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Respiratory Muscle Strength Training and Speech-Language Pathologists: Part 1

Recorded June 18th, 2020

Presenter: Denise Dougherty, MA, SLP

SpeechPathology.com Course #9336

- [Amy] And at this time, it is a pleasure to introduce Denise Dougherty this afternoon, who is presenting part one of our two part series on Respiratory Muscle Strength Training and Speech Pathologists. Denise owns and operates a private practice in Indiana, Pennsylvania, where she conducts therapy with children and adults. She received her bachelor's in communication disorders from Marywood University, and her master's from St. Louis University. Since 2007, Denise has served on the expert workgroup of the physician's office quality measure project for quality insights of Pennsylvania, working on initiating quality measures for CMS to improve effectiveness, efficiency, economy and quality of services delivered to Medicare beneficiaries, specifically, medication review. She's a past president of the American Academy of Private Practice in Speech Pathology and Audiology, a past member of ASHA's Healthcare Economics Committee, and co-editor of "Private Practice Essentials," a practical Guide for SLPs. Denise works as a forensic speech pathologist and expert witness in litigation involving dysphasia, choking deaths and surgical errors. So, welcome, Denise, it's always a pleasure to have you with us.

- [Denise] Thank you. All right. So, we will go ahead and get started. I do need to do the disclosure, that I am receiving an honorarium from SpeechPathology.com for the presentation. Also, let's see. I need to just touch on this as well. In the PowerPoint that we're teaching from, we have anatomical images that we're using with permission from Kenhub.com. We can teach from them, but we cannot reproduce them in your handouts. So you can view the images at Kenhub.com, or you can also go to Google Image, Type in the structures that we're talking about, and you'll get various images and anatomical drawings as well. So, you'll have access to those images through either one of those sources. Okay. So, for our learning outcomes, once we are finished with today's session, you'll be able to explain the rationale for utilizing respiratory muscle strength training, identify appropriate clients for respiratory muscle strength training,

and discuss evidence behind the use of respiratory muscle strength training for three diagnoses. We're certainly going to cover more than three diagnoses, but you should have the information. As far as the course description, in part one, what we're going to do is build on the knowledge that we already have of respiration. We'll talk about why respiratory muscle strength screening is important. There are appropriate diagnoses that we need to look for when we're going to refer a patient for respiratory muscle strength training, including COVID-19, which all of us have been dealing with in one way or another. So we'll look at the evidence for the use of respiratory muscle strength training in those various disease processes, disorders, conditions, and so on. So, our agenda is to do an overview of of respiration.

We'll talk about what is respiratory muscle strength training, we'll look at diagnosis for referral, and then discuss some of the evidence based outcomes that have been determined by various studies in these patient populations. So when we're talking about respiration, we have the basics. We've got the lungs, we have the ribcage, we have the diaphragm. And the other thing that you'll see the diaphragm being referred to, is the abdominal unit. So, depending on what source you're looking at, you'll see it referred to as either one of those terms. When we're looking at the lungs, we know that they are elastic, with the inflation and deflation with respiration.

The lungs remain in contact with the chest wall during the breathing, and the air moves in and out in response to the differences in pressure. Now, what we do know with elasticity of our lungs, it changes with aging. So, we'll start to have a decrease in vital capacity or the maximum amount of air that we can expel, our forced exhalation. The lungs also can become placid or limp. And you will see the term elastic recoil. An example of this would be an emphysema, there is a difficulty in exhaling, so other muscles have to assist in trying to push the air out of the lungs. The other thing that we'll see, and this is what we're Noticing with COVID-19, is when you're responding or the lungs are responding to a bacteria or a virus, they become inflamed. And they also

can become inflamed as we age because of exposure to toxins. But if there has been bacteria or a virus that has attacked the lungs, we end up having inflammation, and sometimes once that bacteria or the virus is disappeared, the inflammation remains. So we're seeing a lot of issues with lungs in patients who are recovering from COVID-19. So, when we're looking at the lungs, we have the right lung, we have three lobes, the inferior superior and the middle lobe, and you see those highlighted. The other terms that you'll see on this slide are the fissures. And the right lung has two fissures; the oblique fissure and also the horizontal fissure. And those fissures are basically just the dividing line between the lobes of the lungs, but it gives you an idea of the anatomy. When we're looking at the left lung, we have the superior and the inferior, so one less lobe, and it only has one fissure.

So that is the oblique fissure. And you'll be able to, if we can get our little arrow going here. There it is. So, this is the dividing line or the fissure. Okay. So, the lungs are freely suspended. They were attached to the trachea and the heart by the main bronchioles and the pulmonary vessels. Now, there are some differences in the lungs between males and females. The lungs are heavier in males than females. Now, it doesn't matter whether we're talking about males versus females, But the right lung is traditionally heavier than the left, again, it has three lobes versus two. When we're looking at the adult lung, it tends to have a dark muddled appearance, appearance versus the infant where the lungs are much bigger.

