COURSE OBJECTIVES

* Recognize the incidence, etiology, and pathophysiology of croup.
* Indicate the clinical manifestations and diagnosis of croup.
* Identify classifications of croup and management strategies applied in emergency settings.

Welcome to this presentation of “Viral Croup Treatment in the Emergency Setting.” I'm Janie Robles. I'm an Assistant Professor of Pharmacy Practice at the Texas Tech University Health Sciences Center.

Viral croup is really one of those diseases that, I think, is really important to fully understand because it does affect so many pediatric population patients. For the most part, we don't see a lot of complications associated with it. It's more a very small amount, but that small amount becomes very crucial to ensure that we initiate therapy in a timely manner to avoid any complications such as intubation and other things like that.

So, for this presentation, I'm going to go over croup, talk about the background, how it's diagnosed, those signs and symptoms, and the categorization of the differences of severity, then looking at all the different types of treatments we could use in croup. And then kind of coming back and relating it back to the treatment, depending on the severity, and then, of course, in the emergency setting. So that's kind of the background of the presentation.

The objectives are: to define the incidence and etiology of croup; to discuss the pathophysiology of croup; describe the clinical manifestations and diagnosis of croup; and then, lastly, looking at the classifications of croup and the management strategies utilized in the emergency setting or the prehospital setting.

One of the things that I wanted to do with this presentation was to include a patient case, so we could walk through it early on, talk about the important aspects of it, come back to
it a little bit later and look at the diagnosis, signs and symptoms, and then coming back at the very end for the treatment.

The patient case is listed here. I'm just going to read through it, and then I'll come back and I'll just emphasize important aspects; how they relate back to croup. And it will be great because then it gives you an opportunity to reflect back throughout the presentation through the case.

Upon arrival to the patient's home, you find Cassie, a 6-month-old girl with difficulty breathing. You find the mother in a steam-filled bathroom with the child in her arms. Respiratory distress is present, and you hear a 'seal-barking' cough.

Her mother informs the crew that she has had cough and congestion throughout the last two days and now has this increased work of breathing with decreased feeding. And two days ago, she developed rhinorrhea, fever, a hoarse cry, and then barking cough. And Cassie developed at high-pitched whistling that prompted the call for the emergency services. And she has a 6-year-old brother with cold symptoms.

Now, that's the overall case for a patient who presents with croup. Let's look at it a little bit more in detail:

We have a 6-month-old girl. Six months is usually where you start to see some of the issues with croup, but then also you see it sometimes a little bit later, up until usually kind of a toddler age. We also have this difficulty in breathing with these patients, and so that's important -- particularly whenever they come to the emergency setting or that prehospital setting itself -- to fully evaluate these patients.

The other aspect that is important is that whenever the child is observed, they're observed in a steam-filled bathroom. And this is key because this is this humidified air that we're providing to the child, and I'll talk about it a little bit later with the non-pharmacological treatments. But it is a treatment that is used with croup, occasionally, at home. Occasionally, it can be used in the hospital setting and, of course, in the emergency setting and prehospital setting. Respiratory distress is present, and I think that's important because it highlights that this patient is more of a concern, not necessarily for intubation at this stage but a very significant distress related to the respiratory system. Then the 'seal-like' barking cough, that's very important. That's a very classic cough for croup.

And then we get a little bit more of the history, and I think that's where it's important whenever we have these patients to really find out is this acute; is it chronic; how long has it been going; is there anything that kind of helps it or makes it worse? And I think you see that they're in this steam-filled bathroom that they're trying to use to make it a little bit better.
But in the history with this, we hear from the mom that she has had this cough and congestion for the last two days, which is very classic when we see croup. Usually, it's day three that we start to see more problems overall. Then we also have this increase of work of breathing, which is important -- it kind of ties back to the respiratory system. And then this decreased feeding, which becomes important because once we have this congestion where there's difficulty in breathing, what we can have, at times, is this decrease in feeding that occurs because they have a harder time breathing. And so it becomes important for us to make sure and maintain that hydration.

And then we have more specific information. Two days ago, what we started to see... we had the rhinorrhea, some fever, a hoarse cry, and then this barking cough that had started.

And usually what we tend to see is that you have a lot of kind of the cold symptoms that you do with any other kind of virus. Congestion, the runny nose, sometimes fevers, but more specific to croup is this hoarse cry, which is important because it tells you what's going on and the pathophysiology of the disease and then the barking cough that goes along with it, which is that ‘seal-like’ barking cough.

What prompted, of course, the call for emergency services is this high-pitched whistling. And so this is suggestive of stridor and this becomes important. It's also a sign and symptom that we see with croup.

And then the last aspect is that we have a 6-year-old brother with cold symptoms, as well. And so that shows us that we have this sick contact.

But as you can see, in this case, there's a lot of little pearls from this that you can really identify how it links back to croup, and I'm going to try to provide some explanation with all of this but definitely think back and reflect back throughout the presentation, and you'll see how it links back to it.

When we think about respiratory illnesses, they tend to be pretty common in pediatric patients. Usually, what we tend to see is more infectious diseases or some sort of infection. And it can either be viral or bacterial.

