Managing Dyspnea With Wheezing

by Bryan Fischberg

EMT Objectives

After reading this article, the EMT should be able to:

- Describe two origins of wheezing;
- Cite two non-asthmatic conditions with wheezing; and
- List at least one indication and one contraindication for a nebulized beta agonist bronchodilator medication.

Introduction

At the end of last year the New Jersey Department of Health issued a waiver for EMTs operating for a BLS agency under a medical director to be able to carry and administer their own nebulized albuterol to patients suffering dyspnea with wheezing from asthma or chronic obstructive pulmonary disease (COPD). Educational materials are being developed by stakeholder groups to support this expanded privilege. The purpose of this article is to enhance your understanding of, and support the materials for, this situation.

The Shortness of Breath Spectrum

Dyspnea is a symptom – meaning it can only be expressed by the patient – that breathing is uneasy or difficult. It can occur with or without signs, which are observable attempts by the body to improve oxygen extraction from the atmosphere and/or increase the elimination of carbon dioxide into it. Signs are categorized by syndromes on a coarse scale of severity for practical purposes.

In respiratory distress, the patient's work of breathing is increased and compensating, perhaps temporarily. It can (but doesn't always) improve without intervention, such as recovery after a period of physical exertion. Routine signs include flared nostrils and widened mouth, shortened phrasing during speech, altered posture such as the well-known tripod position *(see Figure 1)*, increased respiratory rate, and/or using accessory muscles to help draw air. Mental status is usually at baseline or restless. Heart rate often quickens and the oxygen saturation may decrease to the low end of normal for that patient. Supplemental oxygen by a free flow device, and sometimes continuous positive airway pressure (CPAP), are the cornerstones of intervention for respiratory distress.

Figure 1:

The Tripod Position

In respiratory failure, the patient's work of breathing is fatigued, exhausted, insufficient, and decompensating. It usually does not improve without intervention. The patient's skin may be ashen or cyanotic. His mental status may be agitated, combative, or depressed. Respirations may be slow, weak,

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shallow, and/or too quick to be effective. Heart rates can be abnormally fast or slow. Oxygen saturation will be clearly below the patient's baseline. Promptly assisting breathing rate and/or size (tidal volume) with oxygen-enriched ventilation is the key intervention. This is usually by bag-value-mask (BVM) ventilation and employing a positive end expiratory pressure (PEEP) of 5 cm H2O, if available.

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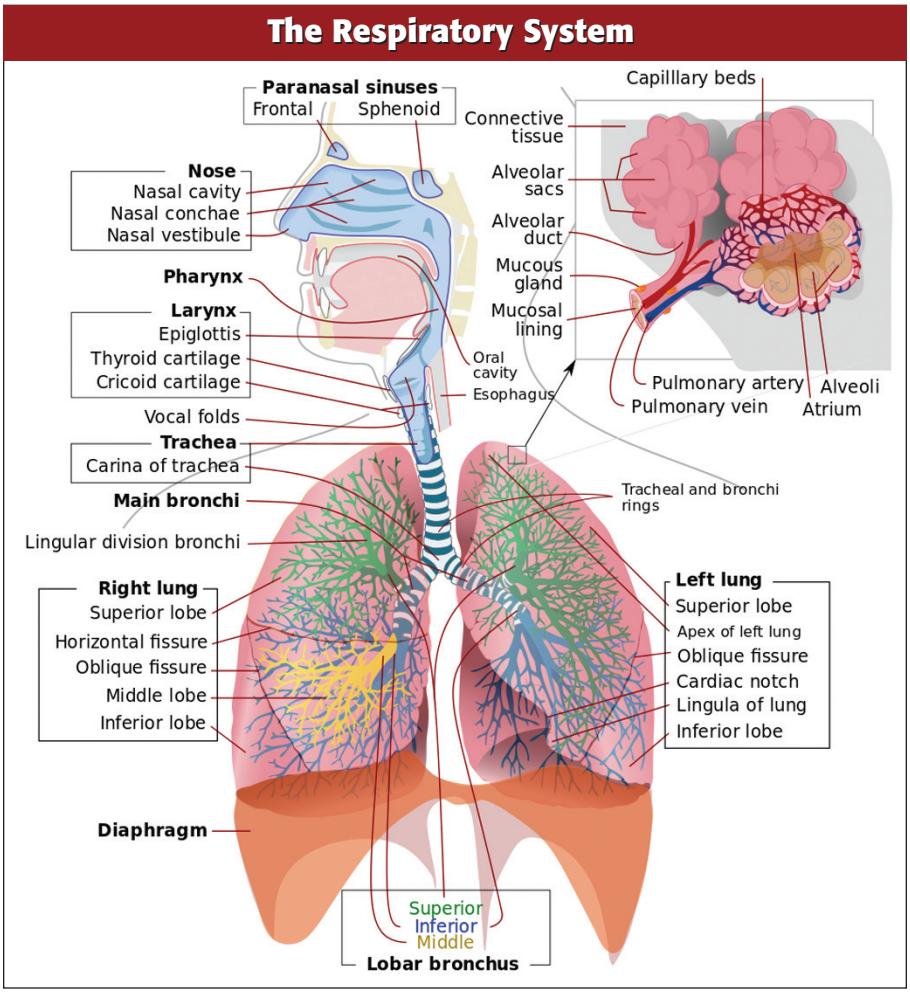
The worst end of the scale is respiratory arrest, which is characterized by unconsciousness and either complete apnea or the occasional, weak, shallow gasps of agonal breathing. Without intervention cardiac arrest is inevitable. Emergently securing the patient's airway and taking over for breathing is the fix in this situation.

