Oxygen Administration and Manual Ventilation in Opioid Poisoning Response

Evidence Summary and Practice Implications

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Key Terms

Airway management: interventions to maintain or restore a person's breathing.

Alveoli: air sacs in lungs where gas (oxygen and carbon dioxide) exchange occurs.

Apneic: not breathing.

Cardiac arrest: the cessation (stopping) of the heart.

Decorticate posturing: abnormal postures such as stiff and bent arms or legs, or clenched fists.

Dyspnea: difficulty breathing.

Hemoglobin: a protein on red blood cells that carries oxygen throughout the body.

Hypercapnia: excessive carbon dioxide in the body.

Hyperoxia: excess oxygen in the body.

Hyperventilation: excessive oxygen volume or pressure.

Hypoventilation: diminished, inadequate respirations.

Hypoxemia: low oxygen levels in the blood.

Hypoxia: low oxygen levels in body tissues.

Layperson or laypeople: an individual or individuals who are neither an expert in a specific area nor have specific training or detailed knowledge of a particular subject, nor are a member of a given profession.

Manual ventilation: providing respirations for a person with inadequate or no breathing.

Non-rebreather: a mask that delivers high amounts of oxygen; consists of a mask with an attached reservoir bag and one-way valves that allow oxygen to flow into the bag and prevent exhaled or ambient air from entering the bag.

Non-regulated provider: an employed provider who is neither licensed nor registered by a regulatory body, who has no legally defined scope of practice, required education, or practice standards.

Oversedation: a level of sedation that is beyond what is typically seen with an opioid poisoning; excessive drowsiness and non-response.

Oxygen administration: oxygen therapy; giving a person oxygen as a treatment for breathing problems.

Oxygen saturation: SpO2; a measurement (in percentage) of how much hemoglobin in the blood has oxygen compared to the amount of hemoglobin without oxygen.

Peripheral chemoreceptors: detect changes in blood oxygen and initiate responses to adapt to hypoxia or hypoxemia.

Provider: any person employed in a health or social service setting to provide care to another person.

Regulated provider: an employed provider who is registered and licensed by an approved regulatory body (as defined under the *Health Professions Act*), with specific education requirements, a legally defined scope of practice, and related practice standards.

Respiration: breathing.

Respiratory arrest: the cessation (stopping) of breathing.

Respiratory depression: breathing too slowly or too shallowly.

Restricted activity: an activity detailed under section 55 (2) (g) of the *Health Professions Act*; a narrowly defined list of activities that may only be performed by specific regulated providers.

Tidal volume: the amount of air moving in and out of the lungs with each breath cycle.

Ventilation: supply of air to the lungs.

Ventilator drive: determines the effort needed by the respiratory muscles to breathe; controlled by respiratory centres in the brain stem.

Wooden chest syndrome: chest and abdominal muscle rigidity due to fentanyl poisoning; causes ventilatory failure.

Key Messages

The BCCDC reviewed available evidence related to best practices for oxygen administration and manual ventilation in the context of opioid poisoning response.

- Evidence supports oxygen administration as part of opioid poisoning response by any provider trained to do so.
- Oxygen administration and ventilation should happen as soon as possible to maximize positive outcomes for the person receiving care.
- Oxygen administration without ventilation (spontaneous or manual) is ineffective.
- Oxygen administration is not a substitute for naloxone.
- No evidence suggests people receiving care for an opioid poisoning will experience oxygen-related harms from short-term oxygen administration.
- Oxygen administered by non-regulated providers does not result in poor clinical outcomes for a person experiencing an opioid poisoning.
- People breathing on their own should receive oxygen via simple face mask or nasal cannulae. There is no clinical guidance to support using pocket masks to deliver oxygen to people breathing on their own.
- Successful manual ventilation depends on individual skill and competence.
- Mouth-to-mouth ventilation is effective at maintaining adequate oxygenation.
- Mouth-to-pocket mask ventilation is more effective than both mouth-to-face shield and bag-valve mask ventilation.
- Manual ventilation with a bag-valve mask is a complex clinical skill. It is best suited to clinically trained providers who have demonstrated ongoing competence with this skill.

Introduction

Responding to respiratory depression or arrest is a critical component of opioid poisoning response. However, there is not much data on the best approach to airway management, there are inconsistent recommendations for how to approach oxygenation and ventilation, and little is known about oxygen administration by laypersons. What is known is that a person's level of training influences the outcomes of different airway management approaches,[1] and some techniques are complex skills that are challenging even for experienced regulated providers to perform effectively.

There are several ways a provider can administer oxygen to respond to respiratory depression or arrest during opioid poisoning response. Oxygen can be administered:

- on its own (i.e., via nasal cannulae or simple face mask) when a person is still breathing,
- together with manual ventilation (e.g., mouth-to-mouth or bag-valve mask) when breathing has stopped or is inadequate, or
- as part of cardiopulmonary resuscitation (CPR).

The ability to provide these interventions largely depends on the responder's individual training and competence. The appropriateness of these interventions should also be considered alongside local context such as: (1) staffing complement, skill, and availability, (2) typical or anticipated response time of Emergency Health Services (EHS) or other emergency response, and (3) service user population.

