Hyperbaric Oxygen Therapy (HBOT) Systemic* and Topical Hyperbaric Oxygen Therapy (THOT) and Continuous Topical Oxygen Therapy (CTOT)

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DESCRIPTION

Hyperbaric oxygen therapy (HBOT) involves breathing 100% oxygen at pressures between 1.5 and 3.0 atmospheres. It is generally applied systemically with the patient inside a hyperbaric chamber. HBOT can also be applied topically i.e., the body part to be treated is isolated (e.g., in an inflatable bag and exposed to pure oxygen). HBOT has been investigated for various conditions that have potential to respond to increased oxygen delivery to tissue.

Note: *The use of hyperbaric oxygen therapy HBOT has been proposed for a wide range of conditions in addition to those addressed by the UHMS. There are little clinical data to support HBOT for these other indications. This policy will address the several potential indications for which there may be published randomized controlled trials (RCTs), case*

series and retrospective reviews, but the evidence is considered insufficient in determining the effects of the technology on net health outcomes.

Systemic Hyperbaric Oxygen Therapy
In systemic or large hyperbaric oxygen chambers, the patient is entirely enclosed in a pressure chamber and breathes oxygen at a pressure greater than 1 atmosphere (the pressure of oxygen at sea level). Thus, this technique relies on systemic circulation to deliver highly oxygenated blood to the target site, typically a wound. Treatment may be carried out either in a monoplace chamber pressurized with pure oxygen or in a larger, multiplace chamber pressurized with compressed air, in which case the patient receives pure oxygen by mask, head tent, or endotracheal tube.

Clinical Context and Therapy Purpose
The purpose of systemic hyperbaric oxygen therapy (HBOT) is to provide a primary treatment modality while in others it is an adjunct to surgical or pharmacologic interventions that is an alternative or an improvement on existing therapies.

Populations
Patients with various conditions that have potential to respond to increased oxygen delivery to tissue.

Interventions
The therapy being considered is systemic hyperbaric oxygen therapy (HBOT).

Comparators
Comparators of interest include breathing oxygen at standard pressure and other supportive measures such as a ventilator. Systemic HBOT may be used as an adjunct to these comparators.

Comparators of interest include medication and surgical therapy. Medications prescribed may consist of systemic antibiotics and systemic or topical antifungals. Systemic HBOT may be used as an adjunct to these comparators.

Outcomes
The general outcomes of interest are overall survival (OS), symptoms, change in disease status and functional outcomes.

Acute Cerebral Edema
Cerebral edema accompanies a wide variety of pathologic processes and may be present in head/brain injury, stroke, brain tumor, cerebral infections (e.g., brain abscess, encephalitis and meningitis), lead encephalopathy, hypoxia, disequilibrium syndrome associated with dialysis and diabetic ketoacidosis, Reye's syndrome, fulminant hepatic encephalopathy, and hydrocephalus. HBO has not been established as a treatment option for cerebral edema.

Acute Coronary Syndromes and as Adjunct to Coronary Artery Interventions Including but not limited to Percutaneous Coronary Interventions and Cardiopulmonary Bypass
HBO therapy has been proposed as an adjunct to standard therapy to improve oxygen supply to the heart and possibly decrease the amount of myocardial ischemic death that could occur and/or to prevent cardiogenic shock. HBO has also been investigated for preconditioning coronary artery disease (CAD) patients prior to elective surgery to improve left ventricular stroke work postoperatively. However, there is insufficient evidence to support the effectiveness of HBO for these conditions.

Acute or Chronic Cerebral Vascular Insufficiency
Cerebral vascular insufficiency is defined as insufficient blood flow to the brain that can lead to a stroke or transient ischemic attack (TIA). Although HBO has been proposed as a treatment option for cerebral vascular insufficiency, there is insufficient evidence in the peer reviewed scientific literature to support its use for this indication.

Acute First-Degree Thermal Burns
HBO for the treatment of acute first-degree thermal burns is not supported by the evidence in the peer-reviewed literature.

Anorectal Disorders
HBO has been proposed as a treatment option for anorectal disorders (e.g., chronic anal fissure, internal hemorrhoids, infectious proctitis). The efficacy of HBO as primary or adjunctive treatment for anorectal disorders has not been established. Randomized controlled trials comparing HBO to standard care (e.g., non-steroidal anti-inflammatory medications, steroid enemas, cauterization or surgical excision) are lacking.

Autism
Autism is the most common condition in the group of developmental disorders known as autism spectrum disorders (ASD). HBO has been proposed as a potential treatment modality for improving cognitive function by increasing tissue oxygenation and improving cerebral blood flow. There are a limited number of randomized controlled trials evaluating HBO for the treatment of autism. Published studies have been primarily in the form of case series with small, heterogeneous patient populations and involved various HBO treatment regimens.