Now, you don't have this image on your slide, but again, if you go to Kenhub.com, you'll be able to pull this image up, but it gives you an idea of all the structures on the way down to the bronchioles. So when we get to the bottom of the trachea, we have the bifurcation, we have that division between the right and the left. And you see on this particular slide, we're looking at the main bronchus in the right lobe. There we go. So, as we go through the different branching of the bronchioles, we end up with finer branches, and then we end up with the alveolar sac. So when we take a look at the

right, it is wider and shorter. It's more vertical than what we see on the left. And when you have an aspiration event, foreign particles tend to go through the right bronchus into the right lung, just because of how the structure is in the body. The left bronchus, it is smaller in size, it's longer. And you see the different structures as it branches off into the lobar bronchus. When we get to the alveolar sac, we start with the terminal bronchial and then we end up with the alveolar sac. And that's where we see the gas exchange. So, you just get to follow the anatomy. Now, when we're looking at the bronchi, this is the passage way to the lungs, there is no gas exchange there. We have the bronchioles and the alveoli. The alveolar sac is where we see the gas exchange. Now, in that process of respiration, the entire bronchial tree will move with that lung during respiration.

Now what tends to happen with aging, the bronchial tubes and the air sacs or the alveoli that we looked at earlier, they lose their shape and they become flatter. The bronchial tubes increase in size, and they become stretched and weakened. And that process can happen as early as age 40. So when we're talking about a healthy individual with no comorbidities, there are changes in the lungs. So again, healthy individuals as well as patients with diseases and disorders can benefit from respiratory muscle strength training. When we look at the ribcage, we have the elevation and the depression.

The thoracic muscles allow that to happen. The intercostals will help lift and lower. And the ribcage forms the majority of the thoracic cage. When we look at the anatomy, the diaphragm is connected to the lower border of the ribcage. Now what happens with aging, is the ribcage starts to stiffen. The ribs end up thinning because of age, they become more calcified, they're more rigid and they're more breakable. So, any fall can really create some fractures of those ribs. Now, the ribcage also ends up becoming smaller as we age, because the intercostals weaken and shrink. And what happens then is the ribcage can actually close in on the lungs, and that makes breathing more

difficult for the aging individual who does not even have any comorbidities. So here you get a view of the true, false, floating ribs. There are seven pairs of true ribs. These are directly attached to the sternum. When we look at ribs eight through 12, these are considered to be false ribs. When we take a look at eight through 10, those are indirectly attached to the sternum. And because we have elasticity, the ribcage allows the ribcage to move during respiration. When you get into the pairs of ribs, 11 and 12, those are called floating ribs, and they're only attached to the vertebrae. So there is no sternum attachment. And these tend to be smaller and more delicate than the remaining ribs in the ribcage.

When we're looking at the difference, again, between males and females, with males, the ribcage tends to expand during puberty because of testosterone. So that allows them to inhale more air to supply the muscles with more oxygen. So, again, difference between the males and the females with ribcage and oxygen. When we're looking at the diaphragm, considered to be the primary muscle, when we inspire, you'll see it expand and contract. And this is what we want our patients to realize when they're doing respiratory muscle strength training; we want the diaphragmatic breathing rather than the cooler killer. So, we need to make sure that they have that, they've learned how to do that 'cause it makes respiratory muscle strength training much more effective. When we're looking at inspiration, there's a number of muscles. And again, you can go to Kenhub Google Image and take a look at these.

The sternocleidomastoid steroid elevates the sternum and the clavicle. So, it helps with expansion of the thoracic cavity. When we're looking at the scalene muscles, these are considered to be accessory muscles for inspiration and they assist in elevating the ribs. The external intercostals elevate the ribs and they stabilize the thoracic cage. And then you have the diaphragm, again, considered to be the primary muscle of inspiration. So when we take a look at the muscles, here you have two views of the sternocleidomastoid. When we're looking at the scalenes, we have the posterior, the

middle and the anterior. When we're looking at the external intercostals, it is the green area, so it's the outermost layer, and then we have the diaphragm. Okay. I am not sure what... Okay. Let's come back. There we go. A little glitch there. Okay. Did we miss this line? There we go. Okay, apologize. All right, when we look at exhalation, we have the internal intercostals, again, an accessory muscle. This helps depress the ribs for exploration, and it stabilizes the thoracic cage. We have some other muscles, the rectus abdominis, very forceful in exhalation, the external and internal obliques, which we'll take a look at, this is helpful with forced exhalation. So, becomes very important when we're doing defecation, when we're doing urination, when we're in childbirth. And then we have the transversus abdominis. Same type of forced exhalation, increases the intra-abdominal pressure, and is very important in defecation, urination and childbirth.