The landscape of community-based witnessed consumption services is changing: Peer-run services are becoming more common, regulated providers are less available, the toxic unregulated drug supply is more potent, and opioid poisonings are increasingly complicated. Given these factors, it is necessary to review the evidence on the airway management component of opioid poisoning response, including who can provide airway management interventions.

Scope and Purpose

This document summarizes evidence on providing oxygen and manual ventilation in the context of community opioid poisoning response. This summary is intended to inform health authorities, community organizations, and health and social service providers who are likely to provide opioid poisoning response in any community-based setting. The aim of this document is to support decision-making around provider capacity, competence, and responsibilities when responding to opioid poisoning events. This document does not provide practice recommendations or overrule existing organizational or program guidelines on airway management in opioid poisoning response. Instead, this document offers practice implications based in evidence, with the intention of supporting all providers with best practice approaches to opioid poisoning response.

Oxygen Therapy

Like other emergency medical interventions, oxygen should be administered at an appropriate dose only when clinically indicated,[2] by providers who have the judgment, knowledge, and skill to make related clinical decisions.[3]

Oxygen therapy is defined as the administration of oxygen at concentrations greater than ambient air (20.9%) to treat or prevent impaired oxygen exchange[4] such as hypoxia.[5] Hypoxia is defined as an oxygen saturation (SpO2) of <90% when breathing room air (or a range dictated by a specific clinical situation[3]), and it can quickly result in a cascade of events that cause permanent damage to body systems.[6]

Some reports suggest that oxygen is one of the most inappropriately administered drugs.[2] A large body of research shows the potential harmful effects of hyperoxia from inappropriate oxygen administration in medical emergencies involving cardiac arrest, stroke, shock, and CPR administration.[7] This indicates that providers should be cautious with oxygen use in certain emergency situations,[2] particularly since there is no data from randomized clinical trials demonstrating the clear benefits of administering oxygen in similar situations.[7] However, this research is based in cardiac emergencies and not respiratory depression or arrest—which are primary features of opioid poisoning. Along with the absence of research specific to opioid poisoning response, there is reason to believe the potential harms of hyperoxia are not applicable to this specific type of emergency event.

Legislation

Under BC's *Health Professions Act*, administering oxygen is a restricted activity that can only be performed by designated health professionals. Those designated health professionals can administer oxygen if their professional regulations (e.g., BCNNM Scope of Practice) allow it. For some regulated providers, oxygen administration does not require a prescriber order (e.g., for RNs[8]), although some of these providers must have additional education before they are allowed to administer oxygen (e.g., LPNs[9]). The Emergency Medical Assistants Regulation of the *Emergency Health Services Act* also permits oxygen administration by Emergency Medical Assistants (e.g., paramedic) with a First Responder license. Individuals who are neither a registrant of a designated health profession nor a licensed Emergency Medical Assistant are not authorized to administer oxygen.

Indications for Use

Oxygen is indicated for hypoxia[5] or hypoxemia.[6] When a person is in respiratory distress or arrest, oxygen is a priority, and should be given before obtaining any kind of detailed history or exam.[10] Increasing oxygen concentration of the air at the start of an emergency helps offset the reduced oxygen entering a person's body because of decreased respirations.[10] The World Health Organization (2009) and the United Nations (2013) both recommend supplemental oxygen and assisted ventilation for initial treatment of a drug poisoning.[11,12]

When oxygen is indicated, there are no conditions that prohibit administration[5] except patient non-consent.[3] The actions of oxygen in the body have a specific range of effective doses, and high doses can cause harm.[5] If a person's hemoglobin is fully saturated (full of oxygen, SpO2 = 100%), additional oxygen will not increase oxygen transport.[13] This means that if a person's SpO2 does not indicate oxygen is needed, providing oxygen could cause oxygen poisoning, which can disrupt normal system functioning and cause difficulty breathing.[14] When administering oxygen, SpO2 should be targeted (e.g., >90%), and the person's response to oxygen therapy should be defined by their specific treatment goals (e.g., Sp02 >90%).[2]

Low Flow Oxygen

Low flow oxygen ranges from 2-10 L/minute. It is typically indicated for people who are breathing on their own but are experiencing dyspnea, to increase their tidal volume.[4] When a person is breathing on their own, low flow oxygen should be given when they are in an upright position, unless contraindicated, such as c-spine clearance required or level of sedation.[4] In the community setting, low flow oxygen is typically delivered by nasal cannulae or simple face mask.[4]

High Flow Oxygen

High flow oxygen is not regularly used in community settings. It is also not typically used in a standard opioid poisoning response because: (1) high flow systems require humidification[15] (which requires additional equipment and training), and (2) high flow oxygen is primarily for individuals with respiratory failure related to underlying conditions (e.g., lung disease).[16] High flow oxygen can be delivered using non-rebreathers[4] as well as high flow nasal prongs.[17]

Clinical Concerns

Potential complications from oxygen administration are usually related to long-term oxygen therapy (for people with chronic respiratory conditions like Chronic Obstructive Pulmonary Disease [COPD]), and may include:

