



SUPPLEMENTAL OXYGEN

Administration Manual

Meets Current CPR, ECC, and First Aid Guidelines

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Chapter 1

SUPPLEMENTAL OXYGEN SYSTEM



Learning Outcomes

After reading this chapter and completing any related course work, you should be able to:

- Describe the benefits of supplemental oxygen during resuscitation and drowning emergencies
- Explain the parts of the Supplemental Oxygen System (SOS)
- Demonstrate the use of the SOS
- Explain the necessary precautions when using the SOS
- Explain the basic care and maintenance of the SOS
- Demonstrate the use of the bag-valve-mask (BVM) and how to connect it to the SOS

Chapter Overview

- Drowning and the Need for Supplemental Oxygen (pg. 2)
- Supplemental Oxygen Systems (SOS) (pg. 2)
- Supplemental Oxygen Delivery Devices (pg. 4)
- Care and Maintenance of Supplemental Oxygen Systems (pg. 8)
- For Your Review (pg. 10)

Need for Supplemental Oxygen

During a respiratory emergency, oxygen is unable to reach the body's vital organs, such as the heart, lungs, and brain. These organs are not able to function without the continuous delivery of oxygen through the bloodstream. **Supplemental oxygen** should be provided to any person experiencing serious respiratory distress.

When providing rescue breaths through a resuscitation mask, approximately 16% oxygen is exhaled by the rescuer into the nonbreathing person. While this is adequate to support the amount of oxygen needed to resuscitate the person, providing a higher concentration of oxygen can improve oxygenation. With the availability of inexpensive, easily deployable oxygen systems, rescuers can successfully deliver supplemental oxygen to distressed persons during resuscitation (**Figure 1.1**).



Figure 1.1 Supplemental oxygen should be used during resuscitation efforts.

Supplemental Oxygen Systems (SOS)

A **supplemental oxygen system (SOS)** can help with numerous breathing emergencies including drowning. A complete system is easy to use and meets or exceeds emergency oxygen requirements (**Figure 1.2**).

Regulations Governing Supplemental Oxygen Use

Some states have established regulations for the purchase and use of supplemental oxygen. The device you use must be designed specifically for emergency use. The Food and Drug Administration does not require a prescription for emergency use oxygen, provided that oxygen systems designed for emergency use contain at least a 15-minute supply of oxygen and deliver a flow rate of at least 6 liters per minute (lpm). Your facility management is responsible for making sure that all local, regional, and state regulations governing emergency oxygen use are followed when providing a supplemental oxygen system, training, and operational protocols.



Figure 1.2 A supplemental oxygen system (SOS).

Oxygen Cylinder

Oxygen used during emergency care will be provided in a seamless steel, aluminum alloy, or kevlar cylinder. In the United States, **oxygen cylinders** will be green or will have a green band around the cylinder and a yellow diamond indicating “oxidizer.” The product label will have appropriate warnings concerning the proper handling of the cylinder (**Figure 1.3**).

The cylinder is filled to a working pressure of approximately 2000 pounds per square inch (psi). The size of the cylinder is identified by code letters. The most common sizes for portable oxygen cylinders are D and E cylinders, which hold 35-650 liters of oxygen at 2000 psi and 70°F (21°C). The size of the cylinder, the amount of oxygen in the cylinder, and the rate of oxygen flow from the cylinder will determine how long the oxygen in the cylinder will last.

Oxygen cylinders have a valve that allows high pressure gas in the cylinder to be delivered by a **pressure regulator**. U.S. federal law requires that most common refillable oxygen cylinders be tested every 5 years to ensure safe use. Oxygen suppliers can provide information on testing and servicing requirements.

Pressure Regulator

Oxygen must be administered at a safe working pressure. To accomplish this, a pressure regulator is placed on the cylinder valve post. The pressure regulators used on portable oxygen cylinders have metal prongs that engage matching holes on the cylinder valve. The arrangement of these holes varies for all various types of gas cylinders. This safety feature ensures that the correct type of regulator is attached (**Figure 1.4**).