I mentioned that oxygen saturations should be compared to baseline. When assessing the level of respiratory compromise, the pulse oximeter reading cannot be used in isolation. For example, patients with chronic obstructive pulmonary disease (COPD), especially chronic bronchitis, live at lower oxygen saturations than typical for the general population. It is not unusual for one of these patients to live normally in the high eighty percent range, which would be abnormally low for most others.

Noisy Breathing is Obstructed Breathing

We cannot see most of the airway – only a little bit in the mouth and nose. However, we can deduce reductions to the ease of air flow in much of the rest of the airways *(see Figure 2)* by sound. Partially obstructed breathing

Figure 2:



is often associated with abnormal (or diminished) sounds, many of which don't require the use of a stethoscope. You are already familiar with snoring in the upper airway, caused by anatomic obstruction by the tongue, and coarse rattling caused by secretions. These can be addressed, respectively, by manual maneuvers and suctioning. Another telltale sign of upper

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airway obstruction is the inspiratory noise called stridor. This is usually from swelling in the soft tissues of the upper airway, creating vibrations from turbulence, but could also be from foreign body aspiration or partial blockage from a mass, such as an abscess or tumor.

Partial obstruction also occurs in the smaller lower airways. Bronchoconstriction is the umbrella term referring to this narrowing in the bronchial tree. At this level the airways have a wrap or layer of smooth (involuntary) muscle that has normal tone, but can be abnormally contracted by spasm, called bronchospasm, or relaxed, termed bronchodilation. These finer airways can also be partially clogged by congestion, creating familiar lung sounds of rhonchi and rales. Swelling or inflammation of the airways can also lead to a narrowing of the lumen, its hollow tubular center. So, bronchoconstriction can be caused by spasm, sputum, and/or swelling. *(See Figure 3, next page)*

When the degree of bronchoconstriction in the medium airways is sufficient compared to the flow of air through them, the turbulent flow vibrates the airways. Wheezing is the characteristic, musical noise created. So, again, noisy breathing is obstructed breathing. Wheezing can occur during either phase of normal

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breathing, respiratory distress or respiratory failure, but not respiratory arrest.

Problems in the lung tissue at the alveolar level can lead to a respiratory sound called grunting. This expiratory noise is caused by premature closure of the vocal cords near the end of exhalation in an attempt to trap some residual air in the air sacs to reduce the chance of their collapse. Grunting can be heard during conditions like pneumonia or near drowning. *(See Table 1)*

Conditions Associated With Wheezing

"All that wheezes is not asthma."
-Chevalier Jackson, MD (1865-1958)

While there are many conditions associated with wheezing, a few stand out for our purposes in EMS. Wheezing is from partial obstruction of small passages in the lower airway. This narrowing also presents resistance to air flow, making it harder to breathe. The resulting dyspnea usually exhibits signs of difficult breathing. In a generic sense, wheezing is usually associated with conditions of respiratory distress.