We tend to see, usually, a lot more viral infections. Of course, usually, with viral infections, there's not much we can do. You just have to wait its course. But with this particular one, with croup, there are some different treatments that we do use, and we tend to see it more often because these kids tend to be at increased risk of exposure, not only because of contacts -- it could be family, it could be day-care setting, at their caregiver setting, whatever it
may be -- and usually those places tend to be smaller with a larger number of individuals. And so that contact between kids is going to be pretty easy just because of how the viruses tend to spread, and it's usually by this droplet aspect of it, so that becomes important.

But when we look at all the viral illnesses, in general, there are two very specific ones that we see more predominantly in the pediatric population. The first is croup, and the other one is bronchiolitis. The first one is going to be croup, so this presentation, which usually is just a brief overview, it affects the upper-respiratory tract infection, usually less than a week. We can use a couple different medications for it. This is different than bronchiolitis that is predominantly more of a lower-respiratory tract infection that really requires more supportive therapy, such as oxygen, and usually, there are not any medications we use unless there's a history of some sort of asthma or something else.

But as you can see, they both affect the respiratory tract, and then it's reflective of the different signs and symptoms that you'll tend to see that will be different. But they both start off somewhat the same with the runny nose, the cough, congestion, some of that, but then, it kind of separates from there. I will say, though, that you can have croup and bronchiolitis at the same time, in addition to a bacterial infection. So, that's why it becomes important to really get all the information from the family and find out the sick contacts, how long this has been ongoing, if they've tried anything -- all those critical key questions to ask.

Now, with croup, it is a common, but it's also a contagious, disease, and I think that's the key component regarding this. So, whenever we think about the healthcare setting, it becomes a 'contact precautions' in terms of isolation, making sure that we have gloves and gowns. That's the usual recommendation for croup. And it affects, as I said already, the upper-respiratory tract, but it's a self-limiting disease so it kind of starts, and then it goes away, just allowing it to go through its course.

But where we tend to see it affect most significantly, and that's why it's the upper-respiratory tract, is the larynx and the trachea. And with that, that's where we start to see those signs and symptoms that become very important for us then to further evaluate to ensure that there are not any serious or severe concerns regarding that. It is known by a couple of other different names: laryngotracheitis or laryngotracheobronchitis, so two very similar names in that way. But basically, what it's just implying is the area itself, as I mentioned. So, the larynx and the trachea, the area that it affects.

Now, the key part about croup, and so, of course, this presentation is very specific to viral croup, is that you have to be careful and not get it confused with two other different diseases that are bacterial in nature that are concerning in pediatrics. And the first one is epiglottitis, and the other one is bacterial tracheitis. And both of these are very key because
both of them are caused by different bacteria. And these patients can sometimes have some of the similar symptoms as with croup, but they're going to appear toxic. And that's going to be the key component that really is going to require, usually, a different approach or antibiotics or the intubation of these patients, and that's going to be key.

We see that the disease has this variation in terms of severity. So, it can be anywhere between mild to severe. And, of course, where we start to see this respiratory distress is in that severe situation. When we look at children, in general, with croup, there's usually a very small amount that require intubation because of the seriousness of the disease, and that's usually 1% or 2%, so a very small amount. But I think it's still important because if there are the different signs and symptoms that we need to know and identify, then we can react and provide the appropriate treatment in a timely manner.

Most of the time, what we tend to see with croup is that it's really managed at home. We really have those mild symptoms; it's a short duration -- usually about a week -- nothing more than that. But what becomes, I think, more concerning from a parent's standpoint is that they start to see that the symptoms generally will become worse at night because, during the day, they seem to be okay. And all of a sudden, the symptoms come without warning; they're very sudden. Usually the patients go to bed at night and they're fine. And then in the early morning hours, that's where you start to see those signs and symptoms really come about and cause those concerns and those problems.

Now, the disease itself typically tends to occur, not only in the fall or the early winter months, but it can occur year-round -- that's the other aspect about it -- but predominantly the fall and early winter months.

We tend to see that it's a slightly more common in boys than it is in girls. And now I'll tell you that it really depends on the reference that you look at because sometimes it looks like the numbers are the same. But most of the information tends to suggest that it's more common in boys.

And it predominantly affects infants and toddlers. So a little bit older ages, so 6 months to about 3 or 4 years, depending on the reference you look at. But overall, we have about half of the kids who develop croup by the first year.

But then we see this peak aspect about 2 years of age. And there's also information that suggests that sometimes there're children that develop it up to 6 years of age. Now, that's more rare from that standpoint because as the children start to become older, of course, the whole area itself becomes more strengthened and it gets larger and everything else, and so that's why we don't tend to see usually the disease progress more often into that older age range that I mentioned, like 6 years of age.
When we look at the disease itself, there is a very specific virus that is predominantly causing it, and it's the parainfluenza virus. And so what we see when this has been studied is that it can enter through the nose or the nasopharynx, and then it goes through and it spreads to the larynx and the trachea. So, if you remember back, that was the area that I had mentioned before that it really predominantly affects because it's the upper-respiratory tract. Now, we tend to see the complications occur because that tends to be the narrowest part of the pediatric airway. And that's why, as kids get older, we don't tend to see the disease quite as often.