- Cytotoxic damage (e.g., to the structure of the lungs),
- Depressed ventilation (because increased blood oxygen interferes with peripheral chemoreceptors, which lowers a person's ventilator drive), and
- Absorption atelectasis (as high levels of oxygen take the place of air in the lungs, which causes alveoli to collapse).[5]

Individuals with respiratory conditions (e.g., COPD, asthma), as well as some neuromuscular disorders (e.g., muscular dystrophy), are at risk of oxygen-induced hypercapnia. Providers should be cautious when giving oxygen to these individuals.[18]

Hyperoxia is not a concern for the short period of time (approximately 20-30 minutes[a]) low to medium concentration oxygen would be administered in a standard opioid poisoning response or while waiting for Emergency Health Services (EHS), including in rural areas with longer EHS response times.[10] **In the context of an opioid poisoning, the risk of harm**

[a] There is no clear definition of short-term oxygen therapy in emergency situations. The estimate of 20-30 minutes is based on evidence examining the various impacts of oxygen therapy and subsequent times assigned to brief oxygen therapy interventions, as well as available literature on emergency oxygen administration.[5,19-22]

from allowing oxygen administration by non-regulated providers is outweighed by the benefits to the person receiving oxygen.[23]

Oxygen in an Overdose Prevention Service

Oxygen administration is widely recognized as an important part of opioid poisoning response in overdose prevention settings.[24-28] At overdose prevention services, oxygen is often given quickly after an opioid poisoning together with naloxone.[25-28] A case series from a Supervised Consumption Service found that oxygen administration was the most common intervention used by staff, even more than naloxone.[29] A qualitative study of providers' experiences indicates that administering oxygen before naloxone reduces the need for naloxone, and subsequently avoids putting the service user into withdrawal.[30] While oxygen will not change the effect of opioids on ventilator drive, this study reflects the potential for oxygen therapy to increase SpO2 above the threshold for naloxone intervention (90%) in people experiencing mild opioid poisoning symptoms (e.g., responsive and breathing normally but signs of oversedation).

A recent large, mixed-methods study at a witnessed consumption site examined a new initiative integrating oxygen administration into drug poisoning response. Service providers received training on oxygen administration and response to make sure they felt confident and competent with oxygen administration.[31] While the study did not clearly define the criteria that signaled a drug poisoning, oxygen was administered when a provider determined a service user showed signs of a mild opioid poisoning (i.e., still breathing on their own but with respiratory depression and oversedation).[31] Administering oxygen as part of drug poisoning response resulted in reduced 911 calls (from 92% of events to 73% of events) and naloxone administration (from 98% of events to 66% of events).[31] Service users reported an improved experience, primarily because they were not forced into withdrawal and 911 wasn't called.[31] These findings support the assertion that some people may benefit from only oxygenation and ventilation as part of a rapid response to a witnessed drug poisoning.[29]

Pulse Oximeters

Pulse oximeters measure a person's SpO2. They emit and measure light to determine the oxygen saturation of blood cells.[32] Pulse oximeters are considered standard equipment in most witnessed consumption settings. They are a valuable assessment and monitoring tool within opioid poisoning response when providers are trained and competent in their use.

For people under 70 years of age, normal SpO2 is 96-98% when awake at rest. For people over 70 years of age, normal SpO2 is 94%.[5] People of all ages may have passing dips to 84% while they are sleeping.[5]

While most oximeters are accurate to within 2-4%,[33] some factors may impact reliability:

- Pulse oximetry is significantly less accurate in individuals with dark skin tones.[34]
- Readings may be unreliable in people who smoke cigarettes due to their elevated carbon monoxide levels.[35]

- Normal SpO2 will be lower (around 88-92%) for a person with a chronic hypercapnic or respiratory condition (e.g., COPD).[4,18]
- Oximeters do not show hypoventilation.[5]
- Oximeters do not show adequacy of oxygen perfusion (e.g., if in shock).[4]
- Falsely elevated readings are likely if a person has anemia or cyanide or carbon monoxide poisoning.[4]
- Excessive movement and swelling impact accuracy of readings.[35]

It's also important to note that while pulse oximeters are a useful clinical tool, there may be a time lag of up to several minutes in the oximeter's detection of respiratory insufficiency (when there is not enough oxygen being delivered throughout the body).[35]

Providers should not rely solely on pulse oximeters. Providers must manually assess respiratory status (number of breaths per minute, breathing quality, skin colour) and respond based on this assessment.

Training

Providers are encouraged to take oxygen administration training if they: (1) are permitted to administer oxygen, and (2) anticipate administering oxygen as part of opioid poisoning response. Many first aid courses include oxygen administration or have the option to add an oxygen administration module to an existing course. Standalone oxygen administration courses are also available. Providers are encouraged to review reputable provincial and national first aid associations.

Oxygen training should include[10,36]:

- when to use oxygen,
- what the different types of oxygen delivery systems and related equipment are and how to use them,
- providing opportunities for people to practice with different oxygen equipment in differing scenarios,
- how to use an oximeter,
- safety precautions when using oxygen,
- how to store and maintain oxygen equipment, and
- when to arrange oxygen inspections.

