-style-type: none"> <li>▪ Recommend patient eat one hour prior to HBOT with protein and/or complex carbohydrates e.g., vegetables, whole grains, meat, cheese, dairy</li> <li>▪ Consider sending simple carbohydrate source, fruit juice, glucose tabs or tube of glucose gel into chamber with patient in the event of symptomatic hypoglycemia during treatment, depending on type of chamber used</li> <li>▪ Assist patient to use glucose gel/tabs or juice prior to HBOT</li> <li>▪ Provide complex carbohydrate e.g., high protein diabetic beverage if needed</li> </ul>	<ul style="list-style-type: none"> <li>▪ Educate that HBOT carries its own mechanism for increased glucose usage through oxygen mediated transport of glucose into muscle cells and may increase insulin sensitivity resulting in hypoglycemia</li> <li>▪ Educate that adequate glucose control (less than 200mg/dL) is vital for wound healing</li> </ul>

*Baromedical Nurses Association*  
*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

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VI. Potential for Impaired Communication related to language barriers, aphasia, acute hearing or visual loss, medical interventions i.e., surgical, radiation therapy or medical literacy deficits

**Rationale:** Many of the indications for HBOT involve patients that have had medical interventions that have left them with communication barriers. Furthermore, there are multiple individuals that do not speak the same language as the staff administering HBOT or are unable to read. As education is one of the cornerstones of informed consent, it is imperative that facilities establish means to overcome these barriers to ensure the patient and family receives education related to their condition and HBOT.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Identify circumstances or situations that may limit the patient's ability to use or comprehend language (written words, pictures and gestures, ambient noise)	x	x	x	x
Assess the patient's preferred language for verbal AND written communication	x			
Assess the patient's primary and preferred means of communication (e.g., verbal, written, gestures)	x			
Learn patient needs and pay attention to nonverbal cues	x	x	x	x
Provide interpreter to communicate in the patient's preferred language	x	x	x	x
Provide an alternative means of communication for times when interpreters are not available (e.g phone, video etc.)	x	x	x	x
Keep distractions such as television at a minimum when talking to patient	x	x		x
Maintain eye contact with the patient when speaking (even when using an interpreter)	x	x	x	x
Do not rush the patient to respond	x	x	x	x
Use short sentences and ask only one question at time	x	x	x	x
Speak slowly and enunciate words clearly	x	x	x	x
Refer to appropriate resources (e.g., speech therapy)	x	x		x
Provide written information and instructions in the patient's preferred language.	x	x		x

SAFETY	EDUCATION
	<ul style="list-style-type: none"> <li>▪ Rights and responsibilities related to communication.</li> <li>▪ Available communication aids</li> </ul>

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*Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy*

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VII. Ineffective Peripheral Tissue Perfusion related to complication wounds and delayed effects of radiation

**Rationale:** HBOT is approved for multiple conditions that are related to ineffective peripheral tissue perfusion that result in impaired healing. As these conditions are common for individuals receiving HBOT, it is imperative that the facility have established plans of care to promote lifestyle changes and processes that can prevent injury.

	Initial Assessment	Pre-Treatment (every)	During Treatment	Post Treatment
Assess for signs of decreased tissue perfusion	x	x		
Monitor fluid balance	x	x		
Assist with position changes		x		x
Promote active/passive ROM exercises	x	x		x
Keep patient warm, but do not apply heat		x	x	
Promote foot and nail care. Refer to specialist if needed	x	x		x
Encourage adequate nutritional balance	x	x		x
Perform wound assessment and care, as ordered		x		x
Monitor for s/s of gangrene, venous ulceration and/or cellulitis	x	x		x
Perform TcPO <sub>2</sub> or other diagnostic procedures, as ordered	x	x		

SAFETY	EDUCATION
<ul style="list-style-type: none"> <li>▪ Appropriate footwear (e.g., diabetic shoes, inserts, offloading boots, etc.) is necessary for adequate healing of wounds on the feet</li> <li>▪ Monitor compliance with wound cares to promote healing</li> </ul>	<ul style="list-style-type: none"> <li>▪ Educate on potential lifestyle changes that could improve tissue perfusion</li> <li>▪ Avoid crossing legs</li> <li>▪ Change positions frequently</li> <li>▪ Reduce risk/impact of atherosclerosis</li> <li>▪ Smoking cessation</li> <li>▪ Appropriate footwear</li> <li>▪ S/S of infection</li> <li>▪ Wound care</li> </ul>



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