The virus activates chloride secretion and inhibits sodium reabsorption, so what you see then is within the tracheal epithelium that you have this edema or this swelling that occurs. And that swelling causes all those signs and symptoms that we tend to see.

So, once we look at the disease, we see within the pathophysiology of the disease, looking at it, that it links back to the different areas with the swelling of the larynx, the trachea, the bronchi, the bronchioles, and then the lung parenchyma. What we tend to see is this obstruction that can occur after inflammation of that subglottic area, and that obstruction is usually where we start to hear that ‘seal-like’ barking cough.

The symptoms generally do occur because of the smaller airways of kids but the resulting effects from the virus itself. And so we have this diameter narrowing, this reduced airflow where we start to see the resultant stridor from that and then this decreased vocal cord mobility that we associate with the hoarseness.

If you remember back to the case itself, there was that hoarse cry, and that's very important; very specific. With older kids, we start to hear them actually have a hoarse voice, for the most part, but with the younger ones, you can hear a difference in the cry.

Within this disease, as I mentioned previously, it is a virus; it's caused by a virus. And parainfluenza virus is the most common. Now, there are three different types, so there's 1, 2 and 3, but the predominant types of cases we see with croup are resultant from types 1 and 2.

There are a number of other etiologies that can occur: we have the adenovirus; the respiratory syncytial virus; influenza A and B and then the human metapneumovirus. So, any of those others could potentially cause it, but the primary cause usually is the parainfluenza virus, either, types 1 and 2, but 3 sometimes can be seen.

Then we can look at the signs and symptoms or the clinical manifestations of the disease, and we see that it generally lasts less than a week with those symptoms really occurring more at night. So, usually up to seven days, we tend to see it.
We do see those peak symptoms starting that Day Two, somewhere around there, and that ties in to the case, where we tend to see most patients Day One, Day Two, they seem to be doing okay at home, and then Day Three is usually when we start to see those problems, between Day Two and Day Three, during those overnight hours.

The symptoms generally do start with these initial cold symptoms, as I mentioned before, with the nasal irritation, this congestion and a runny nose that occurs. Then more significantly, we do start to see the severity of difficulty in breathing that can occur much later.

And it really depends. Sometimes if you do see it within 12 hours, it really suggests that there are significant issues, but usually it can continue up until, as I mentioned, two days later that you start to see those peak symptoms.

With the other specific signs and symptoms that we look at, almost like the classic symptoms for croup, they are: the barking cough, the stridor and then the hoarseness. Those are the three. It's how you can kind of look at it. What is always very important for us, and I think it's for anyone who's evaluating the patient, is that any time the child would do any sort of activity or anybody is trying to examine them, any changes regarding that will actually increase the symptoms for these patients because they become little bit more agitated. So, it's very important to always do the evaluations as calmly as possible, having the mother or the father hold the child, to try to minimize any sort of agitation. But we do see that ‘seal-like’ barking cough, so it's kind of a dry, ‘seal-like’ barking cough; the stridor or that high-pitched whistling sound that we saw in the case. And we usually see it on expiration, but sometimes you can see on inspiration, as well. It's very important to understand that this is not wheezing. Wheezing is usually more associated, I would tend to say, with asthma, but we really don't see that as much with croup.

But we do have this turbulent airflow, and so that's why we tend to see the different signs and symptoms with the stridor, but it can occur with the inspiratory/expiratory phases regarding that.

And then we look, more specifically, at the hoarseness. As I mentioned before, with the case, we had that hoarse cry, but then in older patients, their voice completely changes, and we have this hoarseness that can tend to occur.

And all these are very specific to the location, so when we think about the larynx and the trachea, that's why we're seeing these signs and symptoms.

Now, on this particular slide, I do have a couple other symptoms that we tend to see and, in the following, more of the severe signs and symptoms that I think are important when evaluating a patient who's very severe. But with this one, so a few other symptoms are fever,
and we remember thinking back to different information is whenever you have fever, it increases the risk of dehydration with patients, so that becomes important to really evaluate these patients. You can have sometimes conjunctivitis, and then, of course, there's that dehydration component there.

When we look at the severity of this disease, what we start to see is that there can be a number of different warning signs. So this decreased air entry, difficulty in breathing, this nasal flaring that can occur and, as you can see, it really is showing this progression of symptoms related to the respiratory tract that are of concern. And then we can also see some suprasternal or intercostal retractions; fatigue, which is really important because it highlights that the child is wearing out from the breathing; tachypnea or significant tachycardia -- of course, sometimes if there are any medications that have been administered, that's also important to fully interpret that in relation to it because sometimes if they used, maybe a decongestant, you're going to tend to see that tachycardia. Agitation, as I mentioned, making sure the child stays completely calm. Otherwise, we can see this distress. But I think the most concerning with these is the hypoxia or the cyanosis or the changes in the level of consciousness. And those become very key and really highlighting that maybe there's this inclination that it's going to require intubation of the child, and that becomes the most important aspect in evaluating the patient.