Following a review of the evidence, which included one randomized controlled trial and three case series, Undersea and Hyperbaric Medical Society (UHMS) concluded that although there is a strong case for further studies on the role of HBO in the treatment of autism, HBO cannot be recommended as a routine treatment option.

Brain Injury, Acute and Traumatic Brain Injury (TBI)
In patients with moderate or severe TBI, the goal is to resuscitate the patient adequately to prevent further brain injury. The available evidence on adjunctive HBO treatment for

severe traumatic brain injury is limited, and patient outcomes following HBO therapy are uncertain.

Brown Recluse Spider Bite (Necrotizing Arachnoidism)
Brown recluse spider (i.e., loxosceles reclusa) venom contains enzymes that cause local (e.g., dermonecrosis) and systemic toxicity. There are a limited number of case studies that administered HBO as a treatment option. The studies did not show that HBO therapy produced better patient outcomes than standard aggressive wound care and antibiotic administration

Cancer
HBO therapy has been proposed for use as a cure for cancer and as a means of enhancing tumor response to chemotherapeutic treatment. The American Cancer Society, the National Cancer Institute, and the National Comprehensive Cancer Network (NCCN) do not discuss HBO as a treatment option for any cancers. In 2013, the FDA posted a warning to consumers regarding HBO. The FDA stated that HBO has not been clinically proven to cure or be effective in the treatment of cancer.

Cerebral Palsy
Cerebral palsy (CP) is an umbrella term covering a group of nonprogressive, but often changing, motor-impairment syndromes secondary to lesions or anomalies of the brain arising in the early stages of development. The evidence in the peer-reviewed literature does not support HBO for the treatment of CP.

Chronic Fatigue Syndrome
Chronic fatigue syndrome (CFS) is a disorder of unknown etiology, which may have an infectious basis. It involves a state of chronic fatigue for more than six months and can be accompanied by cognitive difficulties. Because most cases of CFS may be based on a viral infection, no effective therapy exists. Evidence supporting HBO for the treatment of CFS is lacking.

Crohn's Disease
Crohn's disease is a chronic inflammatory disease of the gastrointestinal tract, the cause of which remains unknown. The available evidence is limited and is considered insufficient to determine the effect of HBO treatment on the health outcomes of patients with Crohn's disease.

Dementia
Chronic Brain Syndrome, also called dementia, is a loss of brain function. Alzheimer's disease and Pick's disease are forms of dementia. Alzheimer's is a primary degenerative dementia that typically involves diffuse atrophy of the brain, while Pick's disease is a classical frontotemporal dementia. Korsakoff's is a psychosis that results from a thiamine deficiency and is primarily a memory disorder. The efficacy of HBO for these conditions has not been established.

Epilepsy
Epilepsy, or seizure disorder, is characterized by the tendency to have recurring seizures. HBO is proposed for the treatment of this condition as a means to improve cerebral circulation to the brain and decrease cerebral edema. HBO for the treatment of epilepsy has not been established.

Fracture Healing
The primary goal in the treatment of fractures is the realignment and stabilization of the fractured bone and restoration of function. HBO has been proposed to assist in improving the healing outcomes in delayed or nonunion fractures, but improvement in clinical outcomes has not been established.

Headaches (Cluster and Migraine)
Cluster headaches are an extremely painful but uncommon type of migraine headache. According to the International Headache Society, a migraine headache is a chronic condition with recurrent, episodic attacks. Although HBO has been proposed as a treatment option for headaches, there is insufficient evidence in the peer-reviewed literature supporting the efficacy of HBO for the treatment of this condition.

Hepatic Necrosis
Hepatic necrosis is a severe and progressive form of hepatitis associated with hepatocellular death and hepatic failure. Although HBO has been proposed as a treatment option for hepatic necrosis, there is insufficient evidence in the peer-reviewed literature to support its use for this condition.

In Vitro Fertilization (IVF)
Infertility may be the result of endometriosis, or abnormalities in tubal, uterine, endometrial, cervical, or ovulatory functions. It has been proposed that increasing oxygenation by HBO may aid in egg maturation and alignment of chromosomes during meiosis but there is insufficient evidence to report this claim.