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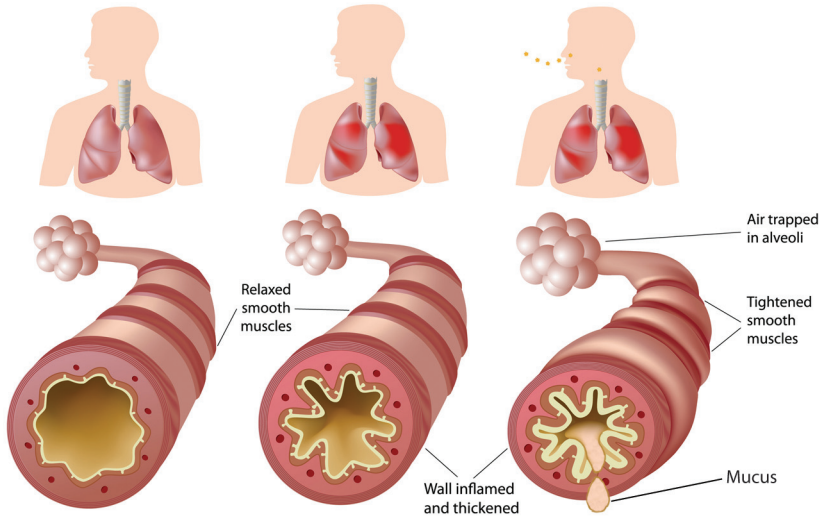
The primary suspects are asthma and chronic obstructive pulmonary disease (COPD). Years ago, these were lumped together, but now they have evolved to be categorized as "close cousins." Asthma is a condition of chronic inflammatory bronchoconstriction of the small airways punctuated by attacks of bronchospasm. The attacks can be acute and, in rare cases, severe enough to induce prompt respiratory failure and cardiac arrest. COPD is a suite of enduring diseases of the lung (e.g., chronic bronchitis and emphysema) characterized by lasting narrowing of the small airways by a blend of spasm, sputum, or swelling, depending on the specific disorder. COPD conditions also have episodic exacerbations, which can be severe enough to require hospitalization and possibly the assistance of a ventilator. Long-acting bronchodilators and steroids – to reduce smoldering inflammation – are mainstays of therapy supplemented by short-term "rescue inhaler" bronchodilators. *(See Photo 1)*

Figure 3:

Pathology of Asthma



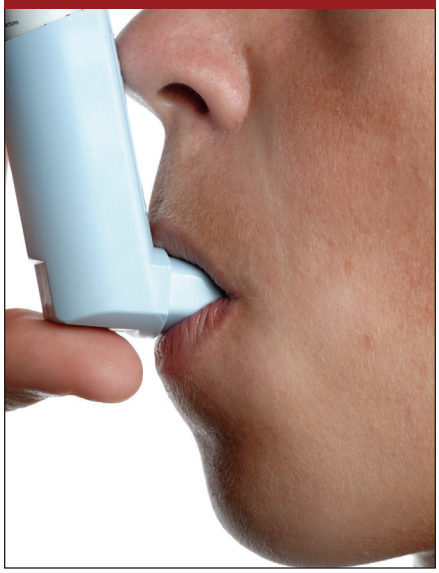
Normal airway
The tubes are open and air can move easily in and out of the lungs.

Asthmatic airway
There is inflammation (irritation and swelling) inside of the tubes. This is usually due to allergies. There is often a little mucus produced.

Asthmatic airway during attack
There is even more swelling. A bronchospasm occurs, which is a tightening of the muscles around the airway. More mucus is produced.

