



# CIGNA MEDICAL COVERAGE POLICY

The following Coverage Policy applies to all health benefit plans administered by CIGNA Companies including plans formerly administered by Great-West Healthcare, which is now a part of CIGNA.

**Subject Hyperbaric Oxygen Therapy,  
Systemic & Topical**

**Effective Date .....4/15/2011**  
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## INSTRUCTIONS FOR USE

Coverage Policies are intended to provide guidance in interpreting certain **standard** CIGNA HealthCare benefit plans. Please note, the terms of a customer's particular benefit plan document [Group Service Agreement (GSA), Evidence of Coverage, Certificate of Coverage, Summary Plan Description (SPD) or similar plan document] may differ significantly from the standard benefit plans upon which these Coverage Policies are based. For example, a customer's benefit plan document may contain a specific exclusion related to a topic addressed in a Coverage Policy. In the event of a conflict, a customer's benefit plan document **always supercedes** the information in the Coverage Policies. In the absence of a controlling federal or state coverage mandate, benefits are ultimately determined by the terms of the applicable benefit plan document. Coverage determinations in each specific instance require consideration of 1) the terms of the applicable benefit plan document in effect on the date of service; 2) any applicable laws/regulations; 3) any relevant collateral source materials including Coverage Policies and; 4) the specific facts of the particular situation. Coverage Policies relate exclusively to the administration of health benefit plans. Coverage Policies are not recommendations for treatment and should never be used as treatment guidelines. Proprietary information of CIGNA. Copyright ©2011 CIGNA

## Coverage Policy

**CIGNA covers systemic hyperbaric oxygen therapy (HBO/HBOT/HOT) in single or multiple chambers as medically necessary first-line treatment for ALL of the following conditions:**

- acute carbon monoxide poisoning

- air or gas embolism
- decompression sickness
- exceptional blood loss when transfusion is not an option

**CIGNA covers systemic hyperbaric oxygen therapy (HBO/HBOT/HOT) in single or multiple chambers as medically necessary adjunctive treatment for ALL of the following conditions:**

- acute cyanide poisoning, after administration of antidote
- acute traumatic peripheral ischemia/insufficiency (e.g., crush injuries, compartment syndrome, suturing of severed limbs)
- clostridial myositis and myonecrosis (i.e., gas gangrene)
- compromised skin grafts and flaps (i.e., preexisting grafts or flaps that are showing signs of failure or necrosis)
- intracranial abscess
- necrotizing soft tissue infections (e.g., necrotizing fasciitis, Meleney's ulcer)
- osteomyelitis unresponsive to conventional medical and surgical interventions
- radiation damage of non-neurologic tissue, delayed (i.e., osteoradionecrosis and soft tissue radionecrosis)
- radiation-induced cystitis or hemorrhagic cystitis (i.e., resulting from chemolytic response, graft-versus-host disease [GVHD])
- radiation-induced enterocolitis
- thermal burns, acute, requiring inpatient hospitalization
- Wagner grade III or higher diabetic wounds/ulcers of the lower extremities that have failed standard wound therapy

**CIGNA does not cover systemic hyperbaric oxygen therapy in single or multiple chambers for the treatment of ANY of the following conditions, because it is considered experimental, investigational or unproven (this list may not be all-inclusive):**

- actinomycosis
- acute cerebral edema
- acute coronary syndrome (ACS)/myocardial ischemia/infarction (MI), cardiogenic shock/preconditioning for coronary artery bypass graft surgery
- acute or chronic cerebral vascular insufficiency
- acute thermal and chemical pulmonary damage (i.e., smoke inhalation with pulmonary insufficiency)
- anorectal disorders (e.g., chronic anal fissure [CAF], internal hemorrhoids, infectious proctitis)
- autism spectrum disorders
- brain injury, closed head injury, traumatic brain injury (TBI), anoxic encephalopathy
- brown recluse spider bites
- cancer
- carbon tetrachloride poisoning
- cerebral palsy
- cerebral radionecrosis
- chronic fatigue syndrome
- chronic peripheral vascular insufficiency
- Crohn's disease
- cutaneous decubitus/pressure ulcers
- dementia
- epilepsy
- fractures, acute, delayed union or nonunion
- headaches (e.g., cluster, migraine)
- hepatic necrosis
- human immunodeficiency virus (HIV)–fatigue
- idiopathic sudden sensorineural hearing loss (ISSHL)
- in vitro fertilization

- Lyme disease
- lymphedema
- malignant otitis externa (e.g., necrotizing external otitis)
- multiple sclerosis
- mycoses
- nonvascular causes of chronic brain syndrome (e.g., Pick's disease, Alzheimer's disease, Korsakoff's disease)
- ophthalmologic conditions (e.g., optic neuropathy, glaucoma, retinal artery occlusion)
- organ storage
- organ transplantation
- pulmonary emphysema
- reflex sympathetic dystrophy/complex regional pain syndrome
- rheumatoid arthritis
- sepsis
- sickle cell disease
- soft tissue injury (e.g., delayed onset muscle soreness, sprains, strains)
- spinal cord injury
- stroke
- tetanus
- tinnitus
- venous stasis ulcers

**CIGNA does not cover topical hyperbaric oxygen (THBO) for any indication because it is considered experimental, investigational or unproven.**

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## General Background

Systemic hyperbaric oxygen therapy (HBO/HBOT/HOT) involves the inhalation of 100% oxygen under increased atmospheric pressure (e.g., 1.4 to 2.8 atmospheres absolutes [ATA]). A hyperbaric oxygen chamber (whether single or multiple chamber [i.e., created to hold several people]) is a device intended to promote the movement of oxygen from the environment to the patient's tissues by means of pressurization. Forcing oxygen into the tissues, organs, brain, and fluids of the body is proposed to stimulate cell growth and regeneration, displace toxins and impurities, and stimulate the immune system. Treatment sessions may last for 30–120 minutes and may be given for up to five times per week. Some conditions may only require one or two treatments (e.g., carbon monoxide with cyanide poisoning) while others may require 10–40 treatments (e.g., osteonecrosis) depending on the severity of the illness and the clinical response of the patient (i.e., complete response occurs or no improvement is being seen).