Now, at the same time, there are a few different things that we do have to evaluate to ensure that there's not a bacterial component because if there is the severe bacterial infection, we can see the serious complications that can occur that are going to require a different therapy but being more aggressive. And so the two different signs and symptoms that we'll tend to see are drooling -- just this inability to swallow and they may kind of sit in the upright tripod position -- but then also that toxic appearance. And as I mentioned before, these kind of tie in back to the epiglottitis and the bacterial tracheitis. So, it's important to distinguish, whenever a patient is evaluated, that these are not present because, if so, then particularly when we think of epiglottitis, it's going to require intubation.

Now, within the diagnosis of croup, we really look at that clinical diagnosis I mentioned. We just went through all the different clinical manifestations. Oxygen requirement typically tends to be a little bit rare but if it is warranted, of course, we're going to initiate that aspect.

Because it is a viral disease, in that way, you can obtain a viral panel. Generally, this is more for epidemiologic purposes, but from our standpoint, we really don't tend to use it as often because from the signs and symptoms, particular the seal-barking cough, it's very apparent that it's croup.

Bacterial infections, so you can do a work up with that, so looking at the white blood cell count and the differential from the serum blood. And then in patients who are pretty severe, of
course, we'll do the ABGs really because it helps to determine if there's this impending respiratory failure.

And then the last aspect is kind of the radiographs of the neck area itself. One of the things that we tend to see with croup, at times, is the steeple sign. So, it all comes back to the specific area and the swelling and we have that narrowing of that subglottic space. It's important to also remember that it's not always exclusive just to croup because we can see it with bacterial tracheitis.

Now, when we look at croup, I talked about the clinical manifestations; the diagnosis. But there're specific categories that we can use to delineate or define croup, based on the symptoms. And so this particular slide really lists it as mild, moderate, or severe, whereas the second slide, I'm going to come through and bring in a very specific croup-scoring aspect that has been more widely studied within the literature.

But I think it's important to understand both because sometimes you may not have all the different aspects on the Westley scoring system, but you can really follow just from their signs and symptoms regarding this.

One of the things that you can see on the table is, at the top, you have your mild, moderate, and severe, and what I've tried to do is, on each of the particular rows, to really keep the same consistent aspect that we're looking at. If we look at the first side there under 'mild', we have that barking cough occasionally and then we look at moderate and severe, and you tend to see this frequent barking cough. So, it's becoming more increased from that standpoint. Then with the 'mild' on the next one there, we're looking at stridor, so no stridor in mild. Sometimes when they're crying, you can see it, but in moderate, we see audible stridor at rest, and then in severe, it's very prominent inspiratory stridor that we tend to see.

Then we look at retractions. Generally, in mild, you really don't have any or they're very mild, either suprasternal and/or subcostal retractions; whereas, in moderate, they become more visible, the suprasternal retractions at rest, which is kind of key and important to really evaluate it because this ties back to the agitation or movement or any of that, and then in severe, the significant sternal wall retractions.

And then we look a little bit more because this is more indicative of the severity of croup. We don't see it in mild, but you can have no or mild agitation in moderate or, in severe, this significant distress or agitation associated with it.

And then the last aspects, in terms of the breathing, in moderate, they may start to have some of that difficulty in breathing, whereas in severe, it's that fatigue, that cyanosis, those very severe symptoms that become of concern. And usually when you think of fatigue and
cyanosis, which really makes you concerned for this impending respiratory failure that may require intubation.

This is the chart I was referring to about the Westley scoring system. Now, there’re a number of different scoring systems, but as I mentioned, this is probably the most common one that you tend to see that has been studied most often within croup.

And the layout of this is there are a certain number of points that are assigned, depending on how the patient presents on the different aspects of inspiratory stridor, retractions, air entry, cyanosis, and then the level of consciousness.

But what we tend to see -- and I'll go through each of those lines -- but when we look at inspiratory stridor, we see that there are 0 points if they don't have any; upon agitation, you get 1 and then 2 points at rest. Then with retractions, you don't have any points if there aren't any present and if there are mild retractions, 1.2 for moderate, and then 3 for severe. So, you can see that progression. You can see that also with air entry, with no points if it's normal. One, if there's a mild decrease, and if there's a marked decrease, then we see 2.

Where it changes a little bit more is when we look at cyanosis and level of consciousness. So, if they don't have any cyanosis, you get 0 points, but if you do have cyanosis upon agitation... so the points really increase with that. Then it's 4 points, and then at rest, if you have that cyanosis, then it's 5 points.

Within the level of consciousness, if everything is normal, of course, 0 points; but if it's depressed or they're disorientated in that way, then it becomes 5 points.

You can see overall, there are a number of different points, depending on these different signs or symptoms that were evaluated in these patients. But within the overall scoring system, the range max really is 17. And then from that, we can fully delineate the differences between mild, moderate, and then severe with mild kind of being less than 3; moderate, your score between 3 to 6; and then severe, greater than 6.

But I think this is an important aspect, and we're going to come back to the case itself, and we'll use this particular scoring system to help us in identifying where we are in terms of severity for the particular patient that we have.