Practice Implications

- Regulated healthcare providers and Emergency Medical Assistants (e.g., paramedics) are permitted to administer oxygen as part of opioid poisoning response.
- Oxygen administration does not replace naloxone administration.
- A person receiving oxygen should not be left unattended.
- Early oxygen administration may be beneficial for a mild opioid poisoning (e.g., when a person is breathing on their own but has respiratory depression and signs of oversedation).

  - If a person experiencing a mild drug poisoning improves quickly (within 1-2 minutes, breathing and Sp02 increase) with administered oxygen, naloxone may not be required.
  - Oxygen administration does not remove the potential for escalating drug poisoning response such as administering additional naloxone and calling 911. Similarly, a mild drug poisoning with oxygen therapy may progress to a severe drug poisoning.
- Ventilation should not be delayed for opioid poisoning involving abnormal breathing (<12 breaths per minute, shallow breathing, or unusual breathing sounds) where oxygen or oxygen supplies are not immediately available.
- Effective oxygenation is the highest priority for a person experiencing an opioid poisoning. There are many ways to effectively deliver oxygen, including mouth-to-mouth, mouth-to-pocket mask, mouth-to-face shield, or a bag-valve-mask with oxygen. The type of oxygen delivery method will depend on the setting, responder skill and experience, and available resources.
- Oxygen administration as part of opioid poisoning response is a short-term emergency intervention. Oxygen should be given until the person is breathing normally on their own.
- Oxygen should not be administered as part of opioid poisoning response for longer than 30 minutes[b] without assessment by a regulated healthcare provider. Call 911 or transfer the person to an alternative level of care that can provide clinical monitoring and assessment if: (1) a regulated healthcare provider is unavailable, (2) opioid poisoning is complicated by prolonged sedation, or (3) a person has a persistently low SpO2 (around 90%-92%).

[b] There is no clear definition of short-term oxygen therapy in emergency situations. The estimate of 20-30 minutes is based on evidence examining the various impacts of oxygen therapy and subsequent times assigned to brief oxygen therapy interventions, as well as available literature on emergency oxygen administration.[5,19-22]

Manual Ventilation

Manual ventilation means providing respirations for a person who is unable to do so on their own. It involves airway assessment, maneuvering of the airway, and applying and maintaining airway support.[15] It may also involve ventilation devices such as a pocket mask. The most important factor for using a ventilation device is the provider's level of experience: An inexperienced provider may not know how to achieve a proper mask seal or be able to assess whether ventilation is successful.[15] Because ineffective ventilation can interfere with other essential interventions and negatively impact clinical outcomes, ventilation interventions are only recommended for providers with adequate training.[1]

While the quality of evidence is low, the World Health Organization strongly recommends that first responders to a drug poisoning focus on: airway management, ventilation, and administering naloxone.[37] A recent large longitudinal study of Supervised Consumption Site service users receiving drug poisoning intervention supports the effectiveness of manual ventilation by trained providers, which includes peer responders.[29]

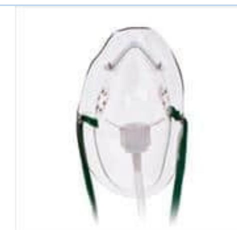
As Part of Opioid Poisoning Response

Manual ventilation as part of opioid poisoning response involves breathing for a person who is unable to do so effectively on their own. This means a person who is not breathing, is breathing less than 12 breaths per minute, or has shallow respirations or unusual breathing sounds. A person experiencing an opioid poisoning can receive manual ventilation without supplemental oxygen (e.g., mouth-to-mouth). This is an appropriate response that can deliver enough oxygen to a person to keep them alive until emergency services arrive or naloxone restores breathing.

Table 1. Oxygenation and Ventilation Devices Used in Opioid Poisoning Response.

Device	Description	Indication for Use	Key Considerations for Use	Supplemental Oxygen (With or Without)	Benefits[c]	Risks[c]	Example
Face shield	A piece of material with an opening over the mouth. May have a one-way valve.	Use mouth-to-face shield ventilation when a person has stopped breathing or has inadequate breathing (<12 breaths per minute, shallow breathing, or unusual breathing sounds).	Providers need minimal training on placement (which way is up).	Without.	Small, portable.	Incorrect placement (upside-down), minimal protection from regurgitation, hypoventilation.	
Pocket mask	A mask with a soft cushioning that covers a person's nose and mouth. It has a one-way valve and may have an oxygen port.	Use mouth-to-pocket mask ventilation when a person has stopped breathing or has inadequate breathing (<12 breaths per minute, shallow breathing, or unusual breathing sounds).	Providers need training on proper placement, maintaining a seal, and oxygen delivery.	With (flow rate of 15-20L/min)[d] when the person receiving care is not breathing. Without.	Ability to ventilate with oxygen, adequate protection from regurgitation, reusable (after proper cleaning).	Delayed response locating and preparing device, hypoventilation.	

[c] Unless otherwise indicated, benefits and risks are identified by providers working in drug poisoning response and people with lived and living experience.
[d] There is scant evidence or available clinical guidance on appropriate oxygen flow rates associated with pocket masks. This is an estimation based on grey literature that discusses the use of these masks with oxygen[38,39] as well as clinical principles on flow rates of rebreather and non-rebreather masks.