Applying these same principles of increased oxygenation, the use of topical oxygen, or topical hyperbaric oxygen (THBO), has been proposed as an adjunctive therapy for the treatment of open acute and chronic wounds (e.g., on the sacrum or an extremity). With topical oxygen, an airtight chamber or polyethylene bag (e.g., sleeve, boot, pouch) is sealed around a limb by a constriction/tourniquet device or on a part of the body with tape. High flow oxygen (usually 10 liters per minute) is introduced into the bag over the wound. These portable units can be used in a physician's office, clinic, or be self-administered in the home setting. Therapy is typically administered 90 minutes per day for four consecutive days, with a three-day break. In total, therapy may last for up to 10 weeks. The evidence in the published peer-reviewed scientific literature does not support the safety and efficacy of THBO.

**U.S. Food and Drug Administration (FDA):** Mono- and multiplace hyperbaric chambers are approved by the FDA as a Class II, 510(k) device. Examples of these chambers include the OxyHeal 1000 Monoplace Hyperbaric Chambers (OxyHeal Health Group, LaJolla, CA) and the Multiplace Hyperbaric Chambers (Makai Marine Industries, Inc., Boca Raton, FL). The devices are approved for the treatment of the conditions recommended by the Undersea Hyperbaric Medicine Society (FDA, 2005; FDA, 2004).

Topical hyperbaric oxygen systems are a Class III device approved by the FDA 510(k) process. An example of a topical system is the Hyper-Box Topical Wound Oxygen System (Qualtech House, Gateway, Ireland). The Hyper-Box is approved for the treatment of open acute or chronic wounds such as decubitus ulcers, infected stumps, skin grafts, gangrenous lesions, burns, frostbite, and skin ulcerations due to diabetes, venous stasis, and/or post-surgical infections (FDA, 2008).

### **Literature Review – Systemic Hyperbaric Oxygen**

**HBO as Primary Therapy:** Evidence in the published peer-reviewed literature and professional society guidelines support the safety and effectiveness of HBO as a primary treatment option for acute carbon monoxide poisoning, air or gas embolism, decompression sickness, and exceptional blood loss when transfusion is not an option (Agence d'évaluation des technologies et des modes d'intervention en santé [AETMIS], 2008; Undersea & Hyperbaric Medical Society [UHMS], 2007; Agency for Healthcare Research and Quality [AHRQ], 2006).

**HBO as Adjunctive Therapy:** HBO has been shown to be effective and is an established adjunctive therapy for the treatment of acute cyanide poisoning, acute traumatic peripheral ischemia/insufficiency (e.g., crush injuries, compartment syndrome, suturing of severed limbs), clostridial myositis and myonecrosis (i.e., gas gangrene), compromised skin grafts and flaps (i.e., preexisting grafts or flaps that are showing signs of failure or necrosis), intracranial abscess, necrotizing soft tissue infections such as necrotizing fasciitis or Meleney's ulcer, osteomyelitis that is unresponsive to conventional medical and surgical interventions, delayed non-neurologic radiation tissue damage (e.g., osteoradionecrosis and soft tissue radionecrosis), and acute thermal burns requiring hospitalization (Latham, et al., 2010; American Cancer Society [ACS], 2008; AETMIS, 2008; Goldman, 2009; UHMS, 2007; AHRQ, 2006).

HBO is also a recognized adjunctive therapy for the treatment of radiation-induced cystitis or hemorrhagic cystitis resulting from chemolytic response or graft-versus-host disease, and radiation-induced enterocolitis (Fink, 2006; Bennett, 2005; Chong, 2005; Fine, 2005; El-Zimaity, 2004; Lazzarini, 2004; Hailey, 2003; Lawson, 2003; Wang, 2003; Kalayoglu-Besisik, 2003; Cesaro, 2003).

Randomized controlled trials and prospective case series support the safety and efficacy of HBO as an effective adjunctive therapy for the treatment of Wagner grades III–V diabetic wounds/ulcers of the lower extremity that are refractory to aggressive medical management including wound care, glucose control and surgical debridement or surgical revascularization. A Wagner grade III wound involves a deep ulcer that contains an abscess, osteomyelitis, or both; grade IV is an ulcer that has led to gangrene of the toes and/or forefoot; and a grade V ulcer has caused gangrene of the entire foot or enough of the foot that it cannot be salvaged (Goldman, 2009; Kranke, et al., 2005; Roeckl-Wiedmann, et al., 2005).

A 2008 update on the indications for HBO by the Agence d'évaluation des technologies et des modes d'intervention en santé (AETMIS) (Quebec) concluded that the recommendations for the indication for HBO as previously published remain "basically unchanged" and the evidence still does not support the effectiveness of HBO for all other conditions. The role of HBO remains experimental for the treatment of cerebral palsy and autism.

### **Literature Review - Other Proposed Indications for Systemic HBO**

There is insufficient evidence in the published peer-reviewed scientific literature to support HBO as a primary or adjunctive treatment of the conditions discussed below (this list may not be all inclusive).

**Actinomycosis:** Actinomycosis is a rare chronic, indolent, suppurative, tissue-destructive infection presenting with lumps and sinus formation, usually involving the head and neck, although it can affect other parts of the body, such as the abdomen and thorax. Adjunctive HBO has been proposed as a treatment option for patients who are unresponsive to medical and surgical intervention; however, studies supporting the efficacy of HBO for this condition are lacking.

**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 (Rowland, 2005). HBO has not been established as a treatment option for cerebral edema.

**Acute Coronary Syndrome (ACS)/Myocardial Ischemia/Infarction (MI), Cardiogenic Shock/Preconditioning for Coronary Artery Bypass Graft Surgery):** ACS includes acute MI and unstable angina. 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.