With the regulator properly positioned on the cylinder post valve, hand tighten the regulator in place and attach the oxygen tubing. Open the cylinder so that oxygen can flow into the pressure regulator. The cylinder post valve is opened by turning a knob or using a special key or wrench provided. Newer systems have a built-in mechanism to open the cylinder. Oxygen cylinder valves also contain safety relief devices (rupture/safety disks) designed to release gas from an over-pressurized cylinder, which can occur due to excessive heat.



Figure 1.3 Oxygen cylinders have distinctive color markings and labels.



Figure 1.4 An oxygen pressure regulator has unique metal prongs that engage matching holes of the oxygen cylinder.

The pressure regulator is equipped with a gauge that indicates how much pressure is in the cylinder. By checking the gauge, you can estimate the amount of time supplemental oxygen can be delivered (**Figure 1.5**). Cylinders should be changed if the gauge shows less than 15 minutes or 500 psi of oxygen remaining in the cylinder.

The regulator also has a flowmeter that controls the amount of oxygen delivered in liters per minute (lpm). Flowmeters can deliver oxygen at 1-25 lpm. A continuous oxygen flow rate of 15 lpm is recommended during resuscitation efforts. The SOS system at your facility may have a preset flowmeter that allows only a flow rate of 15 lpm.



Figure 1.5 With the cylinder opened the pressure gauge reflects the amount of pressure in the cylinder.

Changing Oxygen Cylinders

If you need to replace an oxygen cylinder, follow these steps:

1. Close the valve
2. Open the flowmeter to bleed off oxygen remaining under pressure in the regulator (if adjustable)
3. Remove the regulator from the used oxygen cylinder
4. Properly seat the regulator on the new oxygen cylinder and hand-tighten it in place
5. With the flowmeter off, open the valve and read the starting pressure in the cylinder, which should be approximately 2000 psi

Supplemental Oxygen Delivery Devices

Resuscitation Mask

It is recommended that *resuscitation masks* have a port that allows oxygen to be attached through tubing connected to the oxygen flowmeter. This allows rescue breaths to be delivered with a higher concentration of oxygen (**Figure 1.6**).



Figure 1.6 A resuscitation mask can be attached to supplemental oxygen during rescue breathing.

Bag-Valve-Mask (BVM)

A **bag-valve-mask (BVM)** is a device used to provide breaths to a nonbreathing person by attaching a resuscitation mask to one end of a self-refilling bag and the other end of the bag to the SOS. When the bag is squeezed, air passes through a one-way valve attached to a mask positioned on the person's face (**Figure 1.7**).

The BVM has advantages over a resuscitation mask. The BVM delivers oxygen without requiring you to breathe into the mask. The BVM is also able to provide a higher oxygen concentration (21%) when not attached to the SOS, and a much higher oxygen concentration (90%) when attached to the SOS.

BVMs should include the following features:

- Self-refilling bag
- Non-jam valve system allowing a minimum oxygen inlet flow of 15 lpm
- Standard 15-mm/22-mm fittings
- Reservoir system attached to the bag for delivering the highest concentration of oxygen
- Non-rebreathing valve
- Ability to perform under various environmental conditions
- Various sizes for use with infants, children, and adults

Store the BVM so that it is readily available with the SOS system to reduce the length of time that it takes to set up for use. Until the BVM is ready for use, provide rescue breaths with a resuscitation mask. Once the BVM is attached to the SOS, set the flow of oxygen at 15 lpm and allow the reservoir bag to fill completely.

Two rescuers will be needed to use a BVM to provide ventilations during rescue breathing or CPR. One rescuer will kneel above the person's head, open the airway, and hold the mask on the face. A second rescuer is positioned at the person's side, near the head, and is responsible for squeezing the bag (**Figure 1.8**). Adult, child, and infant-sized masks and bags are available for use. Regardless of the size of the bag used, squeeze the bag only enough to provide chest rise. During CPR, a third rescuer will provide chest compressions (**Figure 1.9**).



Figure 1.7 A bag-valve-mask attached to supplemental oxygen can improve resuscitation efforts.