So, then we come back to the patient case, and I included not only vital signs but also the physical exam. And the important part that I want you to really take away from this is that this information is at rest. And we see that our vital signs, we have the weight of 7.5 kg. This will be important at the very end whenever we identify the exact dosing to provide to this patient. We don't have a temperature, based on that 99.8; our pulse is 160 bpm, which is a little bit on
the higher end for this patient, which given what's ongoing, it's perfectly understandable; forty-five breaths per minute, also on the higher end for this particular patient. And then our blood pressure, 105/65. A little bit on the higher end but nothing too significant.

And then our oxygen is about 92% on room air. This is what we typically tend to see where the oxygen isn't really low in comparison to maybe other diseases because, if you remember, with croup, you don't have a lot of those issues in the lower-respiratory tract that are going to affect the oxygenation of it. So, usually they don't require oxygen, but they may require more of the non-pharmacological aspects of humidified air.

But within the physical exam, again, it's at rest. So, we had that the patient is distressed, audible inspiratory and expiratory stridor. We have the rhinorrhea, which as we mentioned and we looked at before, that's one of the symptoms. The classic croup cough, so that ‘seal-barking’ cough. And then we have this severe subcostal or intercostal retractions and then this decreased airway entry within this, and then the dry mucous membranes. And so I think that's important because it really highlights that this patient is probably a little bit dehydrated; that's going to require some treatment.

Now, let's look at the Westley scoring system. We still have those signs and symptoms from the previous slide, but what I wanted to do is really highlight and emphasize the three different aspects regarding this. So, we have the inspiratory stridor, the retractions, and the air entry. And so we see that this patient is at rest, and we do have the inspiratory stridor. And so that gives us 2 points there. Under the retractions, we have the severe subcostal and intercostal retractions, which are severe there, and so that gives us 3 points there. And then the last one is the air entry, and so we see this marked decrease in airway entry. And so that is 2 points there. So, when we add all of them together, it becomes 7 points, which really shows the severity of it. Severe is greater than 6, at this point, and as you remember, and I have it listed there, the score can be up to 17. We are at that preliminary severe stage where we need to provide some sort of treatment, but then we're not at this impending respiratory failure, at this point, where using the treatment will be very beneficial.

Then we move on to the management of this disease, and it's really going to be reflective of the severity. So, it's going to link back to the mild, moderate and then the severe aspects of the categorizations. But predominantly, where we tend to see more of the treatment occur is in emergency or urgent care facilities. Usually, after treatment is provided to these patients, a small number really require hospital admission afterwards, and those that do are usually the ones that are more severe, and that's where that categorization becomes very helpful and beneficial.
In the treatments, you can break it down to two broad categories with non-pharmacological and then pharmacological, with the non-pharmacological being hydration, this oxygen if they're less than 92% and this humidified oxygen itself or humidified air that you can provide. And then Heliox which is used more for a severe croup.

With the pharmacologic treatments, some considerations that sometimes are used -- they're not always appropriate from that standpoint -- but bronchodilators can be used, corticosteroids, cough and cold products, and then antibiotics. And I do have some slides a little bit later discussing these, their role, and when they should be used or shouldn't be used.

We're going to start off with the non-pharmacological treatment. We have the hydration aspect, and this kind of ties back in to the case. So, we really evaluate to ensure because if they had fever or decrease in feeding, you're going to have these hydration issues. And so you don't want to run into this dehydration aspect where then it may be harder to obtain a line or something like that with the patient.

Oxygen, if it's required, and preferably it's humidified oxygen to try to provide for these patients, and the reason for that humidified aspect is one of the things that we look at or has been looked at in the past is either cool or humidified air. So, if you remember back to the case, they found the mother in this bathroom steamed room, and I think that becomes important because we have the inflamed mucosa, and what that humidified air tends to do is it helps to kind of moisten those secretions or the airway, and it just makes it a little bit better.

Now, when we look at the evidence in the literature, when it's been studied, it's been identified that there's no extra benefit to using it from the evidence-based aspect of it. But because it helps to provide and help to moisten the area, it is still typically recommended by physicians, pediatricians, other individuals -- and then, of course, it's used sometimes in the emergency setting as humidified oxygen to help provide that.

What's important and key is that there shouldn't be any sort of hot steam or any of that aspect. Now, whenever we have the bathroom that's steamed, of course, they're within the area, but it's not this immediate like you tend to see with the specific hot-steam humidifiers where our concern is kids getting hold of them and burning themselves and other things like that. So, really at home, our recommendations tend to be a cool-mist vaporizer -- those tend to help very specifically; that steamy bathroom, as I mentioned; and then the other one which I think is always very interesting, this cold, cool dry air. And that's usually because of the disease time period of the winter months, we tend to see parents usually come into the emergency department, or whatever it may be, to that urgent care setting, and they have just left their home, and they've bundled the child, walked outside, with them where it's this cool, dry air. And then prior to that, they were having a lot of the signs and symptoms -- the barking cough,
the stridor -- they get exposed to that cool, dry air in the vehicle, then they get in the vehicle, and they get to the emergency room or urgent care setting, whatever it may be, and the symptoms are gone. And that's always an amazement from the parents, but it's because what you tend to do is you're actually providing a little bit of treatment with that cool, dry air.

And then in the past, mist tents had always been recommended in the hospital setting, but due to information in the literature in evaluating this, those are no longer recommended.