Yogarathnam et al. (2010) conducted a randomized controlled trial (n=81) to determine if preconditioning coronary artery disease (CAD) patients with HBO prior to first-time, elective coronary artery bypass graft surgery (CABG) with on-pump cardiopulmonary bypass (CPB), would improve postoperative myocardial left ventricular stroke work (LVSW). Preoperatively, the study group (n=41) received HBO for two 30-minute intervals, five minutes apart. The control group (n=40) was not treated with HBO. Hemodynamic monitoring was performed on 22 HBO patients and 25 control group patients. Immediately following HBO, the study group had a significant reduction in pulmonary vascular resistance (PVD) (p=0.03), but the significant difference was not maintained. Intraoperatively, the HBO group had a significant reduction in blood loss (p=0.05). There was no significant difference in the rise in the serum troponin T level, but the rise was greater in the control group. This indicated that HBO-treated patients had less postoperative myocardial injury than the control group. Postoperatively, the HBO group had a significantly improved stroke volume (p=0.01) and LVSW (p=0.05), spent 24 minutes longer on mechanical ventilation and was intubated 36 minutes longer than the control group. The HBO group had a significantly shorter length of stay in the intensive care unit (p=0.05). The study group also had a reduction in blood loss (11.6%), blood transfusion (34%), low cardiac output syndrome (10.4%), inotrope use (8%), atrial fibrillation (11%), pulmonary complications (12.7%), and wound infections (7.6%), but the differences were not statistically significant. No renal or neurological complications were reported in the HBO group compared to 5% and 2.5%, respectively in the control group. Author-noted limitations of the study included the small patient population, recruitment of low-risk patients, and lack of comparison to patients who underwent CABG without the use of CPB and to patients with controlled ischemia. Another limitation of the study is that all patients were not hemodynamically monitored during the postoperative period.

A systematic review (Bennett, et al., 2007) of four randomized controlled trials evaluated HBO when used as an adjunctive therapy to standard ACS and cardiogenic shock treatment regimens versus standalone conventional care. The reviewers concluded that there is limited evidence that HBO therapy either reduces the risk of major adverse coronary events, impacts cardiac dysrhythmia, or decreases the time intervals of ischemic pain during ACS or cardiogenic shock. The studies included small patient populations, and had methodological and reporting inadequacies. The authors could not recommend the use of HBO as an adjunct to standard ACS therapy regimens within this population.

In a randomized controlled trial by Dekleva et al. (2004), 74 patients were assigned to HBO and streptokinase treatment versus streptokinase treatment alone within the first 24 hours after diagnosis. This study was small in sample size, showed treatment effectiveness limited to the first three days following HBO, and excluded patients with significant electrical complications. Due to these limitations, the effectiveness of HBO for the treatment of acute MI cannot be determined.

**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 Thermal and Chemical Pulmonary Damage:** HBO for the treatment of acute thermal and chemical pulmonary damage including smoke inhalation and pulmonary insufficiency in the absence of acute carbon monoxide poisoning 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 (Rao, 2004; Schwartz, 2004).

**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 (n=6-18) and involved various HBO treatment regimens (Rossignol, et al, 2007; Rossignol and Rossignol, 2006).

Rossignol et al. (2009) conducted a multicenter, randomized, double-blind, controlled trial to evaluate the efficacy of HBO in the treatment of children (n=62), ages 2–7 years, diagnosed with autistic disorder. The children were randomly assigned to the study group (n=33) treated with HBO at 1.3 atmosphere and 24% oxygen or to the control group (n=29) treated with slightly pressurized room air and 21% oxygen. Forty, one-hour sessions (two sessions per day for five days) were administered over four consecutive weeks. Compared to the control group, the treatment group had significantly improved outcomes in the mean physician Clinical Global Impression (CGI) scale in overall functioning (p=0.0008), receptive language (p<0.0001), social interaction (p=0.0473), and eye contact (p=0.0102). Significantly more children in the treatment group were rated as “very much improved” (p=0.0471) or “much improved” (p=0.0024). Significant improvements were also reported by the treatment group in the parental CGI scores in overall functioning (p=0.0336), receptive language (p=0.0168), and eye contact (p=0.0322). Significant improvements were noted in total score, irritability, stereotypy, hyperactivity and speech (p<0.03 for each) on the Aberrant Behavior Checklist in the treatment group. The treatment group also showed significant improvement in the Autism Treatment Evaluation Checklist sensory/cognitive awareness score (p=0.0367) compared to the control group. Children over age five years with lower initial autism severity showed the most significant improvements. Due to the short-term duration of this study, the authors stated that studies with long-term outcomes were needed to formally validate the results. It is also unknown what the ideal HBO treatment regimen is for this patient population.

An AETMIS technology assessment (2007) of three case series, one randomized controlled trial and five unpublished studies included small patient populations (n=10–60) and variations in the oxygen and pressure parameters. Although the studies seemed to indicate a reduction in autism symptoms, AETMIS concluded that “there is insufficient evidence to build a strong case for the efficacy of hyperbaric oxygen therapy in the management of autistic disorders.”

**Brain Injury, Closed Head Injury, Traumatic Brain Injury (TBI), Anoxic Encephalopathy:** 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 (Rowland, 2005; AHRQ, 2003).

In a Cochrane review of randomized controlled trials, Bennett et al. (2009) evaluated the benefits and harms of adjunctive HBO for the treatment of patients with TBI. The authors concluded that the combined results of the five studies, involving 432 patients, suggested that HBO may reduce the risk of death but there was no evidence of improved outcomes or quality of life. Due to the limited number of trials and participants, the authors stated it was impossible to be confident in the findings.

An ECRI (2006) emerging technology report regarding HBO for traumatic brain injury included three randomized controlled trials (n=281). According to ECRI, the strength of the evidence was weak due to “study size, variations in treatment delivery, and omission of some important outcome measures such as duration of hospitalization or intensive care unit stay, duration of rehabilitation, or quality of life.” Outcomes regarding coma status, cognitive function, and survival were inconsistent and not reported by all three trials. ECRI concluded that the “small numbers of patients studied and the inconsistent outcome measures reported among studies make it impossible to determine the effect of HBO on key outcomes of cognitive function and survival”.

**Brown Recluse Spider Bites:** 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 (Arnold, 2010; Norris, 2006; Wasserman, 2005).

**Cancer:** HBO therapy has been proposed for use as a cure for cancer and as a means of enhancing tumor response to chemotherapeutic treatment. According to AETMIS (2008), the efficacy evidence for HBO is still insufficient and additional studies are needed. The ACS (2008) stated “Available scientific evidence does not support claims that HBO stops the growth of cancer cells.”

**Carbon Tetrachloride Poisoning:** Poisoning from carbon tetrachloride, which is used in industrial solvents, grain fumigants, insecticides, and the production of fluorocarbons, may cause nausea, vomiting, abdominal pain, diarrhea, confusion, coma, respiratory depression, hypotension, convulsions and even death (Harwood-Nuss, 2001). Although HBO has been proposed as a treatment option for carbon tetrachloride poisoning, there is insufficient evidence to support its effectiveness.

