Emergency Oxygen
Student Handbook, Version 7.0

Purpose of this Handbook
This ASHI Emergency Oxygen Version 7.0 Student Handbook is solely intended to facilitate certification in an ASHI Emergency Oxygen training class. The information in this handbook is furnished for that purpose and is subject to change without notice.

ASHI certification may only be issued when an ASHI-authorized Instructor verifies a student has successfully completed the required core knowledge and skill objectives of the program.

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Section 1 — Introduction

The Case for Emergency Oxygen

Found in the air we breathe, oxygen is the most essential element the human body requires in order to live.

When a serious illness or injury occurs, the body’s ability to process oxygen can be compromised.

Low levels of oxygen in the body, or hypoxia, can result in a deteriorating condition known as shock.

Unless the effects of the decreased amount of oxygen can be reversed, shock can quickly progress into a life-threatening emergency.

Basic priority care considerations, such as maintaining a clear and open airway, ensuring adequate breathing, and controlling external bleeding, should always be your initial priorities of care for an ill or injured person.

The use of emergency oxygen by a first aid provider can help meet an ill or injured person’s critical need for oxygen to further improve the person’s outcome.

Many medical authorities recommend that a person be provided the highest concentration of oxygen available during many medical emergencies.

The air we breathe contains about 21% oxygen. In an emergency, oxygen delivery systems can potentially increase oxygen percentages close to 100%.

Conditions that could benefit from emergency oxygen include the following:

- Divers with a decompression injury
- Serious bleeding
- Difficulty breathing
- Suspected internal injury
- Warning signs of serious illness
- Serious mechanisms of injury

There are few significant medical risks when providing supplemental oxygen in an emergency. When in doubt, provide emergency oxygen for someone who shows signs of respiratory difficulty, if it is available, local protocols allow, and you are trained in its use.
Integrating the Use of Emergency Oxygen

Although the use of oxygen during a medical emergency can be helpful, it is important to remember that it is only a part of your overall approach to care and should not interfere with more urgent care considerations.

Always follow the priorities of care prior to providing emergency oxygen:

- Make sure the emergency scene is safe.
- Activate Emergency Medical Services, or EMS.
- If a person is unresponsive, determine absence of normal breathing.
- If a person is not breathing, perform CPR beginning with chest compressions.
- Control any serious bleeding with direct pressure.
- Manually stabilize a person’s head if you suspect neck or spinal injury.
- Allow a seriously ill person to assume a position in which he or she is most comfortable.

Never delay priority care for a seriously ill or injured person to locate or set up emergency oxygen equipment.

When possible, have a bystander or other provider retrieve emergency oxygen equipment while you stay and provide care for a person.

When you are able to do so, integrate emergency oxygen smoothly into your existing first aid care following local protocols.

Monitor the person for any changes in condition and monitor pulse oximetry/SpO₂ if available. Continue care until the person can receive a more advanced level of care.
Section 2 — Delivery Systems

Emergency Oxygen Delivery Systems

An oxygen delivery system is a complete unit capable of providing emergency oxygen to a person.

In the United States, the Food and Drug Administration (FDA) requires that emergency oxygen systems deliver a minimum of 6 liters of oxygen per minute for at least 15 minutes.

There are many different types of oxygen delivery systems for use in an emergency. Although design variations exist, all of the systems operate in the same general manner.

An emergency oxygen delivery system has four primary components: oxygen cylinder, regulator, tubing, and delivery device.

Factors that affect the ability to provide high concentrations of oxygen include the following:

- The type of oxygen delivery device or mask
- The ability of the oxygen first aid provider
- Oxygen flow rate
- The seal of the mask around the person's face
Primary Oxygen System Components

Oxygen Cylinder

The oxygen cylinder contains purified oxygen. A typical cylinder is highly pressurized to increase the volume of oxygen available for use (Figure 1).

Oxygen cylinders come in many sizes and are usually constructed of aluminum or steel.

A cylinder valve located on the top of the cylinder controls the release of oxygen from the cylinder (Figure 2).

Regulator

The oxygen regulator (Figure 3) attaches to the cylinder at the cylinder valve. It reduces the pressure of compressed oxygen inside the oxygen cylinder to a level more appropriate for patient care.

A regulator can have a fixed flow, which provides a pre-set flow volume when the cylinder valve is opened.

An adjustable flow regulator allows you to use a flow rate controller to set a flow rate of your choice.

Oxygen flow rates are typically measured in liters per minute, often represented as LPM.

Most regulators include a pressure gauge (Figure 3) to allow providers to monitor cylinder pressure.

Oxygen flows from the regulator through outlet ports designed to be used with specialized tubes or hoses.