And as I mentioned before, it becomes very key to ensure that the child really remains calm because any sort of agitation or crying is going to make those symptoms worse, and they're going to become much more distressed from that standpoint. So, ensuring that the family member, or whoever has them, is holding them while they're being examined, and they don't feel any sort of threat or become more agitated.

Whenever we think of other non-pharmacological aspects, we think of Heliox. And this is predominantly, I would say, used more in the ICU setting. It's a mixture of helium and oxygen and, uniquely, you have this low viscosity that increases the respiratory airflow. And that becomes important because then it reduces that demand on the respiratory muscles with this reduction in respiratory distress, which is the key component. But when we look at the studies regarding this, it really doesn't provide any sort of assistance in the moderate croup in terms of severity, but the potential, and that's why I mentioned that sometimes we use it in the ICU, is for that very severe. But I think it's still important to know that there are different options that could be used, depending on what's going on with these patients. But Heliox could potentially be used in that very severe croup classification for these patients.

Now, we move over and switch gears a little bit with pharmacologic therapies. We look at treatment to aim them at the symptoms themselves. Otherwise, there are a number of different medications that could potentially be used. But based on the symptoms, really there're two big ones. And they're nebulized epinephrine and then corticosteroids.

When we look at the information from the literature, it shows us that epinephrine could be used in moderate and severe, but it's a little bit different versus the corticosteroids that could be used in mild, moderate, or severe -- in any of those. So, you can see that the epinephrine, we don't use in the mild setting.

But from the literature, we also identify with the corticosteroids, that they do reduce hospital admissions, they do reduce this emergency department in those mild diseases. And I think that's the key component of it because that's why sometimes we'll use that corticosteroid.
Now, with epinephrine, that's a little bit different because if we're using several doses, usually more than three in three hours, you really have to watch more for that cardiac aspect because there are some adverse effects associated with it, then to ensure that we're not at a point where it's going to require intubation for the patient.

With epinephrine, we're going to look at this one specifically; we have that it's kind of reserved for moderate-to-severe diseases. We have this constriction over the arterials, and but then we have this fluid reabsorption and decreases in edema. And this is important because it helps to provide that relief and that reduction of respiratory distress. And so that's why we use it in that moderate-to-severe -- in those categories. But overall, this is a drug that can be used in the outpatient setting, for the most part. So, we can see it in urgent care emergency departments. The key component of it is that when you administer it, you really have to evaluate the patient. Usually four hours, sometimes patients are watched for three hours, but during that time period, it's going to be very important because what we tend to see is what they call the ‘rebound phenomenon’ of this bronchospasm that can occur, and then you can have subsequent increase in respiratory distress. And then, of course, the adverse effects of the drug with tachycardia.

When we look epinephrine (there are going to be two different ones that I have listed here) racemic epinephrine and then the L-epinephrine, and I have two different slides a little bit later. But it becomes important for us to evaluate these patients and really watch them during that time period. Otherwise, what you can have is more complications if these patients are discharged home or whatever it may be because it's not something that's going to help us for a long period of time.

The drugs tend to work usually up to about two hours but usually no more than that. And so that's why we use it in addition to a corticosteroid that's going to provide this combination treatment for duration of action.

But the adverse drug reactions really tend to limit, and that's why we do tend to use it in the moderate-to-severe is the tachycardia and hypertension. Usually with the L-epinephrine, that's where we tend to see more of those signs and symptoms, but the racemic epinephrine, we could potentially still see some of that, as well.

The two options for epinephrine are the nebulized racemic epinephrine, and that's key because both of these are administered as a nebulizer. Unique racemic epinephrine that's different than the L is that it's a mixture of the two isomers, and it tends to work on a couple different receptors that then produce these bronchodilations and the vasoconstriction of the airway to really allow for that increase in the respiratory airway; to allow for these patients to really breathe much better. What we have is the dosing I have listed there, so it's mL/kg per
dose of 0.05 of the concentration is 2.25%. And it's placed with 2.5 mL of normal saline, and then it's nebulized generally over 15 minutes. It can be repeated usually in 20 minutes, but the maximum per dose that you administer at one point in time is 0.5 mL.

Now, there's a little bit more of guidance, and that's what I've provided there. Usually, kids less than 5 kg, you can use half of that dose, the 0.25 mL, and then a weight of greater than or equal to 5 kg 0.5 because sometimes in that emergency setting, we don't always know the weight, of course, of these patients; the parents can't recall. We do have other measures, like the Broselow tape and everything else, but I think it is helpful to have a little bit of guidance. Usually, the preferred is the racemic epinephrine. If this agent isn't available, then, of course, the next one is the L-epinephrine.

This one as it is stated is just one of the isomers, so it's the levoisomer. And then based on the different receptors that it's affecting, so we still see that bronchodilation, the vasoconstriction of the airway that helps in promoting that oxygenation but reduction of the signs and symptoms, but what's different about this one, you can see that it can cause hypertension. And so if you remember back that I mentioned this is the one that you tend to see more issues with tachycardia and so on. The dose is 0.5 mL/kg per dose of the L-epinephrine and 2.5 mL with normal saline. Again, same approach. Over 15 minutes. You can repeat it in 20 minutes, but the maximum on this one is 5 mL that you administer, at one point in time.

