# Emergency First Aid Oxygen Response in Schools

## $O_2$ Administration in Schools by Nurses and Lay Responders

*The new NASN (2014b) practice tool, "Emergency Resources, Equipment and Supplies for Schools With a School Nurse," lists oxygen, along with albuterol and epinephrine auto-injector, as emergency medications that may be part of the school emergency response plan. I would like to know more about the use of oxygen in the community setting such as a school, while waiting for emergency responders to arrive on the scene. For example, is a medical order or protocol required, who may administer, when should it be administered, do regulations vary by state, how much does it cost, what are storage considerations, and what other equipment is needed in addition to an oxygen tank?*

*Signed,*
*Blue Lips*

**Dear Blue Lips,**

With the increasing prevalence of asthma in schools, as well as anaphylactic reactions to foods, insect stings, inhaled agents, and so on, combined with the increasing reliance on the school nurse for primary care, it is important to consider having oxygen as a part of a school's emergency response. The NASN (2014a) position statement "Emergency Preparedness and Response in the School Setting—The Role of the School Nurse," under Emergency Equipment states, "The availability of essential emergency supplies is an integral component of being able to render appropriate on-site care and manage the emergency condition" (see also Doyle, 2013). More specifically, NASN's (2014b) "Emergency Resources, Equipment and Supplies for Schools With a School Nurse" practice tool provides emergency equipment recommendations as a resource to schools and school nurses. The practice tool lists recommended resources, equipment, and supplies for all schools, with additional considerations for schools with a school nurse. Oxygen is an example of emergency medications and supplies that may be part of the school emergency response plan, along with albuterol and epinephrine auto-injector, for schools with a nurse (NASN, 2014b).

The Illinois "Guidelines for the Nurse in the School Setting" (Illinois Emergency Medical Services for Children, 2010) recommend "give oxygen as tolerated if available," for two of the initial five major assessments in the ABCDE (breathing and disability):

- "Breathing—Position student for maximum ventilatory ability. Give oxygen as tolerated if available. Provide mouth-to-mask ventilation if needed.
- Disability (neurologic status)—Provide reassurance; position to maintain comfort; give oxygen if available." (p. 14)

The other letters in the initial assessment include A—airway, C—circulation, and

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E—exposure with environmental control to prevent heat loss. This same guide specifically lists oxygen delivery as an intervention for the complications that may occur with the following conditions: asthma attack/reactive airway disease, respiratory distress, sickle cell anemia, and throat emergencies (Illinois Emergency Medical Services for Children, 2010).

## Rationale for Use

Hamilton, Sanders, Strange, and Trott (2002) point out in their emergency medicine textbook that the causes of cardiopulmonary arrest in adults versus children are quite contrasting: "Adult cardiopulmonary arrest is most commonly due to cardiac disease. Pediatric arrest is more often the result of acute respiratory failure" (p. 55). Ongoing research has validated that at least 90% of pediatric cardiac arrests are the result of respiratory arrest from hypoxia; no more than 10% are from primary cardiac disease (e.g., viral cardiomyopathy, Wolff-Parkinson-White syndrome, commotio cordis, etc.; Hickey & Painter, 2006). Hypoxic arrests rarely can be defibrillated, and when "successful" usually result in a brain-damaged survivor (Hickey & Painter, 2006). The best approach is to address the hypoxia before it leads to an arrest.

Oxygen deprivation presents a serious emergent scenario. If it's near the start, like asthma, drowning, narcotic overdose, strangulation, aspiration, smoke inhalation, low atmospheric oxygen tension, and so on, increasing the oxygen concentration of the air being taken in helps make up for the lower amount of $O_2$ being received from the reduced volume of air entering the body. If it's a consequence of circulatory deficiency, for example, shock, providing supplemental oxygen helps assure maximum oxygenation of what blood is yet circulating. Respiratory muscle tissue, like all muscle tissue, requires oxygen, and respiratory muscles fatigue proportionally to their oxygen deprivation, no matter the cause. Thus, the emergency situation can result in a rapid downhill vicious cycle leading to respiratory arrest. Cardiac arrest soon follows from the heart's own oxygen deprivation. And since the brain is the most oxygen consuming organ (by far), it suffers an insult proportional to the degree and length of time of its oxygen deprivation.