**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.

In a 2007 systematic review including two randomized controlled trials and four observational studies evaluating the benefits and adverse effects of HBO for the treatment of CP, McDonagh et al., reported that the improvements in motor function when compared to baseline for both HBO and room air were not significantly different. The evidence to support HBO therapy for CP is insufficient at this time.

In a technology assessment on the efficacy of HBO, AETMIS (2007) concluded that the “efficacy of hyperbaric oxygen therapy for the treatment of cerebral palsy has not been scientifically demonstrated to date, and uncertainty persists.” Its use remains experimental. Their review included randomized controlled trials, observational studies and narrative reviews.

In a clinical report for the American Academy of Pediatrics (AAP) regarding the treatment of children and youth with CP, Cooley et al. (2004) stated that HBO “has far more cost and risk in the face of no evidence of improvement in function.”

**Cerebral Radionecrosis:** Cerebral radionecrosis is a complication of radiation therapy of intracranial and extracranial tumors. Delayed radionecrosis may appear as an intracranial mass and is typically surgically removed. Although HBO has been suggested as a treatment option when surgery is not feasible, clinical trials demonstrating the efficacy of HBO for this indication are lacking.

**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 that can be accompanied by cognitive difficulties and typically, exists for a year or more. Because most cases of CFS may be based on a viral infection, no effective therapy exists (Cunha, 2009). Evidence supporting HBO for the treatment CHF is lacking.

**Chronic Peripheral Vascular Insufficiency:** Peripheral vascular insufficiency is most commonly a disease of the arteries and is caused by atherosclerosis which results in insufficient tissue perfusion. Although HBO has been proposed as a treatment option for peripheral vascular insufficiency, there is insufficient evidence in the peer-reviewed literature to support HBO for this indication.

**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.

**Cutaneous, Decubitus/Pressure Ulcers:** Cutaneous, decubitus (pressure) ulcers are typically localized to an area of tissue necrosis that develops when soft tissue is compressed between a bony prominence and an external surface. HBO for the treatment of decubitus or pressure ulcers has generally been considered ineffective or not extensively evaluated (Gifford, 2007).

In a 2010 Health Care Protocol, the Institute for Clinical Systems Improvement (ICSI) noted that hyperbaric oxygen is one of several therapies proposed as an adjunctive treatment option to enhance healing of pressure ulcers. Due to the paucity of comparative data, ICSI did not recommend HBO for this indication.

**Dementia:** Dementia is characterized by progressive deterioration that interferes with social or occupational functions, such as: memory, orientation, abstraction, ability to learn, visuospatial perception, language function, and constructional praxis. Alzheimer's disease accounts for more than 50% of cases of dementia (Rowland, 2005). There is insufficient evidence in the peer-reviewed literature to support the treatment of dementia with HBO.

**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.

**Fractures (e.g., Acute, Delayed Union and/or Nonunion):** 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.

In a Cochrane systematic review, Bennett et al. (2008) concluded that, although HBO has been proposed for many years for the treatment of fractures, there is insufficient evidence within the literature to support or refute that it aids in the healing of acute injuries and fractures, and/or assists in the healing process of a nonunion fracture. Only one small randomized controlled trial was found and it reported no clinically important outcomes following HBO.

**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.

Bennett et al. (2008) conducted a systematic review and meta-analysis to evaluate the safety and efficacy of HBO compared to normal pressure oxygen therapy (NPOT) used for the prevention and treatment of migraine and cluster headaches. The review included nine randomized controlled trials (n=201) including five trials that compared HBO to sham for acute migraines, two that compared HBO to sham therapy for cluster headaches and two that evaluated HBO only for cluster headaches. Pooled data suggested that HBO was effective in relieving migraines compared to sham therapy (p=0.01), but provided no evidence that HBO could prevent migraines or reduce nausea, vomiting or medication requirements. One trial reported better outcomes using HBO in the treatment of cluster headaches (p=0.08). The authors concluded that additional research was necessary to support HBO over NPOT.

In a randomized, double-blind study of the prophylactic effect of HBO therapy on migraines (n=34), Eftedal et al. (2004) reported that no significant prophylactic effect on migraine was seen. The HBO therapy did not reduce the amount of attack-averting drugs used and had no measurable influence on endothelin-1 levels in the blood. In an earlier randomized controlled trial evaluating the use of HBO for cluster headaches (n=22), Nilsson et al. (2001) reported that two patients had remission of headaches for greater than one year following sham treatment; five patients reported mild to moderate attacks during sham treatment and none during HBO. Researchers measured a number of serum markers of vasoactivation but reported no significant outcomes.

**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.

**Human Immunodeficiency Virus (HIV)–Fatigue:** Fatigue is often a chronic, debilitating symptom of individuals infected with HIV. It has been hypothesized that increased oxygenation by HBO may help to relieve the fatigue. However, evidence in the peer-reviewed literature supporting this hypothesis is lacking.

**Idiopathic Sudden Sensorineural hearing loss (ISSHL):** Idiopathic sudden sensorineural hearing loss (ISSHL) is an acute hearing impairment defined as a 30 decibel (dB) or greater hearing loss occurring in at least three contiguous audiometric frequencies over 72 hours or less. The efficacy of HBO for the treatment of ISSHL has not been established.

In a Cochrane review, Bennett et al. (2009) evaluated six randomized controlled trials that assessed the effectiveness of HBO for the treatment of ISSHL and found that there is limited evidence to suggest that HBO improves hearing in patients who present within two weeks of hearing loss. The routine use of HBO was not justified by the review of the clinical trials. Conlin and Parnes (2007) conducted a systematic review of randomized controlled trials to identify, evaluate and review treatments of ISSHL. A total of 21 trials were identified and one study included the use of HBO (n=34) as an adjunctive treatment to pharmacotherapy. A greater rate of improvement was reported with HBO.

**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.

Van Voorhis et al. (2005) conducted a pilot study (n=23) to determine the safety, tolerability, and effects of HBO when used during ovarian stimulation for IVF. The researchers determined that although HBO was well tolerated, the study population was too small to prove or disprove their hypothesis and additional research and studies were needed to determine: 1) methods of accurately and objectively measuring microvasculature of the ovarian follicle in vitro; and 2) the efficacy of using HBO as an adjunct during IVF.