Lymphedema
Approximately 10–38% of all women who have breast-conserving surgery (BCS) or modified radical mastectomy have postsurgical irradiation to the lymph nodes, and 10% of those women develop lymphedema. HBO has not been established as an effective adjunctive treatment for the reduction of lymphedema. Studies have primarily been in the form of case series with small patient populations and reported that the total limb volume did not change significantly from baseline measurements

Multiple Sclerosis
Multiple sclerosis (MS) is a chronic neurological disease in which there is patchy inflammation, demyelination and gliosis in the central nervous system. HBO has been proposed as a treatment modality for MS based on the demonstrated ability of HBO to produce vasoconstriction with increased oxygen delivery and some anecdotal evidence of efficacy.

In a Cochrane systematic review, Bennett and Heard (2011) investigated the use of HBO for the treatment of MS. Two randomized controlled trials reported generally positive results, but the remaining seven randomized trials reported no evidence of treatment effects. Due to the paucity of evidence to confirm beneficial effects of HBO, the authors did not believe that routine use of HBO was justified.

Refractory Mycoses
Mycosis is an infection, or a disease caused by a fungus (e.g., candidiasis, aspergillosis, cryptoccocus). Zygomycosis (e.g., mucormycosis, phycomycosis) is an infection caused by "bread mold fungi" and can infect immunosuppressant individuals (e.g., HIV). HBO has been proposed as a treatment option for some forms of invasive mycosis (e.g., zygomycosis), but its efficacy remains unproven.

Sport's Injuries
Soft tissue injuries can range from abrasions and bruising to disruptions of tendons, ligaments, and muscles. Muscle soreness and damage are commonly associated with athletic activity. HBO has been proposed as an adjunct to conventional therapies (e.g., rest, elevation, pharmacotherapy) to expedite the healing process, but its beneficial impact on health outcomes has not been established.

Spinal Cord Injuries
Bruising, pressure, cutting or severance of the spinal cord may result in partial or complete loss of sensation and movement below the site of injury. Studies investigating the adjunctive use of HBO for the treatment of spinal cord injuries are primarily in the form of small, uncontrolled case series with a range of spinal cord injuries. Overall, results were not favorable. HBO therapy for the management of spinal cord injury has not been widely accepted.

Stroke
Medical therapies for stroke are designed to minimize or prevent ischemic brain infarction, optimize functional recovery and avert stroke recurrence. Specific therapies depend on the stroke syndrome. Guidelines for the early management of acute ischemic stroke (AIS) by the American Heart Association and the American Stroke Association (2018) stated HBO is not recommended for patients with AIS except when caused by air embolization. The limited available data show no benefit from HBO.

Other Conditions
Studies, primarily in the form of case series, case reports and retrospective reviews have investigated HBO as a primary or adjunctive therapy for various other indications including Bell's palsy, frostbite, and Parkinson disease, Overall, improved health outcomes following HBO for the treatment of these conditions have not been established.

The FDA issued a warning (2013) regarding the use of HBO for indications that are not FDA approved (" off label"). Per the FDA, the safety and effectiveness of HBO has not

been established for the following diseases and conditions: AIDS/HIV, Alzheimer's disease, autism, asthma, Bell's palsy, brain Injury, cerebral palsy, depression, diabetes, heart disease, hepatitis, migraine, multiple sclerosis, Parkinson's disease, spinal cord Injury, sport's injury, and stroke.

Summary of Evidence

There is insufficient evidence in the published peer-reviewed medical literature to support the use of systemic hyperbaric oxygen therapy (HBOT) as a primary or adjuvant treatment of the conditions listed below. Further randomized controlled trials (RCTs) are needed to include double blind comparisons of HBOT to sham HBOT. The evidence is insufficient in determining the effects of the technology on net health outcomes:

- Acute carbon tetrachloride poisoning
- Acute cerebral edema
- Acute coronary syndromes and as adjunct to coronary artery interventions including but not limited to percutaneous coronary interventions and cardiopulmonary bypass
- Acute frost bite
- Acute first-degree thermal burns
- AIDS/HIV
- Alzheimer’s disease/Dementia
- Anorectal disorders (e.g., chronic anal fissure, internal hemorrhoids, infectious proctitis)
- Asthma
- Autism spectrum disorder (ASD)
- Bell’s palsy
- Bone graft
- Brain injury, acute and traumatic brain injury (TBI)
- Brown recluse spider bite (necrotizing arachnoidism)
- Cancer
- Cerebral palsy
- Cerebrovascular disease, acute (thrombotic or embolic) or chronic
- Chronic arm lymphedema following radiotherapy for cancer
- Crohn’s disease (includes fistulizing Crohn’s disease)
- Chronic fatigue syndrome
- Demyelinating disease including but not limited to multiple sclerosis (MS) and amyotrophic lateral sclerosis (ALS)
- Depression
- Early treatment (beginning at the completion of radiation therapy) to reduce side effects of radiation therapy
- Epilepsy
- Fracture healing
- Heart disease
- Hepatitis/Hepatic necrosis
- Hydrogen sulfide poisoning