Tubing

Oxygen tubing (Figure 4) delivers oxygen from the regulator to an oxygen delivery device.

Oxygen tubing has specially designed ends that allow providers to connect it directly to a regulator or delivery device.

Delivery Devices Used on Breathing Persons

Oxygen delivery devices deliver oxygen directly to the person. These devices are attached or held closely to the person’s mouth or nose to create a higher percentage of oxygen.

Certain delivery devices are intended for use on a person who is breathing adequately. These devices allow the person to draw the oxygen in with his own breath.

Ventilation Mask

A ventilation mask (Figure 5) with an oxygen inlet port is a very common delivery device included with emergency oxygen delivery systems.

Depending on the flow rate, ventilation masks can deliver oxygen concentrations as high as about 50%.

Use the highest flow rate available between 6 and 15 liters per minute. Make sure the mask seals well on the person’s face.
Simple Face Mask
A simple face mask (Figure 6) is similar to a ventilation mask except that it lacks a ventilation port. It also provides oxygen concentrations as high as 60%.

Use the highest flow rate available between 6 and 15 liters per minute. Make sure the mask seals well on the person’s face.

Non-Rebreather Mask
A non-rebreather mask (Figure 7) can deliver the highest oxygen concentration to a breathing person.

Non-rebreather masks can reach oxygen delivery concentrations between 60% and 95%.

Non-rebreather masks have a reservoir bag that stores free flowing oxygen until it is inhaled. One-way valves help ensure that high oxygen concentrations are delivered by keeping outside air out of the mask and exhaled air out of the reservoir bag.

Use the highest flow rate available between 10 and 15 liters per minute. Make sure the mask seals well on the person’s face.

Nasal Cannula
A nasal cannula (Figure 8) is not considered a high oxygen concentration delivery device. Up to 40% oxygen concentration can be delivered with this device at a maximum flow rate of 6 liters per minute. It has limited application in an emergency and its use is not covered in this program.

Delivery Devices Used on Nonbreathing Persons
Other delivery devices are used when a person is not breathing. These devices use a provider’s breath, compressed bag, or pressure within the oxygen tank to force oxygen into the lungs of the person.

Ventilation Mask
A ventilation mask (Figure 9) with an oxygen inlet port can be used on a nonbreathing person by blowing through the mouth port on the top of the mask.

A ventilation mask with connected oxygen flowing can increase the oxygen concentration of rescue ventilations from approximately 16–17% found in the rescuer’s exhaled air to about 50%.

Masks are clear to detect vomit or other foreign material and are equipped with a one-way valve for protection from disease transmission.

Use the highest flow rate available between 6 and 15 liters per minute. Establish an airway before ventilating and make sure you see a visible rise of the chest on every ventilation.

Bag-Mask Ventilation
A bag-mask device (Figure 10), also known as a “BVM”, uses pressure created by squeezing a self-refilling bag to force air containing oxygen into a person.

With an attached reservoir bag connected to a 10 to 15 liter-per-minute flow of oxygen, this device can provide nearly 100% oxygen concentrations. A BVM is primarily an option for healthcare professionals and professional rescuers.
Unique Delivery Systems

Although all emergency oxygen delivery systems include the same basic features, individual systems may have other unique features to consider.

Some systems automatically begin the flow of oxygen once removed from their storage cases. A pre-connected ventilation mask ensures that the unit is ready to use in an emergency (Figure 11).

Other systems are designed with a fixed-flow regulator so you simply move a lever to begin oxygen flow. Rugged cases can protect pressurized oxygen cylinders from being damaged (Figure 12).

Some systems are disposable. These systems typically cost less and can be discarded after use (Figure 13).

Although a wide variety of systems and delivery devices are available, your training needs to be specific to the emergency oxygen systems you would use in an emergency.

The FDA requires that medical oxygen cylinders bear a label that states: “For emergency use only when administered by properly trained personnel for oxygen deficiency and resuscitation. For all other medical applications, Rx [Prescription] Only.”

To refill an oxygen cylinder, you must go to a medical or compressed gas distributor. Even with the FDA statement and labeling on emergency oxygen, it may still be necessary to have a prescription, or show documentation of training, in order to get an oxygen cylinder refilled.
Section 3 — Pulse Oximetry

Pulse oximetry is a method that allows responders to quickly measure how much oxygen the blood is carrying. It can be helpful as part of a comprehensive assessment, in determining when emergency oxygen may be appropriate, and in monitoring its effectiveness.

Typical pulse oximetry equipment is inexpensive, non-invasive (does not break the skin), and user friendly. The measuring device usually clips onto a fingertip or an earlobe as these are fairly translucent parts of the body.