Sudden cardiac arrest is perhaps the only "nonoxygen" life-threatening medical emergency in which the victim is *usually* well oxygenated at the start of the arrest. Circulating the oxygenated blood is the priority, best with a regained pumping heart rhythm (successful defibrillation), second best with chest compressions. If there are two responders though, and no break in the physical compressions, it is appropriate to ventilate (30:2 adult, 15:2 child), and preferably with supplemental oxygen. It also may be of some benefit, if chest compression only, to provide passive oxygen to the victim's face, but only if there is no delay or break in providing compressions to retrieve (Goldman, 2013). In the event of successful defibrillation, oxygen administration is always indicated while waiting for the emergency medical services (EMS), be it passive if breathing is deemed adequate or coupled to assist ventilation if not (Peberdy et al., 2010).

In the past few years there has been discussion and caution about providing too much oxygen and adjusting oxygen provided using pulse oximetry. This is appropriate for EMS due to the higher flow rates and oxygen concentrations they provide, and the pressurizing oxygenation equipment they use such as CPAP (continuous positive airway pressure), BiPAP (bilevel positive airway pressure), intubation with bag valve ventilation or mechanical ventilator, with the subsequent possibility of very high blood oxygen partial pressures (not $O_2$ saturation), that is, arterial partial pressure of oxygen ($PaO_2$) in excess of 300 mm Hg, where the concern for "hyperoxia" starts (Kochanek & Bayir, 2010). It is *not* a concern for the relatively short pre-EMS period using Food and Drug Administration (FDA)-approved units intended for first aid, which provide medium concentration oxygen, and with them there is no need to employ pulse oximetry. The maximum possible $PaO_2$ achievable with these units is 225 mm Hg, as explained by Safar (1974), the father of modern CPR. Simply put, first aid oxygen units are not capable of delivering too much oxygen. In addition, concern for suppressing ventilatory drive in chronic obstructive pulmonary disease with too much oxygen has been refuted and dispelled, although this is not much of an issue in a school population (Schmidt & Hall, 1989). Concern for causing harm overall, using first aid oxygen units, is not supported, even for those in rural areas with longer EMS response times.

## Who Can Administer

In September 1996, after 3 years of discussion with experts and public comment, the FDA published a regulation in the *Federal Register* that allows lay acquisition and administration of medical oxygen for *emergency use only* when *administered by properly trained personnel* for *oxygen deficiency and resuscitation* (FDA, 1996). FDA-approved oxygen units (or tanks) are labeled with the above italicized language and additional language that goes on to say, "For all other medical applications, Rx Only" (indicating that a medical order is required for anything outside of emergency use by properly trained personnel). In addition, to be FDA-approved, units must have

- a flow rate of at least 6 liters per minute
- a capacity to provide at least 15 minutes endurance when available for use

Less in either category is illegal (FDA, 1987). Thus, to answer the question "Is a medical order required?," school nurses are encouraged to discuss with state school nurse consultants and individual state boards of nursing to determine additional state by state requirements. An irony may exist; for example, in Pennsylvania school nurses *do need* a standing open physician's order to administer $O_2$ at their discretion in an emergency as it is considered a medication and the school nurse is an