We move to the next category, which are the corticosteroids. And these provide the anti-inflammatory action to help reduce the edema. We use it, as I mentioned before, in mild-to-severe disease. It really decreases that need for the epinephrine overall, and patients may require several doses, but usually one tends to take care of the issues regarding it.

It does tend to block these inflammatory mediators that help with the swelling and the inflammation. And there are a couple different agents, so we can use prednisone, dexamethasone and budesonide. But I'll tell you that dexamethasone is really the specific one that we tend to use more commonly and is more studied in the literature and provides more of that information to help us make those decisions on doses and everything else.

In terms of the adverse drug reactions, they're pretty minimal. Usually what we tend to see in patients when they receive it, like dexamethasone or prednisone orally, is those systemic side effects of this potential GI upset or this difficulty in tolerating, particularly dexamethasone because it tastes pretty bad.

We see that dexamethasone can be administered, not only orally, but intravenously or intramuscularly. If they're having a hard time tolerating it, then we usually crush the tablet, but there is no advantage to using the intramuscular/intravenous versus the oral. So, usually, if a
patient can take something orally, that's what we'll do. But, of course, usually in the emergency setting, if a line hasn't been placed, then usually we will administer it intramuscularly.

It does take a little bit to actually see its effect, and so we tend to see generally the onset in about six hours, but it does tend to last longer. And so generally, we say about 45 hours, but sometimes it can last as long as like 72 hours.

In terms of the doses we have, there's a range of 0.15 to 0.6 mg/kg with a maximum of 10 mg. And this is important and you can use it depending on mild-to-severe. Now, usually the dosing of the 0.6 mg/kg, that's what you could look at as the most effective from that standpoint. There is and has been used more commonly.

There are some studies where the 0.15 mg/kg has been used, and that is also beneficial, and that could potentially be used in someone who has more of a mild disease.

Prednisone is, of course, the other one. It is an alternative, but it does have its limitations. It is less potent than dexamethasone. It's pretty good in terms of duration of action, so almost 24 hours. But we can see when we compare it to dexamethasone, it really doesn't provide as much. And what we're looking for is this dual effect. So we do the racemic epinephrine, it helps us for a couple hours before these others kick in and then carry the patient over. But sometimes these patients do require additional dosing. The doses generally tend to range anywhere between 1 to 2 mg/kg and 1 to 3 doses per day.

And then the other agent, of course, is the budesonide, and this is the nebulized corticosteroid. It's that alternative to the dexamethasone and prednisone, but it does have its limitations because of cost and administration. It does take time because it is a nebulized treatment. We have fewer adverse effects because we don't have that systemic absorption, and we do tend to see the effect because it's deposited in the upper airway. Usually, this is reserved for individuals where there is emesis or very severe respiratory distress where maybe we don't have the line, or it would be very difficult to administer it orally. But the dose is 2 mg every 12 hours, and typically, it's just 2 doses that are administered with this.

The next category that we have is antibiotics, and as I mentioned before, that there would be some medications or some groups that you could or could not recommend. This is one that typically isn't recommended unless there is that underlying secondary bacterial infection or if they're toxic in appearance, as I mentioned -- so that confusion or that association with epiglottitis or bacterial tracheitis.

But the therapy really is going to be dependent on the type of infection and severity of the patient. That being said, even though it's not routinely recommended, depending on the severity, it could be used.
This category is important because it not only encompasses over-the-counter but also prescription medications. Sometimes what we tend to see because of the rhinorrhea, the cough, the congestion, parents will use over-the-counter medications, or they'll have prescription medications -- the antihistamines, cough suppressants, and decongestants. Now, in pediatrics, in general, I think there's a stance that we don't use any of these just because the evidence doesn't support them; that there're so many adverse effects regarding these.

And then we have antipyretics. Those are really the only ones that we tend to recommend in croup, particularly, of course, if they have fevers, so Tylenol® and then ibuprofen. But we don't use ibuprofen in kids less than 6 months of age.

Then we move back to the management when we're looking at these patients. And what we see is that mild management, and what I tried to do on these slides is to link it back to the original. So, if you were to look at the different kinds of symptoms such as the cough and then the potential stridor with the crying episodes, we'll see treatment, usually there's nothing there. You could potentially use dexamethasone. As I mentioned before, it's used for mild, but we really have to evaluate if there's a need for oxygen or hydration, which usually there's not an issue for oxygenation but potentially hydration. And then the key part is this parental reassurance and education to help them and you'll tend to see the similarities regarding this.

So, of course, then we move over to the moderate. You have those different signs or symptoms of the cough, the stridor, the retractions, and the agitation. Overall, what we're doing is fully evaluating the symptoms, determining if we need the hydration but potentially oxygenation, avoiding distressing the child, and then this is where we start to consider treatment. So the corticosteroids and the epinephrine are used. And then again, still that reassurance and education for the parents.

And then we move on to the severe management. And so we see all those severe signs and symptoms of more frequent cough, this inspiratory stridor that is very predominant, the significant retractions, agitation, fatigue, cyanosis. And you're going to see the similarities with moderate, so we're still evaluating for the severity of symptoms. We're looking specifically at the hydration; oxygenation. So, this is where you tend to consider that oxygen-humidified air, Heliox and intubation. And then ensuring, of course, the child isn't distressed. But this is where we always will use the pharmacological treatment of the corticosteroids and the epinephrine, and again, that reassurance and education to the parents is always going to be very key.