**Lyme Disease:** Lyme disease is a clinical diagnosis, and currently the early use of antibiotics can prevent persistent, recurrent and refractory conditions. The duration of therapy is determined by each individual's clinical response, but the adjuvant use of HBO therapy is not recommended as part of this treatment.

In their 2010 final report on Lyme disease, the Infectious Diseases Society of America (IDSA) stated that "there is a lack of data regarding the safety and effectiveness" of HBO for the treatment of Lyme disease.

**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 (n=10) and reported that the total limb volume did not change significantly from baseline measurements (Teas, et al., 2004).

Gothard et al. (2010) conducted a randomized controlled trial (n=58) to investigate the effectiveness of HBO in the treatment of patients with ipsilateral arm lymphedema,  $\geq 15\%$  increase in arm volume, following treatment for cancer. Diagnosis included breast cancer (n=56) and Hodgkin lymphoma (n=2). All patients had undergone surgery and radiation therapy. The average interval of time from radiation therapy to randomization was 2.1–21.5 years. Patients were randomized to HBO (n=38) or to the control group (n=20). The study group received 30 HBO treatments while the control group continued best standard care for lymphedema according to the 2006 Lymphoedema Framework Best Practice for the Management of Lymphoedema International Consensus. At the 12-month follow-up (n=46), there were no statistically significant differences from baseline to follow-up in the median volume of the ipsilateral limb (expressed as a percentage of contralateral limb volume) and change over time in either group. There was no clear within-patient improvement from baseline to 12 months with either group. Author-noted limitations of the study included the small patient population and the interval of time from radiation therapy to randomization.

**Malignant Otitis Externa:** Malignant otitis externa (i.e., necrotizing external otitis) is an uncommon, yet potentially fatal infection of the external auditory canal and may involve surrounding tissue and soft bone. HBO therapy has been proposed as an adjunct to traditional therapy (e.g., diabetic control, administration of antibiotics, repeat debridement and surgical resection). However, the efficacy of HBO for this condition has not been established.

Phillips et al. (2011) conducted a Cochrane systematic review to determine the effectiveness of HBO when used as an adjunct to the traditional treatment protocols for malignant otitis externa. The researchers could not locate any randomized controlled trials that had measured the effectiveness of HBO within this population. A small number of case reports and case series were found, but there was no clear evidence that demonstrated the effectiveness HBO therapy for this condition.

**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 systematic review, Bennett and Heard (2010) 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.

**Mycoses:** Mycosis is an infection or a disease caused by a fungus (e.g., candidiasis, aspergillosis, cryptococcus). 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 (McAdam and Sharpe, 2005).

**Nonvascular Causes of Chronic Brain Syndrome (e.g., Pick’s Disease, Alzheimer’s Disease, Korsakoff’s Disease):** 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 (Smith and Seirafi, 2006).

**Ophthalmologic Conditions (e.g., Retinal Artery Occlusion, Optic Neuropathy, Glaucoma):** HBO has been proposed as an adjunctive treatment option for various ophthalmologic conditions, including retinal artery occlusion, optic neuropathy, and glaucoma. Central retinal artery occlusion is unilateral and painless with acute vision loss occurring within seconds (Graham and Ebrahim, 2009; Patterson, 2002). There is insufficient evidence to determine the health outcomes of HBO for the treatment of ophthalmologic conditions.

**Organ Transplant/Storage:** Researchers have hypothesized that HBO may enhance the performance and growth in pancreatic islet grafts, when they are subjected to high levels of oxygen prior to transplant. HBO has also been proposed for administration following organ transplantation to reduce the risk of organ rejection (e.g., liver) as well as, keeping donated organs viable for a longer period of time. However, additional research is required to establish the efficacy of HBO therapy on organ transplantation and storage (Muralidharan, et al., 2007; Juang, 2002).

**Pulmonary Emphysema:** Emphysema is defined as an abnormal permanent enlargement of air spaces in the distal bronchioles that is associated with chronic bronchitis. HBO has been proposed as a treatment option for emphysema, however, improvements in health outcomes have not been established in clinical trials.

**Reflex Sympathetic Dystrophy (RSD)/Complex Regional Pain Syndrome (CRPS):** CRPS, also known as RSD or causalgia, is a neuropathic condition that causes intense pain primarily in the arms, hands, legs or feet. HBO has been proposed as a treatment option for the pain associated with CRPS. Evidence in the peer-reviewed literature does not support the effectiveness of HBO for the treatment of CRPS.

Kiralp et al. (2004) conducted a double-blinded, randomized, placebo-controlled study (n=71) to assess the effectiveness of HBO for treating patients with CRPS. The patients were allocated alternately to receive fifteen, 90-minute therapy sessions of HBO therapy (n=37) or normal air therapy (n=34). The visual analog scale score indicated that pain decreased starting from the first day until day 45 of treatment. An increase in wrist flexion was observed with the HBO group after 15 therapy sessions. A decrease in wrist circumference in the HBO group was also reported. There was a statistically significant difference for all variables except wrist extension. The study is limited by the small patient population and short-term follow-up. Additional studies with larger populations and long-term follow-ups are needed to validate the results of this clinical trial.

**Rheumatoid Arthritis:** Rheumatoid arthritis (RA) is a chronic systemic inflammatory disease of unknown cause that primarily affects the peripheral joints leading to joint destruction and limited mobility (Smith, 2010). Although HBO has been proposed for the treatment of RA to decrease pain and inflammation, there is insufficient evidence supporting its efficacy.

**Sepsis:** Sepsis is a group of disorders that result from infection by bacteria, viruses, fungi, or parasites or the toxic products of these microorganisms. Sepsis involves early signs of circulatory compromise to full-blown circulatory collapse with potentially multi-organ system failure and death (Santhanam and Tolan, 2010). The role of HBO as an adjunctive therapy in the treatment of sepsis remains controversial.

**Sickle-Cell Disease:** Sickle-cell disease is a hereditary disorder of hemoglobin structure and function. The anemia of sickle-cell disease is due to both chronic and acute hemolysis. Several new approaches to treatment of sickle-cell disease are currently under evaluation; however, these approaches do not include HBO (Lodewijk, 2007). Studies supporting HBO for the treatment of sickle-cell anemia are lacking.

**Soft Tissue Injury (e.g., Delayed Onset Muscle Soreness, Closed Soft Tissue Injury, Sprains, Strains):** 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.