The system uses both red and infrared light to measure the peripheral oxygen saturation (SpO₂) of hemoglobin (responsible for transporting oxygen in the blood). Pulse oximeters, as the name implies, also measure the pulse/heart rate. Pulse oximeters are fairly accurate, generally to within plus or minus 2%.

Pulse oximetry should not be the only method used to assess and determine the need for emergency oxygen in a person with outward signs of respiratory distress; nor should it be used to withhold administration of emergency oxygen.

An SpO₂ level of 95% or higher is considered to be normal. SpO₂ of 93–94% may indicate mild hypoxemia (low oxygen) and a level of 92% or less (at sea level) indicates a need for emergency oxygen.

Integrating Pulse Oximetry with Emergency Oxygen

Pulse oximetry is increasingly being used in the management of acute and chronic respiratory disease. It is also a method that can be used to monitor the effectiveness of emergency oxygen for persons in respiratory distress.

Limitations of Pulse Oximetry

While pulse oximetry is a convenient tool for assessing oxygen saturation, it does have some limitations. Pulse oximetry does not measure carbon dioxide levels and is not a substitute for, or as accurate as, arterial blood gas measurement (ABG).

The oximetry reading may be less accurate if the ill or injured person is wearing nail polish, artificial nails, has poor circulation, or has been exposed to the cold or is hypothermic.

Also, since pulse oximetry equipment cannot distinguish between oxygen and carbon monoxide, victims of carbon monoxide poisoning or smokers may have inaccurate or higher readings than their actual oxygen saturation.

Excessive movement, lowered blood pressure, hypoperfusion (shock), and a poor fitting sensor can also affect the accuracy of the oximetry reading.

Another significant point about pulse oximetry is that some individuals with severe, chronic lung disease (e.g., chronic obstructive pulmonary disease (COPD)) may develop a condition called hypercapnia (excessive carbon dioxide in the blood) if they are provided too high a concentration of oxygen to bring their SpO₂ levels above 95%. These individuals will most likely need targeted saturation levels of approximately 88% to 92%.
Skill Guide 1
Using Pulse Oximetry Equipment

Instructions
• Follow the manufacturer’s instructions.

Equipment Use
• Turn on the unit and allow for any self-tests.

Placement
• Apply the probe to the appropriate area, such as a fingertip.

Reading
• Allow the oximeter to obtain a reading and record the results.
• If trained, compare the pulse reading with the person’s actual pulse.
• Deploy emergency oxygen delivery system based on a thorough assessment of signs, symptoms and a pulse oximetry reading.
**Deploy Emergency Oxygen Delivery System**
- Ensure priority person care is being provided.
- Assess and determine need for emergency oxygen based on signs, symptoms and pulse oximetry (if available).
- Turn cylinder valve and gauge away and slowly open valve.

**Prepare Delivery Mask**
- Connect tubing to regulator and mask.
- Set the appropriate oxygen flow rate for mask being used:
  - Ventilation mask — 6–15 LPM
  - Non-rebreather — 10–15 LPM
- Listen for the flow of oxygen through the mask and inflate reservoir bag if necessary.

**Place Device on Person**
- Reassure person about benefits of oxygen.
- Allow person to hold mask in place.
- Ensure mask seal and adjust strap to hold mask in place.

**Provide Ongoing Assessment**
- Monitor person, oxygen flow, cylinder gauge, and pulse oximetry if available.
- Be prepared to provide additional care if person becomes unresponsive or stops breathing.
Skill Guide 3
Oxygen Delivery for a Nonbreathing Person

Deploy Emergency Oxygen Delivery System
- Ensure that CPR is being provided as needed.
- Assess and determine need for emergency oxygen based on signs, symptoms and pulse oximetry (if available).
- Turn cylinder valve and gauge away and slowly open valve.

Prepare Delivery Mask
- Connect tubing to regulator and mask.
- Set the oxygen flow rate to highest rate available up to 15 LPM.
- Listen for the flow of oxygen through the mask.

Integrate Oxygen into Care
- Integrate mask with oxygen smoothly without disrupting care.
- Position mask to create an effective seal on the person’s face.
- Establish an airway with head-tilt, chin-lift.

Continue CPR with Emergency Oxygen
- Provide continuous cycles of 30 compressions and 2 ventilations unless the person moves, an AED arrives, or another provider or EMS takes over care.
- Monitor person, oxygen flow, cylinder gauge, and pulse oximetry if available.
Depressurize Regulator
- Discard one-time use only items.
- Close oxygen cylinder valve.
- Open regulator’s flow controller and wait for sound of flowing oxygen to stop.