- Idiopathic femoral head necrosis
- Idiopathic sudden sensorineural hearing loss without moderate hearing loss
- Intra-abdominal abscesses
- In-vitro fertilization
- Lepromatous leprosy
- Meningitis
- Migraine headaches/headaches
- Motor dysfunction associated with stroke
- Neurologic conditions
- Parkinson's disease
- Preconditioning to improve myocardial function and/or reduce postoperative complications in patients undergoing coronary artery bypass grafting (CABG)
- Pseudomembranous colitis (antimicrobial agent-induced colitis)
- Pyoderma gangrenosum
- Radiation induced injury of head and neck
- Refractory mycoses
- Spinal cord injury
- Sports injury
- Tumor sensitization for cancer treatments including but not limited to radiotherapy or chemotherapy
- Ulcerative colitis (UC)/Inflammatory bowel disease

The FDA issued a warning (2013; updated 2018) regarding the use of hyperbaric oxygen therapy (HBO) for indications that are not FDA approved ("off-label"). Per the FDA, the safety and effectiveness of HBO has not been established for the following diseases and conditions: AIDS/HIV, Alzheimer's disease, autism, asthma, Bell's palsy, brain Injury, cerebral palsy, depression, diabetes, heart disease, hepatitis, migraine, multiple sclerosis, Parkinson's disease, spinal cord injury, sport's injury, and stroke.

Topical Hyperbaric Oxygen Therapy or Topical Oxygen Therapies
There are two types of topical oxygen therapy (TOT), topical hyperbaric oxygen therapy (THOT) and continuous topical oxygen therapy (CTOT).

Topical hyperbaric oxygen therapy (THOT) is a technique of delivering 100% oxygen directly to an open, moist wound at a pressure slightly higher than atmospheric pressure. It is hypothesized that the high concentrations of oxygen diffuse directly into the wound to increase the local cellular oxygen tension, which in turn promotes wound healing. Devices consist of an appliance to enclose the wound area and a source of oxygen; conventional oxygen tanks may be used. The appliances may be disposable and may be used without supervision in the home by well-trained patients. Topical hyperbaric oxygen therapy (THOT) has been investigated as a treatment of wounds, burns, or infections.

Topical oxygenation may be performed in the home or clinic and office setting. Typically, therapy is offered for 90 minutes per day for four consecutive days. After a three-day break, the cycle may be repeated.

Clinical Context and Therapy Purpose

The purpose of topical hyperbaric oxygen therapy (THOT) is to provide a treatment option that is an alternative or an improvement on existing therapies in treating wounds, burns or infections.

Populations

The relevant population of interest is individuals with wounds, burns, or infections.

Interventions

The therapy being considered is topical hyperbaric oxygen therapy (THOT). Patients with wounds, burns, or infections are actively managed by emergency care providers, dermatologists, wound care specialists, and primary care providers in a clinical setting.

Comparators

Comparators of interest include dressings, debridement, and medication. Medications prescribed may include topical antibiotics and antiseptics. Pain and anxiety management medication may also be used. Topical hyperbaric oxygen therapy (THOT) may be used as an adjunct to these comparators.

Outcomes

The general outcomes of interest are overall survival, (OS), symptoms, change in disease status, and functional outcomes. Based on the site and severity of the wound, burn, or infection, patients may require prolonged physical and occupational support to evaluate symptoms. Additionally, the existing evidence on the use of topical hyperbaric oxygen therapy involves studies that treat patients for 12 weeks, but information on follow-up was limited. Therefore, follow-up should be determined based on the site and severity of the wound, burn or infection and can range from months to a year after starting treatment.

Summary of Evidence

Based on review of the peer reviewed medical literature topical hyperbaric oxygen therapy (THOT) may be a promising treatment based on studies, but it cannot be recommended for routine clinical care at this time due to a restricted volume and quality of supporting scientific evidence. More investigation is necessary to determine if topical hyperbaric oxygen therapy (THOT) can be used in the clinical setting**.** Per the 2018 guidelines by the Undersea and Hyperbaric Medical Society for chronic wounds, the guidelines states **"**before topical oxygen therapy can be recommended for non-healing wounds, its application should be subjected to additional scientific scrutiny to better establish indications for use, dosing and response to treatment.
Future clinical studies should address these issues.**"** Further randomized controlled trials are warranted to examine the safety and effectiveness of this therapy. The evidence is insufficient in determining the effects of the technology on net health outcomes.