Photo 1:

A "Rescue Inhaler"



In anaphylaxis, the immune system reacts to a local antigen exposure in an exaggerated way that affects multiple organ systems because of profound histamine release. Bronchoconstriction, hence dyspnea and wheezing, is common. As you're aware, when the airway, breathing, or circulation is affected, promptly using an epinephrine auto injector is important. *(See Photo 2)* You'll recall

Table 1: Summary of Abnormal Respiratory Sounds

Location	Abnormal Sound	Respiratory Phase
Upper Airway	Snoring	Inspiratory
	Stridor	Inspiratory
Medium Airways	Wheezing	Inspiratory or Expiratory
Alveolar	Grunting	Expiratory

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Photo 2:

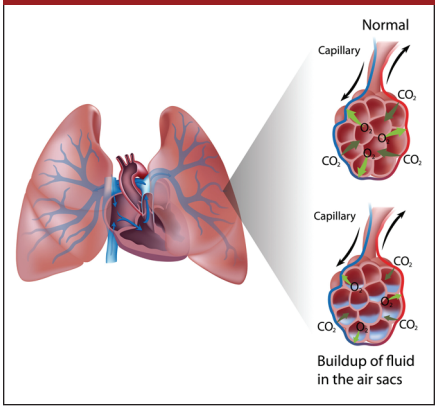
Epinephrine Auto Injectors

that the action of epinephrine is to relax and enlarge tightened airways (bronchodilator) to aid breathing and constrict widened blood vessels (vasoconstrictor) to benefit blood pressure.

When congestive heart failure originates from a weakened left side of the heart, pulmonary edema can result.

Figure 4:

Pulmonary Edema



(See Figure 4) The accumulation of fluid leads to the swelling of fine airways, accompanied by compression of these airways from surrounding lung tissue engorgement. The wheezing that results is nicknamed "cardiac asthma" and precedes the signs of fluid accumulation in the air spaces.

Direct inhalation of hot, toxic, or irritating gas, dust, or powder can annoy the airways. As you might expect, as they inflame and swell wheezing could easily occur.

Characterizing Wheezing

To help track the progression of wheezing and document it accurately, it helps to consider its intensity, phase, and tone.

Intensity is often described as audible without assistance at the "loud" end of the scale, and scant, distant, or quiet at the other. In the middle of the range, where a stethoscope is needed to appreciate wheezing, we usually don't give the intensity any special description. Louder wheezing usually means more air flow is occurring and "tight" wheezing expresses diminished sound, evident of poor air flow.

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The timing with the **phase** of breathing – expiratory or inspiratory – is another important characteristic. INspiratory wheezing is usually caused by factors OUTside the bronchial tree. EXpiratory wheezing, while breathing OUT, is usually owing to bronchoconstrictive factors INside the airway. Wheezing that lasts during an entire single phase is prefixed "pan-" or "holo-." Paninspiratory wheezing is heard throughout the entire inhalation. By contrast, end-expiratory wheezing is heard only near the end of exhalation. If you hear it during both inhalation and exhalation, it is described as biphasic.

Tone or pitch relates to the degree of obstruction. In a pipe organ, the smaller pipes emit a higher note than the long, broad tubes responsible for bass notes. A high pitch wheeze is also called sibilant. Lower, groaning wheezing is sometimes called sonorous. Tone also suggests the level of involvement; i.e., do you hear a single note or a chord? Monotonal wheezing usually arises from small airways of consistent caliber. Polyphonic wheezes, which consist of a chord of multiple tones, suggest higher and broader involvement of the bronchial tree, including larger airways.

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Assessing to Distinguish Wheezing Conditions

There is nothing exotic to assessing a patient having dyspnea with wheezing. However, completeness is important. Since a broad spectrum of pulmonary conditions can produce wheezing, the more complete your assessment and documentation, the easier it will be – for you or others to whom you hand off the patient – to deduce the origin of the problem and work to resolve it. For example:

- Since many patients with chronic respiratory problems are on oxygen routinely, is this assessment with the patient breathing room air or supplemental oxygen?
- Is the patient cyanotic or fatigued from distress? Remember, it is important to distinguish respiratory failure from distress.
- What is their preferred position? Sitting? Leaning forward in a tripod position?
- What is their actual respiratory rate? Being expedient and estimating the rate does not help as much as taking the time to actually measure it each time.
- Are the mechanics and work of breathing normal? Is there any nasal flaring or mouth breathing? Does breathing look easy or are there retractions and use of accessory or abdominal muscles? Is the patient exhaling through pursed lips? Is the time to exhale disproportionately prolonged?
- How many words, phrases, or syllables do they speak at a time? Phrasing can be a very revealing observation to characterize the actual level of distress. For

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example, some patients can be breathing quickly, but explain their story to you in full phrases or sentences.