According to Bennett et al. (2010) in a Cochrane systematic review including nine randomized controlled trials (n=219), there was insufficient evidence to conclude that HBO in the treatment of delayed onset of muscle soreness or closed soft tissue injury is efficacious.

In a 2006 emerging technology report, ECRI reviewed ten case series (n=176) which used HBO for the treatment of acute soft tissue injury and concluded that they could not determine if HBO “speeds wound healing, shortens hospital length of stay, reduces the incidence of infection or number or severity of complications, improves survival rates, or improves quality of life, but overall, no minor complications or instances of harm were reported”. In two randomized controlled trials addressing efficacy, ECRI was unable to compare the results because of the variations in patients, types of injuries, and outcome criteria. Based on two studies, they concluded that the data suggested that HBO plus standard therapy may result in “a higher incidence of complete or partial limb salvage than patients treated with standard therapies alone.”

**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 (Rowland, 2005).

**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. In a Cochrane review conducted by Bennett et al. (2008), the authors assessed the safety and effectiveness of adjunctive HBO therapy in the treatment of acute ischemic stroke. Three randomized controlled trials (n=106) met inclusion criteria. The authors determined that there is insufficient evidence to make any determinations regarding the safety and efficacy of HBO therapy for stroke patients.

**Tetanus:** Tetanus is caused by the bacteria *Clostridium tetani* and is characterized by an acute onset of hypertonia and generalized muscle spasms. Although HBO has been proposed as a treatment option for tetanus, there is insufficient evidence in the peer-reviewed literature to support its efficacy.

**Tinnitus:** Tinnitus, also commonly referred to as “ringing in the ears” or “head noise,” is defined as the perception of sound in the head when no external sound is present. This symptom can occur in one ear or bilaterally, as well as internal and external to the auricle. HBO has been investigated as a treatment option in order to increase the supply of oxygen to the ear and brain in an attempt to decrease the severity of hearing loss and tinnitus. Overall, improved clinical outcomes have not been reported following HBO.

Bennett, et al. (2009) conducted a systemic review of seven randomized controlled trials (n=392) to assess the benefits and harms of HBO for the treatment of tinnitus and/or sudden sensorineural hearing loss. The significance of any improvement in tinnitus could not be assessed by pooled data and the routine use of HBO for the treatment of tinnitus could not be justified.

In a study to analyze the effectiveness of HBO treatment on tinnitus, Porubsky et al. (2007) randomized 360 patients suffering from tinnitus into two HBO treatment protocols (2.2 bar vs. 2.5 bar). Twelve patients (3.3%) experienced complete remission of tinnitus, in 122 (33.9) the intensity lessened, and 44 (12.2%) had a subjectively agreeable change of noise characteristics. No change was found in 157 cases (43.6%) and 25 (6.9%) experienced deterioration. There was no statistically significant difference between the two groups ( $p>0.05$ ). Out of 68 patients with a positive expectation of HBO effects, 60.3% stated that the tinnitus had improved compared to 47.2% of patients ( $n=271$ ) who underwent therapy with an indifferent expectation and 19% ( $n=21$ ) of patients with a negative expectation. The influence of subjective expectation on the outcome was statistically significant ( $p<0.05$ ).

**Venous Stasis Ulcers:** Venous stasis ulcers are the result of chronic venous insufficiency and can lead to life-threatening infections of the lower extremities. Although HBO therapy has been proposed for the treatment of this population, its efficacy has not been established by clinical trials. A systematic review of randomized controlled trials evaluating HBO for the treatment of chronic wounds (Kranke, et al., 2005) included one trial with 16 patients who had venous ulcers. At six weeks the author reported significant reduction in the ulcer area. Large randomized controlled trials with long-term follow-ups are needed to validate the results of this study.

**Other Indications:** Studies, primarily in the form of small case series ( $n=5-20$ ), case reports and retrospective reviews have investigated HBO as a primary or adjunctive therapy for various other indications including: altitude sickness, avascular necrosis, Bell's palsy, comatose patients, cutaneous polyarteritis nodosa lesions, frostbite, dental implants and tooth extractions, femoral head necrosis, fibromyalgia, gastrointestinal ulcers, heat stroke, myofascial pain, Parkinson disease, chronic periodontitis, scleroderma, venomous snake bites, and to improve the success of osseointegration following maxillofacial implants. Overall, improved health outcomes following HBO for the treatment of these conditions has not been established (Latham, et al., 2010; Nogueira-Filho, et al., 2010; ACS, 2008; AHRQ, 2006).

#### **Literature Review – Topical Hyperbaric Oxygen (THBO)**

There is insufficient evidence in the published peer-reviewed scientific literature to support the effectiveness of THBO for the treatment of acute or chronic wounds. The available studies have been primarily in the form of nonrandomized studies and case series with small patient populations and short-term follow-ups.

Blackman et al. (2010) conducted a prospective controlled study to compare the efficacy of THBO ( $n=17$ ) to silver-based dressing (control group,  $n=11$ ) for the treatment of diabetic foot ulcers. Wounds were more severe and ulcer durations were longer in the treatment group compared to the control group. The THBO group received therapy five times per week for 90 days. Wounds were debrided in each group as indicated. The number of ulcers with complete healing in the THBO group compared to the control group was statistically significant ( $p=0.04$ ). Fourteen of 17 ulcers (82.4%) in the treatment group and five of 11 ulcers (45.5%) in the control group healed after a median of 56 and 93 days, respectively. At the 24-month follow-up no ulcers had reoccurred in either group. The authors noted that there was a possible selection bias with the more serious wound patients being assigned to THBO. Limitations of the study include the small patient population and nonrandomization.

Tawfick and Sultan (2009) conducted a prospective comparative study to evaluate the safety and efficacy of THBO for the treatment of chronic venous ulcers refractory to medical management. A total of 46 ulcers were treated with THBO and debridement, and 37 ulcers were treated with dressings and debridement. Patients selected the treatment option they preferred. Treatment was continued for 12 weeks or until complete healing occurred. Compared to the control group, a significant number of ulcers in the THBO group showed a reduction in surface area by week three and complete healing by week 12 ( $p=0.016$  and  $p<0.001$ , respectively). At 12 weeks, the mean reduction in ulcer surface area was 96% in the THBO group, compared to 61% in the control group. The median time to full healing was 45 days in the THBO group and 182 days in the control group ( $p<0.001$ ). Nine of 19 methicillin resistant staphylococcus aureus (MRSA) positive ulcers in the THBO group were negative after five weeks of therapy compared to none of 17 in the control group ( $p=0.007$ ). During the follow-up period none of the 37 THBO-treated healed ulcers showed signs of recurrence compared to 5 of 13 ulcers in the control group and two control group ulcers begin to deteriorate prior to complete healing. Limitations of the study include the small patient population, selection of treatment option by the patients, and nonrandomization.