Continuous Topical Oxygen Therapy (CTOT)
Continuous topical oxygen therapy (CTOT) is a newer alternative to topical hyperbaric oxygen therapy (THOT) that does not require patient immobilization or in-clinic administration and can be used at the same time as dressings and offloading. A portable oxygen concentrator refines and delivers atmospheric (normobaric) oxygen to the wound site through a cannula, the end of the cannula (tube) is placed onto the wound site and is covered with an occlusive dressing or pressure dressing. The oxygen is delivered at a low flow rate so the wound will not dry out. Continuous topical oxygen therapy (TCOT) has been proposed in the treatment of skin ulcerations resulting from diabetes, venous stasis, post-surgical infections, gangrenous lesions, pressure ulcers/decubitus ulcers, infected residual limbs, skin grafts, burns and frostbite.

The goal of topical continuous oxygen therapy (TCOT) is to provide an uninterrupted and continuous supply of oxygen to a moist wound. The dressing is designed such that the oxygen is supplied in a manner that most closely approximates the normal diffusion of oxygen in moist tissues yet a rate sufficient to fuel the increased oxygen demands required in healing tissues. With this therapy the dressing helps provide an environment for optimal wound healing while managing wound exudate levels, protecting against wound dehydration and protecting against external contamination. Contraindications to this wound therapy include wounds with inadequate perfusion to support healing; ulcers due to acute thrombophlebitis; ulcers due to Raynaud's disease; necrotic wounds covered with eschar or slough; wounds with fistulae or deep sinus tracts with unknown depth.

The following are continuous topical oxygen therapy (CTOT) devices:

- **EPIFLO® Transdermal Continuous Oxygen Therapy** (Ogenix) consists of a small, silent, disposable, oxygen concentrator and a long sterile cannula (tube). It is used with any fully occlusive sterile wound dressing to continuously blanket the wound with near 100% oxygen. The patient is free to ambulate and can continue with normal daily living activities while being treated 24 hours per day. EPIFLO® can be worn near the wound beneath clothing without impairing its operation.

  EPIFLO® extracts oxygen from the air, concentrates it to near 100%, and "pumps" the oxygen through the cannula to blanket the wound. The wound is covered with a fully occlusive dressing of the doctor's choice. The dressing does not inflate and the patient has no sensation of air movement. EPIFLO® provides a silent, continuous, slow flow of oxygen (3 ml/hr for 15 days) that will not dry out the wound. Some clinicians suggest that EPIFLO® mimics the bloodstream in delivering the necessary metabolic energy to oxygen starved cells. EPIFLO® energizes ischemic cells to jump start the natural healing process. Oxygen helps form collagen, granulation tissue, new blood vessels and skin.

- **TransCu 0_2 Wound Care Device or EO_2 System** (EO2 Concepts) is a portable oxygen delivery system that provides a continuous flow of oxygen to a wound. Through a dressing attached to the device, oxygen is provided directly to the

wound for 24 hours per day, 7 days a week. Oxygen is an important part in the wound healing process.

The EO_2 System employs a TransCu 0_2 device which uses fuel cell technology to continuously generate pure humidified oxygen at adjustable flow rates from 3-15 ml/hr and delivers it directly to the wound bed environment within the OxySpur dressing. The OxySpur Oxygen Diffusion Dressing is an all-in-one dressing for medium to high exudating wounds. It's design ensures even distribution of oxygen over the entire wound.

Summary of Evidence
Based on review of the peer reviewed medical literature continuous topical oxygen therapy (CTOT) may be a promising treatment based on studies, but it cannot be recommended for routine clinical care at this time due to a restricted volume and quality of supporting scientific evidence. More investigation is necessary to determine if continuous topical oxygen therapy (CTOT) can be used in the clinical setting**.** Per the 2018 guidelines by the Undersea and Hyperbaric Medical Society for chronic wounds, the guidelines states **"**before topical oxygen therapy can be recommended for non-healing wounds, its application should be subjected to additional scientific scrutiny to better establish indications for use, dosing and response to treatment.
Future clinical studies should address these issues." Further randomized controlled trials are warranted to examine the safety and effectiveness of this therapy. The evidence is insufficient in determining the effects of this technology on net health outcomes.