Then it transitions over to the emergency setting, and what we look at is that the mainstay of treatment really is this nebulized epinephrine and steroids, usually in those moderate-to-severe cases. And I think what you can see from the previous slides that I have had is that moderate-to-severe is very key based on those signs and symptoms, so really
understanding that aspect is going to be very key. If these patients are unresponsive to treatment, it's always very important to know that the next step, of course, could potentially be intubation. And a key part of this is that you're always going to intubate these patients with smaller intubation that are for the age and size of the patient, just because of the concern with the swelling, inflammation, and everything else. It's going to be much more difficult, and so the sizes used to intubate will be smaller than the usual recommended.

Now, for the treatment, we still look at the non-pharmacological and the pharmacological aspect. And so we see, with the non-pharmacological, this oxygen supplementation if it's needed and as I mentioned before, humidified oxygen that is recommended because it does help with hydrating the mucus area -- the epithelial.

Hydration is going to be very key. So, the bolus and/or replacement fluids, depending on what's warranted in the patient. And then with the treatment, this is always going to be the case. So in that emergency setting, if the patients are in that moderate to severe, you will be using that epinephrine. And so, as I mentioned before, the preferred and the usual is usually racemic epinephrine, but if that's not available, then we do use that L-epinephrine.

And then the corticosteroids -- the usual recommendation is dexamethasone because we can administer it many different routes, but you can also administer it IM, if warranted, at that point. And depending on the urgent care settings or the prehospital settings, it may be limited to the types of medications that are available, and so it becomes very key.

Then we come back to the case -- so we started off with the case, went through it in detail, then came back to it a little bit later, and then now looking at the signs and symptoms. So, now after going over all those different treatments and we talked about how it was a severity of croup when we look at the classification. If you think back to the normal recommendations for treatment, it would be to ensure hydration and oxygenation, so we make sure that we administer this fluid bolus to ensure that we don't have those dry mucous membranes, making sure we hydrate them. Provide humidified air, if they warrant it, and then we do give racemic epinephrine into these patients depending on the doses, but in this particular patient based on the weight, it would be 0.5 mL via the nebulizer over 15 minutes. So we give it x 1, and then we evaluate them, and if we need to, then we could administer it again in about 20 minutes. And then the other aspect is that this patient would warrant dexamethasone, based on the severity, and so we think back to the dosing of the 0.6 mg/kg per dose and then the weight of the patient that was 7.5 kg, and so we get 4.5 mg, roughly.

And that's administered intramuscularly because, most of the time, these patients of course, may not have an IV line, and sometimes it's not warranted if they don't have these dry mucous membranes or anything.
But you have that potential. If you have that IV line, you can administer IV, but otherwise, intramuscularly x 1 dose. And usually, dexamethasone is just that 1; whereas, the racemic epinephrine, you can usually do at 2, 3, but as I mentioned before, if you're using more than 3 in about 3 hours, then it's really going to require extra caution and cardiac monitoring in these patients.

The last aspect, in terms of croup, we look at patient education. Because it is a virus, it is spread through droplets, as I mentioned before. The prevention is going to be very key with handwashing and encouraging families to avoid sick contact. There are not any vaccines available for this because it's not bacterial. It's more of a virus, and we don't tend to see usually for a virus except for maybe like the flu. But it's also important for us to relay to the families that they should seek immediate attention, particularly if they're having problems with difficulty breathing, drooling, the difficulty swallowing that ties back to the bacterial nature; if they have a hard time speaking or crying; and then those really severe aspects of cyanosis, lethargy, and retractions. And I think the retractions are always important to really emphasize to parents to look at their belly to see if it looks like their belly is kind of sucking inward, and they're able to see the ribs more because, otherwise, I think it's very hard sometimes for parents to fully understand what that means. But it becomes pretty important and helpful.

In summary of this presentation for croup, we see that it is a respiratory viral illness that's pretty easily transmittable with the secretions, as I mentioned before. With healthcare professionals, it's always important because it's contact precautions -- gloves, of course, gowns, to reduce the likelihood of it being transmitted to other individuals but also to oneself. It does occur with the normal cold signs and symptoms we tend to see. It's kind of a slow progression. We usually start to see it for two days, and then we start to see more problems with it. But generally, at about seven days, we start to see this resolution of it completely. And that's important because when we compare it to other diseases, with other diseases, you do see those complications.

And then with this one, in particular, with most viral infections, there's really not a lot that we can do, but with croup, there are two medications you could look at, two broad categories: the corticosteroid or dexamethasone predominantly used and then with a bronchodilator, the racemic epinephrine. Depending on the severity, those are definitely options that could be provided to these particular patients.

I've included also some references for you, if you wanted to do a little bit more reading - - very specifically in croup.
I thank you for watching this presentation. I hope all these different aspects of the case, and then also of the treatment and the knowledge of the drugs will be helpful for you in the emergency setting or the prehospital setting.

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