Nasal cannulae	A thin tube that affixes behind a person's ears. The tube is connected to an oxygen delivery system to send oxygen directly to nostrils.	Use to help oxygenate the body when a person can breathe on their own but is having difficulty breathing or has low (~90%) SpO2.	Providers need minimal training on placement in nostrils (not pointing up), and training on oxygen delivery.	With (flow rate of 2-6 L/minute[4,5]).	Quick placement, easy to use, minimally invasive.	Incorrect placement in nostrils (pointing up), nasal irritation.	
Simple face mask	A mask that covers a person's nose and mouth. It has no attached bag.[4]	Use to help oxygenate the body when a person can breathe on their own but is having difficulty breathing or has low (~90%) SpO2.	Providers need training on oxygen delivery.	With (flow rate of 5-10 L/min[5,40]).	Quick placement, easy to use.	Claustrophobic, uncomfortable.	
Bag valve mask	A mask with a soft cushioning that covers a person's nose and mouth and has an attached bag that is operated manually.[4] Can also deliver oxygen.	Use for manual ventilation when a person has inadequate respirations[4] (<12 per minute, shallow breathing, or unusual breathing sounds); use for manual ventilation and oxygenation when a person is not breathing on their own.	Providers need complex training and practice, particularly around mask seal, compression rate and pressure, and oxygen delivery.	With (flow rate of 15-20L/min[38]). Without.	Ability to ventilate with oxygen, requires 2+ people for optimal effectivity.[41]	Difficult to use,[34] hypoventilation from ineffective mask seal,[13] not suited to a single responder,[41] hyperventilation.[34]	

Mouth-to-Mouth, Mouth-to-Pocket Mask, or Mouth-to-Face Shield

When a person is not breathing on their own, oxygen is ineffective unless a person is also being ventilated.

Effective rescue breathing is a difficult skill for laypeople to acquire, perform, and remember.[1] It requires dedicated training and hands-on practice to learn.[1] It is, however, the most effective ventilation strategy for laypeople because it is possible to maintain SpO2 >90% with mouth-to-mouth (with or without a barrier such as a face shield).[29]

There is a lack of rigorous and population-specific research on manual ventilation during opioid poisoning response. Available evidence is limited to a few studies not specific to opioid poisoning response that show that ventilation devices for giving rescue breaths are often ineffective. One study compared mouth-to-pocket-mask ventilation (MPV) and mouth-to-face-shield ventilation (MFV) among responders with first aid training who received an additional 15-30 minutes of training on each specific mask. This study found that responders were more likely to effectively ventilate with MPV rather than MFV.[42] Other studies confirm that while both devices do not provide enough ventilation, MPV is superior to MFV: laypersons with basic training successfully ventilated with MPV 32%[43]-50%[3] of the time, whereas only 19% of the time with MFV.[43] This limited evidence indicates that pocket masks are beneficial for ventilation in opioid poisoning response. There is, however, an absence of clinical guidance on the use of pocket masks for oxygenation alone.

In summary:

- A pocket mask is a valuable device to provide manual ventilation <u>and</u> supplemental oxygen to someone who is not breathing normally on their own.
- It is <u>not</u> recommended to use a pocket mask solely for oxygen administration in a person who is breathing on their own.
- It is recommended that responsive individuals breathing on their own who require supplemental oxygen receive it through masks designated for this purpose—a simple face mask or nasal cannulae—according to relevant oxygen delivery guidance.

Bag Valve Mask

Ventilation using a bag valve mask (BVM) is often referred to as a complex clinical skill. Providers look for visual cues from the person receiving care—such as chest rise, coloration, vital signs, and SpO2[33,44]—at the same time as physical cues like resistance on bag squeeze and rate of breath delivery.[34] Providers do this while also recognizing and responding to differing clinical patterns.[33] These responses to clinical patterns are critical, in-the-moment decisions around technique adjustment, such as reassessing facemask seal or ventilation rate and volume.[33] Providers must also rapidly assess the individual needing ventilation. This includes:

- Whether the person is suited to manual ventilation (individuals who are obese, elderly, have a beard or no teeth are typically difficult to ventilate[13]).

- Knowing how to properly position the person (e.g., performing head-tilt-chin-lift or jaw thrust manoeuvres to help maintain an open airway).[33]
- Being able to insert an oropharyngeal airway (to prevent airway obstruction by moving the tongue forward).[41]

There are several risks of ventilation with a BVM (e.g., aspiration, gastric perforation[45]), and most unsafe practice relates to hyperventilation (from excessive volume or pressure).[33] While volunteers with basic training in a simulation study adequately ventilated with a BVM only 43% of the time,[3] research consistently shows that trained providers perform unsafe manual ventilation,[33,46] including excessive ventilation by emergency responders.[47] Research has also found that experienced providers such as nurses and paramedics are not consistently capable of ventilating to minimum standard when using BVM alone.[41] When comparing BVM to MPV during CPR, one study found that nurses performed pocket-mask ventilation significantly more effectively than BVM ventilation.[48] Another study looking at ventilation during CPR showed that laypersons produced more higher quality ventilations with mouth-to-mouth than either MPV or BVM.[49]