Practice Guidelines and Position Statements

Undersea & Hyperbaric Medical Society (UHMS)
In 2019, the Undersea and Hyperbaric Medical Society (UHMS) issued the 14th edition for hyperbaric oxygen therapy that included the following recommendations:

Indications for Hyperbaric Oxygen Therapy:
- Air or gas embolism
- Carbon monoxide poisoning and carbon monoxide poisoning complicated by cyanide poisoning
- Clostridial myositis and myonecrosis (gas gangrene)
- Crush injury, compartment syndrome and other acute traumatic ischemias
- Decompression sickness
- Arterial insufficiencies
    - Cranial retinal artery occlusion
    - Enhancement of healing in selected problem wounds
- Severe anemia
- Intracranial abscess
- Necrotizing soft tissue infections
- Osteomyelitis (refractory)
- Delayed radiation injury (soft tissue and bony necrosis)
- Compromised grafts and flaps

- Acute thermal burn injury
- Idiopathic sudden sensorineural hearing loss

In 2015, the Undersea and Hyperbaric Medical Society (UHMS) issued a clinical practice guideline for the use of hyperbaric oxygen therapy in the treatment of diabetic foot ulcers, that included the following recommendations:

- In patients with Wagner Grade 2 or lower diabetic foot ulcers, we suggest against using hyperbaric oxygen therapy (very low-level evidence in support of HBO_2, conditional recommendation)
- In patients with Wagner Grade 3 or higher diabetic foot ulcers that have not shown significant improvement after 30 days of treatment, we suggest adding hyperbaric oxygen therapy to the standard of care to reduce the risk of major amputation and incomplete healing (moderate-level evidence, conditional recommendation)
- In patients with Wagner Grade 3 or higher diabetic foot ulcers who have just had surgical debridement of an infected foot (e.g. partial toe or ray amputation; debridement of ulcer with underlying bursa, cicatrix or bone; foot amputation; incision and drainage of deep space abscess; or necrotizing soft tissue infection), we suggest adding acute post-operative hyperbaric oxygen therapy to the standard of care to reduce the risk of major amputation and incomplete healing (moderate - level of evidence, conditional recommendation)

In 2009, the Undersea and Hyperbaric Medical Society (UHMS) issued a position paper on the treatment of autism spectrum disorder (ASD) with hyperbaric oxygen therapy which states: There are few data upon which to base firm conclusions regarding the use of hyperbaric oxygen therapy for the treatment of ASD. “At this time, the UHMS cannot recommend the routine treatment of ASD with hyperbaric oxygen therapy outside appropriate comparative research protocols”.

The Undersea and Hyperbaric Medical Society (UHMS) issued a position paper on the treatment of multiple sclerosis with hyperbaric oxygen therapy: The synthesis of data presented suggests there is little evidence for the efficacy of hyperbaric oxygen therapy from trials with a low potential for bias. Most randomized controlled trials have failed to show any clinical benefit, while a minority have suggested some benefit. “At this time, the UHMS cannot recommend the routine treatment of multiple sclerosis with hyperbaric oxygen therapy outside appropriate comparative research protocols”.

In 2018, the Undersea and Hyperbaric Medical Society (UHMS) updated their position statement on topical oxygen for chronic wounds which states:

Topical oxygen may be a promising treatment based on some recent studies, but it cannot be recommended for routine clinical care at this time due to a restricted volume and quality of supporting scientific evidence. More investigation is necessary to determine if topical oxygen can be used in the clinical setting for wound care. In particular, we need

better information on precise indications for use, optimal dosing regimens and standardized outcomes. Future clinical studies should address these issues.

Before topical oxygen therapy can be recommended for non-healing wounds, its application should be subjected to additional scientific scrutiny to better establish indications for use, dosing and response to treatment.

American College of Hyperbaric Medicine (ACHM)
In 2015, the following indications are approved by the American College of Hyperbaric Medicine and are reimbursable through CMS:

- Air or gas embolism
- Acute carbon monoxide intoxication
- Clostridial myositis and myonecrosis (gas gangrene)
- Crush injury, compartment syndrome or other acute traumatic ischemias
- Decompression illness
- Enhancement of healing in select problem wounds
- Extreme anemia
- Intracranial abscess
- Necrotizing soft tissue infections
- Osteomyelitis (refractory)
- Delayed radiation injury (soft tissue and bony necrosis)
- Skin flaps and grafts (compromised)

If sufficient data demonstrates that hyperbaric oxygen therapy is associated with a favorable risk-benefit ratio for an indication, which is not currently on the approved list from the Centers of Medicare and Medicaid, The Undersea and Hyperbaric Medical Society or a Commercial Insurance Carrier, the ACHM will endorse the application of hyperbaric therapy for the supported indication. Indications that meet these criteria and are supported by the ACHM as appropriate for hyperbaric oxygen therapy include:

- Acute thermal burns
- Acute central retinal artery occlusion
- Acute frost bite
- Actinomycosis (refractory and recalcitrant)
- Brown recluse spider bites
- Idiopathic sudden sensorineural hearing loss

The ACHM supports the treatment of patients with non-approved indications only in a research setting using a protocol that has been approved by an Institutional Review Board. The ACHM supports the continued performance of well-designed clinical trials in these areas, especially those that are prospective, randomized, controlled trials. The ACHM does not support the treatment of non-approved conditions for financial gain, without investigational treatment protocols. College members who intentionally mislead the patient or family into believing that hyperbaric therapy is an approved indication or is supported by peer reviewed literate will be dismissed from the ACHM.