**Table 1.** Pennsylvania Statewide Basic Life Support Protocols for Oxygen Administration and Initial Patient Contact

| Procedure Number | Title | Instruction Regarding Oxygen | Further explanations |
|---|---|---|---|
| 202-BLS-adult/peds | Oxygen administration statewide BLS protocol | Criteria: Patients presenting with the following conditions:<br>1. Shock<br>2. Shortness of breath or respiratory distress<br>3. Inhalation injury/toxicity<br>4. Suspected or known stroke or seizure<br>5. Chest pain<br>6. Suspected or known major trauma<br>7. Acute change in level of consciousness<br>8. Patient whose condition seems serious during initial assessment<br>9. Patient with priority condition on initial patient contact (Protocol 201 below)<br>10. Patients who normally receive oxygen as part of their usual medical care<br><br>Exclusion criteria: None | Procedure pediatric patients:<br>1. Use appropriate size face mask or nasal cannula for pediatric patients.<br>2. If the pediatric patient will not tolerate the mask or cannula, use blow-by oxygen via oxygen extension tubing. |
| 201-BLS-adult/peds | Initial patient contact statewide BLS protocol | Criteria: All patients<br>Exclusion criteria: None<br>Procedures: All patients (after considerations for trauma, airway, absence of pulse, need to ventilate, and control of serious or uncontrolled bleeding).<br>• If priority condition exists administer high concentration oxygen, treat immediately, and transport with reassessment and treatment by applicable protocol while en route to the appropriate medical facility. | Priority conditions are listed as:<br>1. Unable to obtain open airway<br>2. Poor general impression<br>3. Altered mental status and not following commands<br>4. Difficulty breathing/ inadequate ventilation<br>5. Hypoperfusion (shock)<br>6. Complicated childbirth<br>7. Chest pain with systolic blood pressure < 100<br>8. Uncontrolled bleeding<br>9. Severe pain, anywhere |

Source: Pennsylvania Department of Health, Bureau of Emergency Medical Services (2013).

obligated health care responder, whereas trained lay responders can administer without it, if the unit is FDA-approved. As mentioned earlier in the article, school nurses are encouraged to check state nurse practice acts, delegation regulations, as well as coverage through their state's Good Samaritan law for trained (or untrained) lay responders administering oxygen in an emergency.

## EMS Protocols, Including When to Administer

Per the Pennsylvania Statewide Basic Life Support Protocol for Oxygen Administration, supplemental oxygen is administered by standing order to any "patient whose condition seems serious during initial assessment" (Pennsylvania Department of Health, Bureau of Emergency Medical Services, 2013). See Table 1. This table also reflects EMS practice nationwide and underscores both the (vital) importance of this intervention and the time criticality for it in many medical emergencies. Clearly, the protocols are weighted to avoid delay in oxygen administration. The consequences of delay are well known to all who practice critical care, as well as to those who are involved in related liability.

It is also important to note that there are no contraindications for the administration of oxygen. In addition, under the Pennsylvania Initial Patient Contact Protocol "if priority condition exists, administer high concentration oxygen, treat immediately, and transport." *Poor general impression* as well as *difficulty breathing* are listed as priority conditions, amongst others, for initiation of oxygen administration. The guidance is for oxygen to be administered immediately when these priority conditions exist, *prior* to

**Table 2.** Agencies Providing Emergency Supplemental Oxygen Training

| |
|---|
| American Red Cross |
| American Safety and Health Institute |
| Cintas Safety |
| Ellis and Associates |
| Emergency Care and Safety Institute |
| EMS Safety |
| Medic First Aid |
| Premedics Systems |
| StarGuard |

obtaining a history and focused physical exam.

## Recommended Training

The FDA has not provided clarification regarding *proper training*, leaving it up to the manufacturers, oxygen fillers, and training organizations. Oxygen servicing companies are required to record documentation of training to meet their FDA requirement, in order to dispense oxygen for medical use in instances where there is not a specific medical order. If the recipient of the unit (and of future refills of the unit) is a licensed health care provider (e.g., school nurse) where oxygen administration is inclusive in their training and practice, his or her license is accepted as documentation. On the other hand, lay responders, including other school staff members who are not licensed health professionals, are required to be trained (Airgas Safecor, 2005).

Different agencies provide training such as the American Red Cross (2011). Training includes when to utilize oxygen, different types of oxygen delivery systems, safety precautions, and assembly of the oxygen system including how to turn on the unit and verify the oxygen system. There have been no legal cases or regulatory action brought against anyone or any institution for lay responder first aid oxygen administration when perceived to be an emergency, whether or not it turned out to be. Some state and regional discordance occurred early in the wake of the FDA regulation, but federal preemption has effectively eliminated it, that is, it is legal in all 50 states. As with implementation of stock albuterol or epinephrine auto-injector, training is necessary even in the absence of a requirement. See Table 2 for a listing of multiple agencies that provide training in use of emergency supplemental oxygen.