Disassembly
- Loosen regulator.
- Slide it off neck of cylinder.
- Check for corrosion and debris.
- Have oxygen cylinder refilled at a local medical or compressed gas distributor. A prescription and/or proper training (certification) may be required.

Reassembly
- Briefly open and close cylinder valve.
- Examine and insert gasket.
- Attach regulator to oxygen cylinder.
- Pressurize the system and check for leaks.

Return to Service
- Depressurize the regulator.
- Replace any disposable items.
- Store the system for use in an emergency.
Safety Precautions

Although the use of emergency oxygen equipment is safe under normal conditions, you should be aware of some potential hazards.

Be sure to follow all of the manufacturer’s recommendations regarding the maintenance, operation, and use of the oxygen equipment.

When full, oxygen cylinders are highly pressurized. If damaged, they could rapidly release their contents, causing serious injury or damage.

To improve the safety of oxygen providers, a number of safeguards are built into the oxygen equipment. Oxygen cylinder valves and regulators use a pin-indexing safety system to prevent the use of incompatible regulators with oxygen cylinders (Figure 2, Figure 14).

Oxygen cylinders are color-coded to prevent accidental use of another gas. In the United States, green is the color code for oxygen. Medical cylinders are also required to be labeled specifically for the gas and its intended use.

Ensure that cylinders are appropriately labeled for oxygen use and that they are within the required hydrostatic test date.

Use plugs, caps, and plastic bags to protect equipment from dust and dirt when it is out of service.

Cleaning, repairing, or filling oxygen equipment should be performed by qualified, properly trained personnel.

Always handle oxygen cylinders carefully. Never stand a cylinder upright without support. Use a case for protection. Carry unprotected oxygen cylinders with two hands. When transporting them in a car, secure and block cylinders to prevent them from rolling.

Store oxygen cylinders in clean, dry locations away from sunlight or high temperatures that could increase the pressure in the cylinder. Choose a storage location that protects cylinders from objects that could fall on them. Secure cylinders in a manner to prevent them from tipping over or rolling.

While oxygen is not flammable, all substances require oxygen to burn. Concentrated oxygen can rapidly accelerate the rate at which things burn.

Problems associated with fire and emergency oxygen delivery equipment are rare.

Always extinguish smoking materials and any open flame around oxygen equipment.

Avoid using oxygen in confined spaces. Ensure adequate ventilation when providing or using oxygen.

The FDA has concluded that the improper use of plastic sealing gaskets (Figure 15a) could increase the risk of an oxygen regulator fire. Injuries have occurred as a result.

These single-use gaskets are commonly provided when oxygen cylinders are refilled. Only use these types of gaskets once, because leaks can occur that could ignite the gasket material and result in a fire or explosion.

Consider the use of metal-bound rubber sealing gaskets (Figure 15b) that can safely be used multiple times. Precaution should be taken to prevent oxygen-related fires when using both emergency oxygen and an Automated External Defibrillator, or AED. Direct the delivery device or mask away from a person when delivering a defibrillation shock.
Additional Recommendations

Other recommendations to help reduce oxygen-related fires include the following:

- Follow the manufacturer’s instructions for attaching regulators to cylinders.
- Use a sealing gasket specified by the regulator manufacturer.
- Crack cylinder valves before attaching regulators to expel foreign matter from the valve’s outlet port.
- Visually inspect sealing gaskets for damage before use.
- Be sure the valve, regulator, and gasket are free from oil or grease.
- Never use wrenches or tools to tighten the regulator to the cylinder. This could damage the gasket. Hand-tighten only.
- Open the cylinder valve slowly. If you hear a leak, quickly close the valve. Verify that the regulator is properly attached and the gasket is properly placed and in good condition.

Additionally, there are a few emergency oxygen use recommendations that will increase your safety.

- Ensure that everyone who may use the oxygen equipment is adequately trained in its operation and in oxygen safety. Also, oxygen providers should have knowledge of operating instructions from the equipment manufacturer.
- Ensure that the constant flow controller on the regulator is set to the “Off” or zero position before securing it tightly to the cylinder.
- When pressurizing the regulator, point the oxygen equipment so the cylinder valve and regulator pressure gauge are pointed away from the oxygen provider and any other people.
This required course evaluation allows you to rate the training course you have just completed. This evaluation will provide your training provider with feedback on the quality of the instruction you received.

Instructor ___________________________ Date of Course ______________________

Please rate the following course elements as indicated below. Place a check in the box that best represents your opinion of the quality of each element.

Thank you for your help.

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What did you like most about this course? ____________________________________________

What did you like least about this course? ___________________________________________

Would you recommend this course to others? □ Yes □ No
Emergency Oxygen