Tenth European Consensus Conference on Hyperbaric Medicine
In 2016, the tenth European Consensus Conference on Hyperbaric Medicine issued recommendations for accepted and non-accepted clinical indications of hyperbaric oxygen treatment that included the following:

Condition	Level of Evidence	Strength of Recommendation
Carbon monoxide (CO) poisoning	B	Level 1
Open fractures with crush injury	B	Level 1
Prevention of osteoradionecrosis after dental extraction	B	Level 1
Osteoradionecrosis (mandible)	B	Level 1
Soft tissue radionecrosis (cystitis, proctitis)	B	Level 1
Decompression illness	C	Level 1
Gas embolism	C	Level 1
Anerobic or mixed bacterial infections	C	Level 1
Sudden deafness	B	Level 1
Diabetic foot lesions	B	Level 2
Femoral head necrosis	B	Level 2
Compromised skin grafts and musculocutaneous flaps	C	Level 2
Central retinal artery occlusion (CRAO)	C	Level 2
Crush injury without fracture	C	Level 2
Osteoradionecrosis (bones other than mandible)	C	Level 2
Radio-induced lesions of soft tissues (other than cystitis and proctitis)	C	Level 2
Surgery and implant in irradiated tissue (preventative treatment)	C	Level 2
Ischemic ulcers	C	Level 2
Refractory chronic osteomyelitis	C	Level 2

Burns 2nd degree more than 20% BSA	C	Level 2
Pneumatosis cystoides intestinalis	C	Level 2
Neuroblastoma, Stage IV	C	Level 2
Brain injury (acute and chronic TBI, chronic stroke, post anoxic encephalopathy) in highly selected patients	C	Level 3
Radio-induced lesions of larynx	C	Level 3
Radio-induced lesions of the CNS	C	Level 3
Post-vascular procedure reperfusion syndrome	C	Level 3
Limb replantation	C	Level 3
Selected non-healing wounds secondary to systemic processes	C	Level 3
Sickle cell disease	C	Level 3
Interstitial cystitis	C	Level 3

Level of Evidence: Grade A = High level of evidence; Grade B = Moderate level of evidence; Grade C = Low level of evidence; Grade D = Very low level of evidence.

Strength of Recommendation: Level 1 = strong recommendation (we recommend); Level 2 = weak recommendation (we suggest); Level 3 = neutral recommendation (would be reasonable); no recommendation = no agreement was reached by the group of experts.

PRIOR APPROVAL

Prior approval is required for systemic hyperbaric oxygen therapy (99183 and G0277)

POLICY

Systemic hyperbaric oxygen therapy (HBOT) (99183, G0277) is considered **investigational,** including but not limited to the following indications:

- Acute carbon tetrachloride poisoning
- Acute cerebral edema

- Acute coronary syndromes and as adjunct to coronary artery interventions including but not limited to percutaneous coronary interventions and cardiopulmonary bypass
- Acute frost bite
- Acute first-degree thermal burns
- AIDS/HIV
- Alzheimer's disease/Dementia
- Anorectal disorders (e.g., chronic anal fissure, internal hemorrhoids, infections proctitis)
- Asthma
- Autism spectrum disorder (ASD)
- Bell's palsy
- Bone graft
- Brain injury, acute and traumatic brain injury (TBI)
- Brown recluse spider bite (necrotizing arachnoidism)
- Cancer
- Cerebral palsy
- Cerebrovascular disease, acute (thrombotic or embolic) or chronic
- Chronic arm lymphedema following radiotherapy for cancer
- Chronic fatigue syndrome
- Crohn's disease (includes fistulizing Crohn's disease)
- Demyelinating disease including but not limited to multiple sclerosis (MS) and amyotrophic lateral sclerosis (ALS)
- Depression
- Early treatment (beginning at the completion of radiation therapy) to reduce side effects of radiation therapy
- Epilepsy
- Fracture healing
- Heart disease
- Hepatitis/Hepatic necrosis
- Hydrogen sulfide poisoning
- Idiopathic femoral head necrosis
- Idiopathic sudden sensorineural hearing loss without moderate hearing loss
- Intra-abdominal abscesses
- In-vitro fertilization
- Lepromatous leprosy
- Meningitis
- Migraine headaches/headaches
- Motor dysfunction associated with stroke
- Neurologic conditions
- Parkinson's disease
- Preconditioning to improve myocardial function and/or reduce postoperative complications in patients undergoing coronary artery bypass grafting (CABG)