It is not recommended that only one person operates a BVM. When one person alone operates a BVM, it is difficult to maintain a tight mask seal while they perform several procedures simultaneously: opening the airway with jaw lift, holding the mask tightly, and squeezing the bag.[41] **Mouth-to-mask techniques that are simpler, faster, and more effective are recommended approaches for single-rescuer response**.[50,51] Even with 2 responders, technical difficulties and mask leaks are well documented drawbacks to BVM.[41] A tight seal can be difficult to achieve regardless of provider training, based on patient age and gender, facial anatomy, provider hand size, and mask-holding technique.[41]

Events Involving Cardiac Arrest

Evidence supporting CPR guidelines[52] found that laypersons have difficulty detecting a pulse,[30] particularly if there are environmental conditions that make pulse detection a challenge, such as noise. These individuals may also have difficulty determining which type of arrest (respiratory or cardiac) happened. However, the pathophysiology of opioid poisoning indicates that respiratory arrest will occur before cardiac arrest.[30,33] This means that a person experiencing an opioid poisoning will stop breathing before their heart stops. A 6-year chart review at Insite Supervised Consumption Service found that no person receiving emergency response required chest compressions, but all required naloxone and oxygen or ventilation.[30]

Some people experience a sudden cardiac arrest without prior respiratory difficulties or arrest. This can be seen as a "nonoxygen" life-threatening medical emergency[10] where the person is typically well oxygenated. In these situations, there will be enough oxygen in the body for approximately 4 minutes.[53] After that, oxygenated blood will stop circulating and additional oxygen is needed. In these situations, focus on cardiac resuscitation before ventilation. The best way to regain oxygenated blood circulation is with successful defibrillation or chest compressions.[10]

Key Considerations

Education and Training

All providers have equal ability to provide technically correct care when trained to do so. Organizations must be able to provide comprehensive education and hands-on training for providers to deliver oxygen safely. This includes a financially-sound sustainment plan for training evaluation, onboarding new staff, providing training refreshers, and pathways for consults and referrals.

Staffing

Because each program has unique staffing makeup, the following may help determine provider readiness or suitability to including oxygen administration within opioid poisoning response:

- Existing and future staffing composition (e.g., peer only, nurses and peers, prescriber on site), including staff-to-service user ratios.
    - Determine whether providers will have the ability to constantly reassess a person receiving oxygen to ensure oxygen administration continues to be necessary, and that the route of delivery is the best one for that person.[4]
    - For ventilation with BVM, evidence strongly supports that at least 2 trained providers perform this intervention. Consider how staffing this intervention may impact other service user care.
- Staff perspectives on the program's current approach to oxygen administration and manual ventilation.

Drug Poisoning Presentations

Oxygen administration as part of opioid poisoning response may vary depending on the local service user population and complexity of drug poisonings. A context that typically involves mild drug poisonings may need different interventions than one with severe drug poisonings, particularly if staff have existing time challenges managing drug poisonings. Severe drug poisonings may include decorticate posturing, jaw clenching, finger stiffness, wooden chest syndrome, or other positioning difficulties in the person experiencing an opioid poisoning. These symptoms may slow down response time when attempting to manually ventilate or impact oxygen delivery.

Response Capacity

Limitations to staff response time to drug poisonings—such as staffing numbers and composition, time spent monitoring post-drug poisonings, and performing other care duties—may influence the addition of oxygen administration to provider responsibilities. In addition, it is critical that providers can elevate the level of care if there are complications with oxygenation or ventilation. This includes determining what other resources the providers can draw from, such as supervisors and additional trained responders, as well as factoring in typical EHS response time.

Supplies

Shortages of oxygen and related supplies has been reported as a challenge to implementing oxygen administration as part of drug poisoning response.[31] Verify whether the program is able to manage supply requirements. This includes the financial cost as well as ordering, maintaining safety, and receiving and implementing training updates.

Safety

Oxygen is highly flammable and poses a fire risk when used and stored in proximity to open flames.[4] Programs offering, or considering offering, inhalation services should be particularly mindful of this risk. Refer to local health authority guidance for more details on safety requirements related to oxygen.

Conclusion

Non-regulated providers frequently respond to opioid poisonings in community settings. As respiratory depression is a primary feature of opioid poisoning, examining evidence related to airway management and ventilation interventions may provide an opportunity to expand opioid poisoning response capacity to improve outcomes and experiences.

While BC legislation currently only permits regulated healthcare providers and Emergency Medical Assistants to administer oxygen, evidence supports the administration of oxygen by any provider trained to do so as part of opioid poisoning response. While oxygen is not a substitute for naloxone, it is possible that a person's clinical status may improve with oxygen alone and naloxone may not be required. **Oxygen administration without ventilation (spontaneous or manual) is ineffective.**

All forms of manual ventilation are difficult to perform successfully, even for experienced regulated providers. This indicates that a person's professional designation is inconsequential: Skill and competence is individual, perhaps related to the training received as well as available and ongoing opportunities to practice skills and have them evaluated. Of the limited available evidence, research shows that mouth-to-pocket mask ventilation is more effective than mouth-to-face shield or using a BVM. Manual ventilation with BVM is consistently found to be a complex technical skill that requires significant training and competence. Ventilation with BVM requires immediate and ongoing clinical assessment and response that involves clinical knowledge, skill, and experience typically only available to regulated providers. As such, opioid poisoning response with BVM is best suited to experienced clinical providers who have demonstrated ongoing competence with this skill.