- Is there coughing? Is it producing sputum? If so, what color is it?
- Are sounds of breathing audible without a stethoscope? If not, what does your auscultation with a stethoscope reveal? If the patient coughs, do the breath sounds or their pattern change immediately after the cough?
- In the "SAMPLE" history, did the patient make any efforts to relieve the distress? Did they help or aggravate the situation? What medications, episodic or chronic, did the patient administer before your examination? Has this happened before and what was the outcome? Has the patient ever been hospitalized or on a ventilator for breathing difficulty? Are they, or were they, a cigarette smoker?
- What is the oxygen saturation? Pulse oximetry *(See Photo 3)* has a secondary role and should be used to confirm or track the progression of a condition you already suspect by assessing the patient appropriately. The oxygen saturation should also be interpreted in the context of the patient's normal situation. We've already mentioned how patients with COPD have a baseline saturation that is lower than the typical patient. Remember that for an oxygen saturation by pulse oximetry to be credible, the pulse rate reported by the oximeter needs to be close to the patient's actual pulse rate. In most circumstances, this is either a palpated pulse rate (e.g., radial) or auscultated heart rate (e.g., apical).

Photo 3:

Pulse Oximeter

Management Approach

Management of these patients should initiate routinely with attention to any need for clearing, positioning, or intervention to secure an effective airway. Then allow the patient to assume a position of comfort that optimizes their mechanics of breathing, as their blood pressure and safety tolerates. Use of free flow oxygen should be titrated to the patient's level of distress.

Don't hesitate to initially consider a nasal cannula; it is comfortable, well-tolerated, conservative with a limited portable oxygen supply, and often effective. If your treatment plan includes giving a nebulized treatment, the nasal cannula is convenient because it can stay in place before and after the breathing treatment by mouthpiece. But, have an easily-attained threshold to escalate the oxygen therapy to a reservoir mask (e.g., non-rebreather mask) if needed.

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In the short term, the concern for eroding breathing effort from hypoxic drive in COPD should not deter you from being aggressive with oxygen in true distress. If you'll be with the patient for an extended period of time, like a long-distance transport, consider humidifying the oxygen. If there is respiratory failure or arrest, swiftly intervene with manual oxygen-enriched ventilation.

A mainstay of managing acute dyspnea with wheezing is "rescue" short-acting inhaled nebulized bronchodilator medication. As you're likely aware, most patients use these on their own and often try them before reaching out to EMS. However, not all bronchoconstriction is caused by bronchospasm. Thus, the helpfulness of inhaled bronchodilator medication varies. Like all medications, the assurance of rights of drug administration and accurate documentation applies.

Beta-two action relaxes smooth muscle that contributes to bronchoconstriction, thereby helping relieve wheezing from bronchospasm.

The most common family of medications for these rescue situations is the β_2 (beta-two) agonist. This is a subset of drugs that stimulate part of the body's natural "fight-or-flight" response driven by the sympathetic branch of the autonomic nervous system, called sympathomimetic drugs. Epinephrine is also a sympathomimetic drug, but has stronger and broader effects. β_2 action relaxes smooth muscle that contributes to bronchoconstriction, thereby helping relieve wheezing from bronchospasm. Side effects of this mist include tachycardia, shaking or tremor, nervousness or jitteriness, and cough.

Some patients with cardiovascular disease take β-blocking drugs and this medicine may either thwart the action of the inhaler or the inhaled agonist may aggravate the cardiovascular condition. The use of these β_2 drugs in wheezing situations other than asthma or COPD – like the

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"cardiac asthma" of congestive heart failure – is controversial in emergency medicine and not universally endorsed. That's one of the reasons why EMS medical directors' approaches may vary, leading to differences among agencies' protocols.