- Pseudomembranous colitis (antimicrobial agent-induced colitis)
- Pyoderma gangrenosum
- Radiation induced injury of head and neck
- Refractory mycoses (except for actinomycosis as indicated above)
- Spinal cord injury
- Sports injury
- Tumor sensitization for cancer treatments including but not limited to radiotherapy or chemotherapy
- Ulcerative colitis/Inflammatory bowel disease (IBD)

There is insufficient evidence in the published peer review medical literature to support the use of systemic hyperbaric oxygen therapy (HBOT) as a primary or adjuvant treatment of the conditions listed above Further randomized controlled trials (RCTs) are needed to include double blind comparisons of hyperbaric oxygen therapy (HBOT) to sham hyperbaric oxygen therapy (HBOT). The evidence is insufficient in determining the effects of the technology on net health outcomes.

Topical Hyperbaric Oxygen Therapy (THOT) (A4575)
Topical hyperbaric oxygen therapy is considered **investigational** for all indications.

Based on review of the peer reviewed medical literature topical hyperbaric oxygen therapy (THOT) may be a promising treatment, but it cannot be recommended for routine clinical care at this time due to a restricted volume and quality of supporting scientific evidence. More investigation is necessary to determine if topical hyperbaric oxygen therapy (THOT) can be used in the clinical setting**.** Per the 2018 guidelines by the Undersea and Hyperbaric Medical Society for chronic wounds, the guidelines states **"**before topical oxygen therapy can be recommended for non-healing wounds, its application should be subjected to additional scientific scrutiny to better establish indications for use, dosing and response to treatment. Future clinical studies should address these issues.**"** Further randomized controlled trials are warranted to examine the safety and effectiveness of this therapy. The evidence is insufficient in determining the effects of the technology on net health outcomes.

Continuous Topical Oxygen Therapy (CTOT) (E0446)
Continuous topical oxygen therapy (CTOT), also known as transdermal continuous oxygen wound therapy or continuous diffusion oxygen (CDO) wound therapy, including but not limited to the following is considered **investigational** for all indications.

- EPIFLO Transdermal Continuous Oxygen Therapy
- TransCu 0_2 Wound Care Device or E0_2

Based on review of the peer reviewed medical literature continuous topical oxygen therapy (CTOT) may be a promising treatment, but it cannot be recommended for routine clinical care at this time due to a restricted volume and quality of supporting scientific evidence. More investigation is necessary to determine if continuous topical oxygen therapy (CTOT) can be used in the clinical setting**.** Per the 2018 guidelines by the

Undersea and Hyperbaric Medical Society for chronic wounds, the guidelines states **"**before topical oxygen therapy can be recommended for non-healing wounds, its application should be subjected to additional scientific scrutiny to better establish indications for use, dosing and response to treatment. Future clinical studies should address these issues." Further randomized controlled trials are warranted to examine the safety and effectiveness of this therapy. The evidence is insufficient in determining the effects of this technology on net health outcomes.

PROCEDURE CODES AND BILLING GUIDELINES

To report provider services, use appropriate CPT* codes, Alpha Numeric (HCPCS level 2) codes, Revenue codes, and/or ICD diagnosis codes.

- 99183 Physician or other qualified health care professional, attendance, and supervision of hyperbaric oxygen therapy, per session
- A4575 Topical hyperbaric oxygen chamber, disposable
- E0446 Topical oxygen delivery system, not otherwise specified, includes all supplies and accessories
- G0277 Hyperbaric oxygen under pressure, full body chamber, per 30-minute interval

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POLICY HISTORY

Date	Reason	Action
March 2022	Annual Review	Policy Revised
March 2021	Annual Review	Policy Renewed
March 2020	Annual Review	Policy Revised
March 2019	Annual Review	Policy Revised
March 2018	Annual Review	Policy Revised
March 2017	Annual Review	Policy Revised
March 2016	Annual Review	Policy Revised
April 2015	Annual Review	Policy Revised
May 2014	Annual Review	Policy Revised
July 2013	Annual Review	Policy Revised
August 2012	Annual Review	Policy Revised
August 2011	Annual Review	Policy Revised

New information or technology that would be relevant for Wellmark to consider when this policy is next reviewed may be submitted to:

Wellmark Blue Cross and Blue Shield
Medical Policy Analyst
PO Box 9232
Des Moines, IA 50306-9232

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