Figure 1.8 Two rescuers are needed to properly use a BVM.

If you are using the BVM and the person's chest does not rise when you squeeze the bag, the problem could be with the BVM or with your use of the BVM.

Problems can be caused by failure to:

- Maintain a good mask seal
- Maintain an open airway
- Squeeze the bag to generate the necessary volume of air
- Remove a foreign body airway obstruction

If you believe the problem is with the BVM, switch to a resuscitation mask attached to oxygen until another BVM is available.

Non-rebreathing Mask

A **non-rebreathing mask** allows oxygen to be administered to a person who is having breathing difficulty including a person who might be experiencing a heart attack. A non-rebreathing mask is a combination mask and reservoir bag (**Figure1.10**). Oxygen fills the reservoir bag, which is attached to the mask by a one-way valve. Exhaled air escapes through flapper valve ports on the sides of the mask. These valves prevent the person from rebreathing exhaled gases, delivering oxygen at a concentration of about 90%. To be effective, a non-rebreathing mask must be attached to a SOS capable of delivering an oxygen flow rate of 12–15 lpm (**Figure1.11**).



Figure1.9 When using a BVM during CPR, three rescuers are needed.



Figure1.10 A non-rebreathing mask may be used for a person having difficulty breathing.



Figure1.11 Attach the non-rebreathing mask to a SOS with a flow rate of 12–15 lpm.

Pulse Oximetry

Routinely administering supplemental oxygen to persons with medical conditions unrelated to drowning requires some caution. Evidence suggests that if a person is having serious difficulty breathing, rescuers should apply oxygen. For others, however, supplemental oxygen use over time should be adjusted in response to the percentage of oxygen in the blood and how the person feels. The percentage of oxygen in the blood can be determined using **pulse oximetry**, which involves placing a small, portable device called a **pulse oximeter** on a person's finger (**Figure1.12**).



Figure1.12 A pulse oximeter is used to measure oxygen saturation.

A pulse oximeter provides a measurement that appears as a percentage of hemoglobin saturated with oxygen. If you have a pulse oximeter available, you should use it to help guide how much supplemental oxygen should be provided to achieve a target saturation of 94–98% for most acutely ill persons. Persons with known chronic obstructive pulmonary disease (COPD), such as emphysema, will usually have a saturation between 88% - 92%.

The person should be constantly monitored and if the person's oxygen level gets above the desired percentage, you may decrease the flow rate of oxygen or remove the oxygen. The person should be monitored. If the person's condition worsens or the pulse oximeter shows a reading of less than 94%, supplemental oxygen may be reapplied. See **Table 1.1** for an overview of the administration of oxygen to a responsive person in respiratory distress.

Table 1.1 Administering Oxygen to Responsive Persons

Administering Oxygen to a Responsive Person in Respiratory Distress

Is it needed? Look for these signs:

- Breathing that is excessively fast, slow, weak or labored
- Skin is cool to the touch, pale or blue in appearance
- Reduced level of consciousness

If one or more of the above is true, confirm with pulse oximetry:

- Turn on device
- Place on dry finger
- Restrict person's movement for 10 seconds
- Note the blood oxygen level:
95% or more is normal for most; 89% or more normal for COPD sufferers

Provide oxygen if needed:

- Contact EMS
- Prepare Non-rebreathing mask (appropriate size for person)
- Attach to oxygen tank (set at 15 lpm)
- Allow the reservoir bag to inflate and position on the person's face
- Discontinue if the person's condition improves and pulse oximetry levels return to a normal range for the person
- Continue to monitor and care for the person until EMS arrives

Care and Maintenance of Supplemental Oxygen Systems

Oxygen delivery systems require little maintenance. But to ensure optimum performance, your SOS should be checked at the beginning of each workday as part of your facility's opening procedures. Many facilities often equip an emergency response bag with SOS equipment so that all items are available in one bag when responding to an emergency. Other items in the bag typically include bag-valve-masks, manual suction, resuscitation masks, gloves, first aid supplies, pulse oximeter, an automated external defibrillator (AED), and AED supplies (**Figure 1.13**). Use of a trauma type bag also provides a safe place for the oxygen cylinder to be stored when providing care.