The inhaled route dominates this therapy for its ease of administration and low risk of complications. The two most common methods are metered dose inhalers (MDI - *see Figure 5)* and small-volume nebulizers

Photo 4:

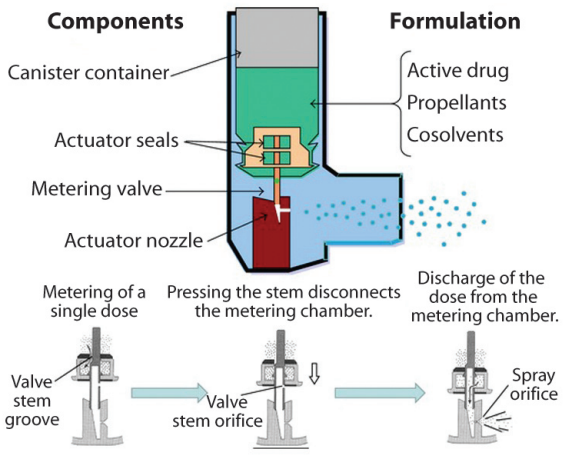
Small Volume Nebulizer

(SVN - *see Photo 4)*. The medication involved in the statewide waiver is albuterol (salbutamol), which is the same agent popular with many rescue MDI therapies.

The particle size of the nebulized fog is important, because it needs to stay suspended in the inhalation air stream to be carried deep into the lungs. There is a range of effective particle sizes, the goal being around 5 microns. That is five millionths of a meter – about the size of a red blood cell or a couple bacteria. Or, imagine the period at the end of this sentence enlarged to the circumference of a tennis ball. A 5-micron particle, similarly enlarged, would be about the size of a ball bearing. *(See Figure 6)*

Figure 5:

MDI Components and Formulation



The use of a spacer with an MDI and the use of appropriate gas flow (either air or oxygen) with a SVN help achieve an effective distribution of particle sizes when inhaled.

Poor technique is sometimes a reason these nebulized medications are ineffective, and this may be why EMS is called in the first place. Patients who are tachypneic in respiratory distress often don't take deep breaths; they compensate by breathing faster instead. Because of their air hunger and anxiety, they don't adhere to good inhaler technique. As you might expect, it is important to draw the medicated fog fully into the lungs. That is why, when you were trained in your EMT refresher class to assist patients with an MDI, you were encouraged to have the patient exhale deeply, then start inhaling as the canister of the inhaler is depressed into the actuator to generate a "puff" of mist. Patients should also be encouraged to hold their breath after inhaling the mist and exhale in a controlled manner through pursed lips. When your patient is short of breath, this is often easier said than done. But if you can get good compliance, the payoff is big.

The same goes for finding the spacer to use with an MDI. The improvement in medication delivery is often worth a couple moments to find this accessory to the inhaler. The spacer works by letting the bigger droplets and particles settle out in the chamber, leaving the lighter and smaller particles suspended in the cavity, sorted out and ready to be more effectively inhaled. *(See Figure 7, next page)*

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Inhaled bronchodilators are not always successful. Sometimes, asthma attacks or exacerbations of COPD are so severe that the patient cannot effectively draw the medicated mist or powder into his lungs. Or, secretions are sometimes so copious, thick, and obstructive that the inhaled medicine cannot adequately contact the target tissues in the lung and relieve the problem. ALS units have a variety of injectable drugs – that aren't vulnerable to ineffective inhalations – to help mitigate these situations.

Reassessment of the patient should be comprehensive, but focus on the abnormal parameters you discovered

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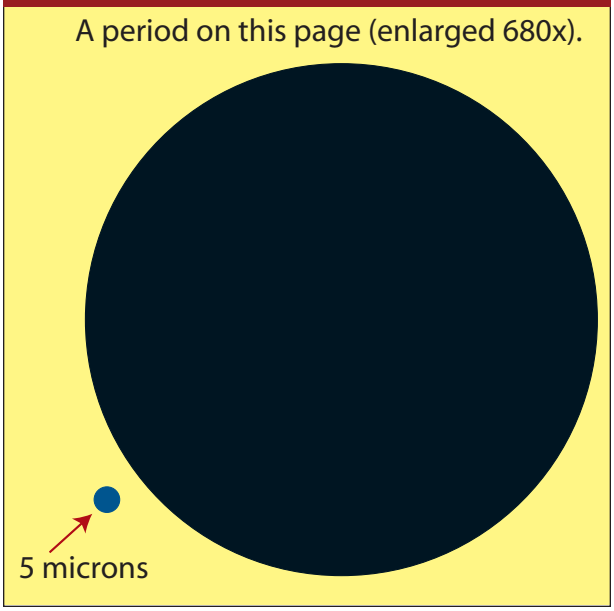
Figure 6:

How small is a 5-micron particle?