Gordillo et al. (2008) conducted a case study of 57 patients with wounds (e.g., venous ulcer, pressure, surgical) that were present for at least four weeks. Of these 57 patients (83% were diabetic), 32 qualified for systemic HBO. The remaining 25 patients consented to receive THBO. The difference between the median initial wound volume for the THBO group and the median final wound volume was significant (3.3 cm<sup>3</sup> vs. 1.4 cm<sup>3</sup>, respectively; p=0.001). The gene tests found a higher expression of the vascular endothelial growth factor (VEGF) gene in THBO-treated healing wounds (p=0.031). The authors concluded that based on the results of this study, larger, well designed studies are warranted to determine if THBO is effective in treating problem wounds in a clinical setting.

Edsberg et al. (2002) conducted a prospective, uncontrolled study to observe the effects of THBO and THBO with electrical stimulation for the treatment of chronic wounds. Eight patients with stage III or stage IV chronic pressure ulcers received THBO treatments twice daily, seven days a week. THBO sessions lasted for 90 minutes with 2–3 liters of humidified oxygen delivered at 22 millimeters mercury (mm Hg). Three of these patients also received electrical stimulation, once daily for five days. At the end of four weeks, the average wound size had decreased by 34.4% ± 22.9% in five of the eight patients. The initial wound size before treatment ranged from 87.75 centimeters squared (cm<sup>2</sup>) to 7.04 cm<sup>2</sup> with an average of 30.1 cm<sup>2</sup> ± 28.5 cm<sup>2</sup>. No significant differences in healing were observed between patients receiving THBO and patients receiving THBO with electrical stimulation.

### **Professional Societies/Organizations**

**American College of Chest Physicians (ACCP):** The 2008 ACCP guidelines for the management of thromboembolic disorders recommended that HBO not be used for the treatment of patients with venous ulcers.

**American College of Foot and Ankle Surgeons (ACFAS):** ACFAS (2006) reported that systemic HBO therapy has shown promise in the treatment of diabetic foot wounds with hypoxia severe enough to interfere with healing. However, most of the HBO studies had been hampered by methodological errors that prevented defining a role for this modality in the routine treatment of diabetic foot ulcers. The benefit of HBO therapy for this indication has not been proven conclusively in large multicenter randomized clinical trials.

**Infectious Diseases Society of America (IDSA):** In their 2010 final report on Lyme disease, IDSA stated that “there is a paucity of data regarding the safety and effectiveness” of HBO for the treatment of this condition.

**Undersea and Hyperbaric Medical Society (UHMS):** UHMS (2007) has approved the following indications for systemic HBO:

- air or gas embolism
- carbon monoxide poisoning
- carbon monoxide poisoning complicated by cyanide poisoning
- clostridial myositis and myonecrosis (gas gangrene)
- crush injury, compartment syndrome, and other acute traumatic ischemias
- decompression sickness
- enhancement of healing in select problem wounds
- exceptional blood loss (anemia)
- intracranial abscess
- necrotizing soft tissue infections
- osteomyelitis (refractory)
- delayed radiation injury (soft tissue and bony necrosis)
- skin grafts and flaps (compromised)
- thermal burns

Following a review of the evidence, which included one randomized controlled trial and three case series, UHMS (2009) 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.

Regarding topical oxygen, UHMS stated (2005) “Topical oxygen should not be termed hyperbaric oxygen since doing so intentionally or unintentionally suggests that topical oxygen treatment is equivalent or even identical to hyperbaric oxygen. Mechanisms of action or clinical study results for hyperbaric oxygen cannot and should not

be co-opted to support topical oxygen since hyperbaric oxygen therapy and topical oxygen have different routes and probably efficiencies of entry into the wound and their physiology and biochemistry are necessarily different. The application of topical oxygen cannot be recommended outside of a clinical trial at this time based on the volume and quality of scientific supporting evidence available.”

### Summary

Evidence in the published peer-reviewed scientific literature and professional societies and organizations support the safety and effectiveness of systemic hyperbaric oxygen therapy (HBO) as a first-line therapy and as an adjunctive therapy for a carefully selected subgroup of conditions.

There is insufficient evidence in the published, peer-reviewed scientific literature to support the use of systemic HBO for all other conditions. Evidence in the peer-reviewed literature to support the safety and effectiveness of topical oxygen, or topical hyperbaric oxygen, for any indication is lacking.

## Coding/Billing Information

**Note:** This list of codes may not be all-inclusive.

### Systemic Hyperbaric Oxygen Therapy:

**Covered when medically necessary:**

CPT®* Codes	Description
99183	Physician attendance and supervision of hyperbaric oxygen therapy, per session

HCPCS Codes	Description
C1300	Hyperbaric oxygen under pressure, full body chamber, per 30 minute interval

ICD-9-CM Diagnosis Codes	Description
040.0	Gas gangrene
250.7.0 - 250.73	Diabetes with peripheral circulatory disorders
324.0	Intracranial abscess
459.81	Unspecified venous (peripheral) insufficiency
526.89	Other specified diseases of the jaws, other
558.1	Gastroenteritis and colitis due to radiation
595.82	Irradiation cystitis
595.9	Unspecified cystitis
673.00 – 673.04	Obstetrical air embolism
686.00- 686.09	Other pyoderma
728.86	Necrotizing fasciitis
730.00 - 730.09	Acute osteomyelitis
730.10 - 730.19	Chronic osteomyelitis
730.20 - 730.29	Unspecified osteomyelitis
906.4	Late effect of crushing