Figure 1.13 Check your equipment bag each day to ensure all items are in proper working condition.

The use of the SOS should be integrated into your facility's EAP. Protocols can be as simple as designating a member of the emergency response team or supplemental responder to bring the SOS to the rescuer.

Follow these guidelines for the proper care, maintenance, and use of your SOS:

- Do not expose the cylinder to temperatures above 130°F (54°C)
- Do not puncture or drop the cylinder
- Do not use any type of grease or oil (or petroleum jelly or suntan oil) on any part of the cylinder
- Do not use oxygen near a fire or open flame
- Do not remove the valve from the oxygen cylinder
- Have the cylinders refilled by a professional medical oxygen supplier
- Keep the cylinder secure in a carrying case. If you must remove the cylinder from its protective case, lay it down
- Replace masks, one-way valves, and oxygen tubing following use
- Depending on the equipment you have, the system may or may not be left assembled at the end of each day. Refer to the manufacturer’s instructions for your system

A simple checklist for a facility’s SOS can be seen in **Table 1.2**.

Table 1.2 Supplemental Oxygen System (SOS) Checklist

Oxygen cylinder	Be certain the cylinder says oxygen, that there is no damage to the valve and that the cylinder is still within its safe hydrostatic safety testing period
Amount of oxygen in the cylinder	Check the pressure gauge. Replace the cylinder if there is less than 15 minutes or 500psi remaining. Know the capacity and refill recommendations for your specific oxygen cylinder
Oxygen tubing and masks	Check that tubing is attached to the regulator and the mask
Pressure regulator	Check to see that no oxygen is leaking when under pressure
Documents	Maintain all documents regarding the purchase, refill, hydrostatic safety test, and daily inspections

FOR YOUR REVIEW

Summary

During certain medical events such as near-drownings, oxygen is cut off from vital organs. Supplemental oxygen should be provided to any person experiencing breathing problems from a drowning event or other illness or injury resulting in severe respiratory distress.

Though delivering rescue breaths provides adequate oxygenation, providing a higher concentration of supplemental oxygen can improve a resuscitation effort.

The availability of a supplemental oxygen system (SOS), allows you to successfully deliver higher levels of oxygen to distressed persons. The system is simple and safe to use, providing a continuous flow rate of 15 liters per minute (lpm).

A bag-valve-mask (BVM) is a device used to provide ventilations to a nonbreathing person by attaching a resuscitation mask to one end of a self-refilling bag and the other end of the bag to the SOS.

For a person who is breathing, but showing signs of severe respiratory distress, oxygen can be provided through a non-rebreathing mask.

A pulse oximeter provides a measurement of oxygen saturation in a person with difficulty breathing. This will help you when administering supplemental oxygen to achieve a target saturation of 94–98% for most acutely ill persons. Monitor the person until EMS personnel arrive.

Key Terms

- Bag-valve-mask (BVM)
 - Non-Rebreathing Mask
 - Oxygen Cylinder
 - Pressure Regulator
 - Pulse Oximeter
 - Pulse Oximetry
 - Supplemental Oxygen System (SOS)
-

Appendix A

BLS: SUPPLEMENTAL OXYGEN SUPPORT (SOS)

Provide SOS during rescue breathing and CPR whenever it is available.



1. Attach oxygen tubing to the oxygen regulator and the resuscitation mask or BVM.



2. Open the oxygen tank.



3. Adjust the flow rate to 15 liters per minute (unless equipped with a preset flow rate).

4. Observe the BVM oxygen reservoir bag fill and refill as ventilations are delivered.

Appendix B

BLS: BAG-VALVE-MASK (BVM)

Using a BVM is a two - rescuer skill that provides an effective way to deliver ventilations during rescue breathing and CPR. With the BVM attached to supplemental oxygen:



1. Rescuer 1 positions the mask and opens the person's airway.



2. Rescuer 2 squeezes the bag smoothly every 5 seconds (adult) or every 3 seconds (child or infant) during rescue breathing.

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