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initially to signal either relief from respiratory distress, or deterioration to respiratory failure.

Reassessment of the patient should be comprehensive, but focus on the abnormal parameters you discovered initially to signal either relief from respiratory distress, or deterioration to respiratory failure.

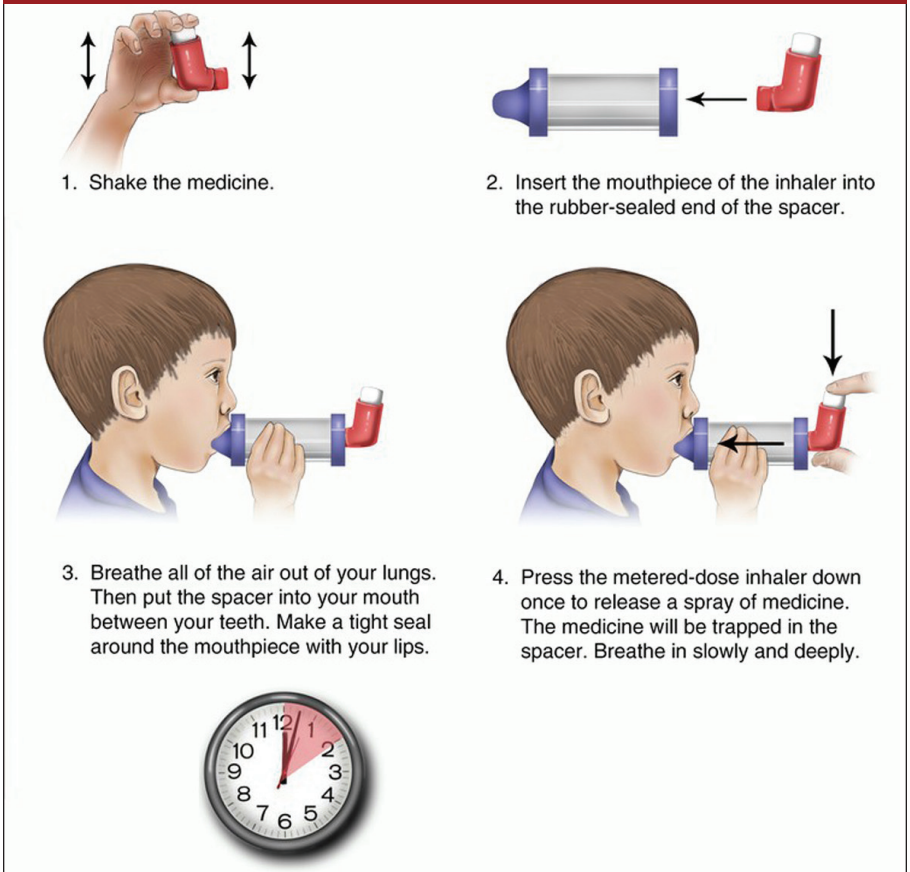
It is worthwhile to note that, early in the administration of nebulized medication by SVN, patients having their oxygen saturation monitored may have a transient dip near the beginning of therapy. In part, these patients are often being taken off high-concentration oxygen masks at a high rate of 10-15 liters/minute and switched to an SVN at a lower rate of 6 L/min oxygen flow producing fog. The medicated fog takes up space in the tidal volume and displaces some of the oxygen. So, the overall oxygen concentration being inhaled goes down, indicated by an early dip in the oxygen saturation reading. If, instead of rebounding, the decline progresses to respiratory failure, then move to assisted ventilation with high concentrations of oxygen.

Early in the administration of nebulized medication by SVN, patients may have a transient dip in their monitored oxygen saturation.

Other secondary therapies for these situations exist in your tool box, like CPAP and epinephrine. But these are secondary and should only be integrated with oxygen and nebulized treatments under the direction of your medical director or advisor.

Figure 7:

Using A Spacer With A Metered Dose Inhaler



Summary

Wheezing is a sign of respiratory difficulty that can be managed with an attentive administration of special inhaled medication added to oxygen. Accurate assessment and early intervention with a multipronged approach can bring effective relief to the patient in respiratory distress and help stave off deterioration. However, inhaled bronchodilator medications are no "silver bullet" and need to be used selectively.

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