Delays in oxygen administration and ventilation may result in negative clinical outcomes for the person receiving care. Delays may be due to: (1) unavailability of staff trained to administer oxygen and perform manual ventilation, (2) inaccessible oxygen or ventilation supplies, or (3) ineffective manual ventilation technique. **If oxygen is not available, providers should not delay ventilation.**

Programs should ensure that their oxygen administration and manual ventilation guidelines for opioid poisoning response integrate the best available evidence. Guidelines should also include how the unique local context may impact the success of these interventions. This includes reviewing staffing composition, training, and staff perspectives on skill and competence, considering the local service user population and drug poisoning presentations, as well as individual program ability to meet ongoing education, training, and safety requirements. Any new or changes to oxygen administration and manual ventilation requirements should be paired with corresponding protocols and education.

Resources

Several organizations offer oxygen therapy courses that provide the skill and knowledge to administer supplemental oxygen and safely handle and assemble related equipment. For example, the Canadian Red Cross offers oxygen therapy training and an airway management course. This course provides knowledge and skill related to airway management, including decision-making around airway management interventions. There are several options for this training:

- A standalone oxygen therapy course (1-2 hours).
- A standalone airway management course (1-2 hours).
- A 5-hour course when combining Basic Life Support (BLS) with either oxygen therapy or airway management.
- A 6-hour course when combining both oxygen therapy and airway management with BLS.

Parkdale Queen West Community Health Centre in Toronto created a *Comprehensive Overdose Response with Oxygen: Training for Shelter Providers in Toronto* resource. This details the creation of a training package for new staff. The package includes oxygen implementation and hands-on training via a 4.5-hour education module on comprehensive drug poisoning response, as well as how to integrate a follow-up evaluation plan to ensure knowledge retention. This may be a useful reference for organizations considering implementing oxygen as part of opioid poisoning response.

Appendix A - Example Scenarios

These scenarios are examples of how to incorporate appropriate oxygen administration and manual ventilation into opioid poisoning response. These are not prescriptive, as every drug poisoning event is unique. The aim is to offer providers a practice-based example using the evidence in this summary to demonstrate how airway management interventions differ based on individual assessment and response.

Scenario 1: Oxygen Administration

Innes is a long-term service user of a local health and social service organization. She often comes in to collect harm reduction supplies, and sometimes sits outside to smoke substances. Wen works at the site and knows Innes well.

Wen goes outside to check on Innes. Wen finds Innes staring into space, with a cigarette dangling from her lips. Wen asks Innes if she’s okay. Innes looks at Wen but doesn’t respond. Wen wonders whether Innes may be experiencing a drug poisoning, even though Innes’ skin colour looks normal, and she is breathing normally. Wen sits down next to Innes and asks her how she’s feeling. Innes still doesn’t respond: She closes her eyes and her head droops a little. Wen calls Innes’ name. Innes slowly lifts her head and opens her eyes. Wen checks Innes’ breathing, which is at 12 breaths per minute. Wen cannot hear any abnormal sounds like gurgling. Innes’ skin colour looks the same as usual, but her pupils are small. Wen lets Innes know they’re going to put out her cigarette, so it doesn’t burn her, and Innes doesn’t respond.

Wen feels worried that Innes is so drowsy. Wen tells Innes they’re going inside to get some emergency supplies. When inside, Wen lets a coworker know what’s happening.

Wen returns quickly and Innes is hunched over. Innes is breathing, but her breaths seem a bit shallower than before, with longer gaps in-between breaths. Wen tells Innes that they’re going to put an oximeter on her finger. The oximeter reads 90%. Wen tells Innes they’re concerned she might be having an opioid poisoning, and they’re going to put on a face mask to give her oxygen. Wen makes sure there’s no one else nearby smoking, then puts a simple face mask on Innes, connects the face mask oxygen tubing to the oxygen tank, and turns on the oxygen at 6L/min. Wen encourages Innes to take deep breaths. Innes responds by taking a few deep breaths.

After a couple of minutes, the oximeter reads 94%. Innes’ breathing is still at 12 breaths per minute but not as shallow. After 10 minutes on oxygen, Innes’ oximeter reads 96%, and her breathing is at 14 breaths per minute. Wen turns off the oxygen. Innes tells Wen she felt really out of it and dazed. She said she felt different as soon as she took a hit, so stopped and had a cigarette. Wen asks Innes if they can go inside together, so that there is someone around to monitor and help with any other response if it’s needed.

Scenario 2: Manual Ventilation

Innes is a long-term service user of a health and social service organization. She often comes in to collect harm reduction supplies, and sometimes sits outside to smoke substances. Wen works at the site and knows Innes well.