## Cost of Oxygen Units

Costs of a unit vary, ranging from $400 to $500 each. There are no maintenance costs when the unit remains unused. Units have a checklist for monthly visual checks and twice a year operational checks. If it is used but more than 15 minutes of oxygen time remains in the unit, it is considered operational for the next use. Most companies recommend refill of the unit if less than 30 minutes of oxygen use remains ($15.00 to $45.00 per unit). When implementing an emergency oxygen supply program, schools should consider additional spare units to rotate rather than wait for refill. Masks used to deliver the oxygen can be cleaned or replaced after use (approximately $15.00 each). Costs are a consideration for schools, as well as an opportunity to identify community partners to assist with funding.

## Other Associated Equipment

The recommended delivery device for emergency oxygen in the community setting is a pocket mask and associated tubing. The rationale for the pocket mask instead of nasal cannula is the following:

- persons trained in rescue breathing are trained in using a pocket mask for nonbreathing victims
- it provides a medium concentration "simple" rebreather mask for breathing victims
- it can be rotated (180 degrees) to fit the full face of a very small child for a seal for rescue breathing (no mask switching, one size, one type for all victims)

As explained, only an adult-size pocket mask and tubing is required to be on hand with the oxygen unit. It is recommended that one or two spare mask assemblies be available with each unit in case of multiple uses in a day.

## Storage and Maintenance Considerations

Unit specific storage and maintenance considerations are provided on the manufacturer's label and accompanying checklist or in-box literature provided. They are to be followed carefully to ensure the reliability and safety of the unit, and also to meet warranty requirements.

## Availability of School Nurses

According to NASN's most recent data on school nurse availability, "38.01% of schools have a full-time nurse while 74.6% of schools have an RN in the building at least once per week" (Burkhardt Research Services, 2007). Based on this, it is very likely that a severe asthma attack, anaphylactic reaction, or any other life-threatening occurrence will not be attended to by a nurse. This fact is helping to drive epinephrine availability legislation and encouraging training of responders to administer beyond the nurse. The same thinking and implementation has applied to AEDs. Similar rationale can be extended to bronchodilator inhalers and oxygen. Barbara Malcolm, MSN, RN, former chairperson of Health Services in Allentown, Pennsylvania, with 16 years experience responding to school emergencies with oxygen, provides this reflection:

> In most schools the school nurse is the only health care provider. Add to this the frequent times when more than one emergency situation is occurring at the same time. We have found that having non-medical personnel trained in emergency procedures, such as giving oxygen, to be critical in providing care needed for these

situations. (personal communication, October 20, 2014)

John Kloss, EMT-P, executive director of the Eastern Pennsylvania EMS Council, adds, "Immediate public access to first aid oxygen embraces the Eastern PA EMS Council's mission of a system designed to save lives" (personal communication, October 27, 2014).

In conclusion, there are a lot of good reasons to have oxygen as a response in schools with full-time school nurses, and the same for schools without a school nurse each day, every day. The FDA regulation allowing for the latter has been in place for a long time. School nurses must work with school administrators and medical directors, state school nurse consultants, and specific state nurse practice acts in determining how to proceed with making oxygen available as an emergency supply alongside albuterol and epinephrine auto-injectors in their schools at large. ■

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***Guest Authors***

***. . . Descendants of Lillian Wald***

**Pete Goldman, MD**
**Lt Col ret., USAFR**
**Consultant for Lif-O-Gen First Aid Oxygen Div.**
**Allied Healthcare Products Inc.**
**St. Louis, MO**

Pete is a former dir. of emergency services, USAF Hospital, Andrews, as well as flight surgeon for the 334th and 121st Tactical Fighter Squadrons, USAF and DC Air National Guard, respectively. He was the first med. dir. of the American Safety and Health Institute. He held emergency dept. and inpatient admitting privileges at Lehigh Valley Hospital, Allentown, PA, for over 20 years. He is coinventor of an automated first aid oxygen unit, now Lif-O-Gen Automated First Aid Oxygen. He has developed and assisted in the development of several lay first aid oxygen curricula. He is a former member of the Committee on Medical Gases, Compressed Gas Association, and as such formally interacted with the FDA on their regulatory development allowing lay emergency oxygen administration. He holds an active-retired cat. license to practice medicine in Pennsylvania.