909.2	Late effect of radiation
927.00 - 927.9	Crushing injury of upper limb
928.00 - 928.9	Crushing injury of lower limb
929.0 - 929.9	Crushing injury of multiple and unspecified sites
946.3	Full-thickness skin loss due to burn (third degree NOS) of multiple specified sites
946.4	Deep necrosis of underlying tissues due to burn (deep third degree) of multiple specified sites, without mention of loss of a body part
946.5	Deep necrosis of underlying tissues due to burn (deep third degree) of multiple specified sites, with loss of a body part
958.0	Certain early complications of trauma, air embolism
958.90 - 958.99	Traumatic compartment syndrome
986	Toxic effect of carbon monoxide
987.7	Toxic effect of hydrocyanic acid gas
989.0	Toxic effect of hydrocyanic acid and cyanides
993.3	Caisson disease
996.52	Mechanical complication of other specified prosthetic device, implant and graft, due to graft of other tissue, not elsewhere classified
999.1	Complication of medical care, not elsewhere classified, air embolism

**Experimental/Investigational/Unproven/Not Covered:**

<b>ICD-9-CM Diagnosis Codes</b>	<b>Description</b>
037	Tetanus
038.0 - 038.9	Septicemia
039.9	Actinomycotic infection of unspecified site
042	Human immunodeficiency virus [HIV]
088.81	Lyme disease
117.0 - 117.9	Other mycoses
199.1	Malignant neoplasm without specification of site, other
239.9	Neoplasms of unspecified nature, site unspecified
282.60 - 282.69	Sickle-cell disease
290.0 - 290.9	Dementias
291.1	Alcohol-induced persisting amnesic disorder
294.8	Other persistent mental disorders due to conditions classified elsewhere
299.00	Autistic disorder, current or active state
299.01	Autistic disorder, residual state
331.0	Alzheimer's disease
331.11-331.19	Frontotemporal dementia
332.0-332.1	Parkinson's disease
337.20-337.29	Reflex sympathetic dystrophy
339.00	Cluster headache syndrome, unspecified
339.01	Episodic cluster headache
339.02	Chronic cluster headache
340	Multiple sclerosis
343.0 - 343.9	Infantile cerebral palsy
345.00 - 345.91	Epilepsy and recurrent seizures
346.00 -	Migraine

346.91	
348.1	Anoxic brain damage
348.5	Cerebral edema
351.0	Bell's palsy
340	Multiple sclerosis
343.0 - 343.9	Cerebral palsy
345.00 - 345.91	Epilepsy
346.00 - 346.91	Migraine
348.5	Cerebral edema
354.4	Causalgia of upper limb
355.71	Causalgia of lower limb
362.30	Unspecified retinal vascular occlusion
362.31	Central artery occlusion of retina
362.32	Arterial branch occlusion of retina
362.33	Partial arterial occlusion of retina
362.34	Transient arterial occlusion of retina
365.00-365.9	Glaucoma
377.34	Toxic optic neuropathy
380.14	Malignant otitis externa
388.30 - 388.32	Tinnitus
389.10 - 389.18	Sensorineural hearing loss
410.00 - 410.92	Acute myocardial infarction
411.1	Intermediate coronary syndrome
434.91	Unspecified cerebral artery occlusion with cerebral infarction
437.1	Other generalized ischemic cerebrovascular disease
440.20	Atherosclerosis of the extremities, unspecified
446.0	Polyarteritis nodosa
446.0	Polyarteritis nodosa
454.0	Varicose veins of lower extremities with ulcer
455.0	Internal hemorrhoids without mention of complication
455.1	Internal thrombosed hemorrhoids
455.2	Internal hemorrhoids with other complication
457.0	Postmastectomy lymphedema syndrome
457.1	Other noninfectious lymphedema
492.8	Other emphysema
523.40- 523.42	Chronic periodontitis
534.00- 534.91	Gastrojejunal ulcer
555.0 - 555.9	Regional enteritis
565.0	Anal fissure
569.49	Other specified disorder of rectum and anus
570	Acute and subacute necrosis of liver
617.1	Endometriosis of ovary
617.2	Endometriosis of fallopian tube
707.00 - 707.09	Pressure ulcer
710.1	Systemic sclerosis
714.0 - 714.9	Rheumatoid arthritis and other inflammatory polyarthropathies
729.1	Myalgia and myositis, unspecified
733.40	Aseptic necrosis of bone, site unspecified

733.42	Aseptic necrosis of bone, Hean and neck of femur
733.82	Nonunion of fracture
768.70 - 768.73	Hypoxic-ischemic encephalopathy [HIE]
780.01	Coma
780.71	Chronic fatigue syndrome
780.79	Other malaise and fatigue
784.0	Headache
785.51	Cardiogenic shock
854.00 - 854.09	Intracranial injury of other and unspecified nature without mention of open intracranial wound
905.7	Late effect of sprain and strain without mention of tendon injury
905.8	Late effect of tendon injury
947.1	Burn of larynx, trachea, and lung
952.00 - 952.9	Spinal cord injury without evidence of spinal bone injury
982.1	Toxic effect of carbon tetrachloride
987.8	Toxic effect of other specified gases, fumes, or vapors
989.5	Toxic effect of venom
990	Effects of radiation, unspecified
991.0	Frostbite of face
991.1	Frostbite of hand
991.2	Frostbite of foot
991.3	Frostbite of other and unspecified sites
992.0	Heat stroke and sunstroke
993.2	Effects of air pressure, other and unspecified effects of high altitude
995.91	Systemic inflammatory response syndrome (SIRS), sepsis
995.92	Systemic inflammatory response syndrome (SIRS), severe sepsis
998.59	Other postoperative infection
V42.0-V42.9	Organ or tissue replaced by transplant
	All other codes

### **Topical Hyperbaric Oxygen**

#### **Experimental/Investigational/Unproven/Not Covered:**

<b>HCPCS Codes</b>	<b>Description</b>
A4575	Topical hyperbaric oxygen chamber, disposable

<b>ICD-9-CM Diagnosis Codes</b>	<b>Description</b>
	All codes

**\*Current Procedural Terminology (CPT®) © 2010 American Medical Association: Chicago, IL.**

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## Policy History

<b>Pre-Merger Organizations</b>	<b>Last Review Date</b>	<b>Policy Number</b>	<b>Title</b>
CIGNA HealthCare	4/15/2008	0053	Hyperbaric Oxygen Therapy
CIGNA HealthCare	7/15/2008	0395	Topical Hyperbaric Oxygen (THBO) Therapy
Great-West Healthcare	7/12/2006	96.226.04	Hyperbaric Oxygen Therapy (HBOT)

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