Wen goes outside to check on Innes. Wen finds Innes staring into space, with a cigarette dangling from her lips. Wen asks Innes if she's okay. Innes looks at Wen but doesn't respond. Wen wonders whether Innes may be experiencing a drug poisoning, even though Innes' skin colour looks the same as usual, and she is breathing normally. Wen sits down next to Innes and asks her how she's feeling. Wen tries to count Innes' breaths, but they're shallow and it's hard to see how many. She counts at least 8 breaths. Innes closes her eyes and her head droops a little. Wen calls Innes' name and she doesn't respond. Wen lets Innes know they're going to put out her cigarette, so it doesn't burn her, and Innes doesn't respond.

Wen feels worried that Innes is having an opioid poisoning and calls for help. Wen tries to stimulate Innes by pinching her shoulder muscle and calling her name loudly. Wen's coworker comes outside with the emergency kit. Innes' body starts to slump. Wen and the coworker protect Innes' head while they slide her to the ground and onto her back. Wen tries to count Innes' breathing and can still only count 8 breaths a minute. Wen calls Innes' name loudly and pinches Innes' shoulder muscle again to try to get her to respond. They tell Innes they're going to give her naloxone. Innes still doesn't respond.

Wen asks the coworker to call 911 then give Innes one dose of naloxone. Wen says they're going to start rescue breaths as Innes' breathing is only 8 per minute. Wen takes out a face shield from the emergency kit, puts it over Innes' mouth, and begins breathing through the valve: 1 breath every 5 seconds. Wen can see Innes' chest wall rising and falling with each breath they give. Wen's coworker puts the pulse oximeter on Innes' finger as she calls 911: it's 90%. The coworker gives Innes one dose of intramuscular naloxone.

Three minutes after the dose of naloxone, Innes' breathing is still 8 breaths a minute and shallow. Innes' skin looks pale, and the oximeter reads 92%. Innes still doesn't respond to pain or verbal stimulus. Wen continues rescue breathing at 1 breath every 5 seconds, and the coworker gives a second dose of intramuscular naloxone. After 2 minutes, Innes' oximeter still reads 92%. Wen stops rescue breathing to assess Innes' breathing. Innes is breathing at 12 breaths per minute. Wen stops rescue breathing as Innes is breathing normally. Wen notices that Innes has nail polish on her fingers and knows this may interfere with the oximeter reading. Innes' skin colour is returning to normal, but Innes still isn't responding. Wen continues to watch Innes' breathing while waiting for EHS to arrive.

Scenario 3: Oxygen Administration and Manual Ventilation

Innes is a long-term service user of a health and social service organization. She often comes in to collect harm reduction supplies, and sometimes sits outside to smoke substances. Wen works at the site and knows Innes well.

Wen goes outside to check on Innes. Wen finds Innes standing, staring into space, with a cigarette dangling from her lips. Wen asks Innes if she is okay. Innes looks at Wen and says "yeah". Innes' skin colour looks the same as usual, but her pupils are tiny. Wen asks Innes how she's feeling. Wen tries counts Innes' breaths, but they're shallow and it's hard to see how many she's taking. She counts at least 8 breaths. Innes walks slowly towards the door and with slightly slurred speech says she's going inside. Wen reminds Innes to put out her cigarette, which Innes does very slowly. Innes' lips appear to be turning blue.

Wen feels worried that Innes is experiencing an opioid poisoning and tells Innes this. Wen walks inside with Innes and suggests Innes sit down to have her oxygen level checked. Innes sits down slowly. Wen asks for help from a coworker, who comes with an emergency kit. Wen puts an oximeter on Innes' finger and it reads 84%. Wen can't think of any reasons why Innes' oximeter reading would be inaccurate, other than smoking cigarettes. Wen has a hard time counting Innes' breaths, which appear to be around 6 per minute. Wen tells Innes they're concerned she isn't getting enough oxygen and is having an opioid poisoning. Wen tells Innes they need to give her naloxone, and Innes shakes her head. Wen asks Innes if they can put an oxygen mask on her, and Innes says okay. Wen's coworker has connected a simple face mask to an oxygen tank, and places the face mask on Innes. Wen tells Innes to take deep breaths. Innes doesn't respond and closes her eyes, her head drooping. The oximeter reads 86%, and Wen cannot see that Innes is breathing. Wen and the coworker protect Innes' head while they slide her to the ground and onto her back. Wen calls Innes' name loudly and pinches Innes' shoulder muscle to try to get her to respond. They tell Innes they're going to give her naloxone. Innes still doesn't respond.

Wen asks the coworker to call 911 then give Innes one dose of intramuscular naloxone. Wen takes the simple face mask off Innes and uses a pocket mask to give rescue breaths to Innes through the valve: 1 breath every 5 seconds. Wen can see Innes' chest wall rising and falling with each breath they give. The coworker gives Innes one dose of intramuscular naloxone. Wen continues rescue breathing at 1 breath every 5 seconds.

Two minutes after the dose of naloxone, Innes gasps and opens her eyes. The oximeter reads 90%, but Innes' skin looks pale and her pupils are still constricted. Wen encourages Innes to take deep breaths and explains what happened. Innes is breathing at about 12 breaths per minute, but they appear shallow. Wen lets Innes know they're going to put the face mask back on to help get oxygen into her body. Innes nods, and Wen puts the face mask back on at 6L/minute. Wen continues to encourage Innes to take deep breaths while waiting for EHS to arrive.

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