Okay, so now we get to the pictures. The innermost intercostal, you see the big band of green. The internal, very difficult to see. And you'll get a little bit of a view right here, that green area, is kind of like the peanut butter in a peanut butter sandwich, very difficult to see. Okay. When we're looking at the rectus abdominis, this is what gives us our six pack. We have the transverse abdominis that we mentioned, and then we have the external and internal obliques. So all of these work together in the process of our respiration.

Okay. So when we are going through the breathing process, system at rest, the lungs are partially inflated, it's about 40% of what the lungs capacity is. When we're looking at respiration and voice, we have the subglottic pressure that's important when we're doing the inspiratory activity and exhalation< we control the airflow, the sound pressure, and it's the driving force for our vocal fold vibration. So quick overview. Now, what's really good about respiratory muscle strength training is it is a drug free training device. It provides a nonpharmacological benefit to our patients. It is very cost effective, and it has a lot of improvements that we'll see in the system. So it helps

improve the respiration. We can target inhalation only, we can target exhalation only, or we can do the combination; inhalation/exhalation, inspiratory/expiratory. So it depends on the device what you can do with that. So definitely, we'll see changes in respiration. We'll see changes in speech. You see this a lot. When you use the tool with Parkinson's patients, there is much more breast support for voice. So the voice is much louder. And it does improve the swallow. There's a lot of studies out there that look at the change in the penetration aspiration scale score. Studies with Parkinson's, I believe there's some studies on ALS, but you do see a real benefit with airway protection and the decreased risk of aspiration. So again, depending on the tool that we're using, or the attachment, we're working on the inspiratory muscles, or the expiratory muscles, or you can combine them. Some tools, they work on both other tools, you have an attachment that you have to put on to be able to do inspiratory and expiratory training.

And we'll talk about those tools when we get to part two. And we also work on the muscles of deglutition and foundation. So, why do we end up with respiratory muscle weakness anyway? Well, we talked about briefly, when we were going over the respiration and the muscles and the lungs and the ribcage, there is a difference in the elderly individual. Some of these changes, as we mentioned, can begin around age 40, with the changes in lungs, changes in your muscle mass and your muscle strength. Now, you'll end up with atrophy and loss of muscle mass. What you'll see with this is sarcopenia. So when you're looking at your patients charts, if you're seeing sarcopenia, this is loss of a skeletal muscle. And what they have determined, is this can, in some individuals, kick in around age 30. If you live a very sedentary lifestyle or you're not exercising, the rule is, if you don't use it, you lose it. So, we'll see this in some of our younger adults, technically, you know, what we see is around age 60, there starts to be some atrophy of muscles. Now, they found when you hit about 60 years of age, depending on how active you are, you could have lost by that time 10 to 50% of your skeletal muscle. Once you lose it, you're not going to get it back. So, it's really

important that we prevent that loss of muscle mass. And exercise is one way that we will need to do that. When you reach the age of 75 to 85, you've lost anywhere from 45 to 50% of your skeletal muscle, and after the age of 85, you've lost more than 55% of your skeletal muscle. So, you'll see this in numerous patients, definitely with the Parkinson's patients. I see sarcopenia with those individuals. And they don't have the expiratory force to do a good, strong, productive cough. You'll also see problems with the frail individual with muscle weakness. So for whatever reason, the muscles have atrophied, you've lost muscle mass, or they're not functioning properly anymore. Now, you'll see problems with hyperinflation; you can't get rid of the air in the lungs. You'll see increased work of breathing, so it is much more effortful. And we see a lot of our patients with COPD, they expend so much calories and so much energy just trying to do the work of breathing. And we'll also see cachexia, if there is just not good use of the nutrition.

You'll see a lot of muscle weakness in neurological dysfunction. The neurological, the neurodegenerative diseases, you'll see this, Parkinson's, ALS, Huntington's, etc. So, numerous reasons why we end up with respiratory muscle weakness, in addition to traditional aging. And we also will see this with the COVID patients who are recovering. When we're looking at the symptoms of respiratory muscle weakness, you'll end up with dyspnea.

So we have the shortness of breath. And for a lot of individuals who experience shortness of breath, there's a lot of anxiety because this becomes extremely difficult for them to inflate the lungs and get the oxygen that they need, so they get very, very anxious. And that creates some issues. They have exercise intolerance. If we don't get the oxygenation, you're not going to be able to do well with your physical therapy, with your occupational therapy. So we have poor endurance. And we see this a lot with our ADLs when we read the reports from occupational therapy; the patient could not get dressed without so many rest breaks. So if we increase the muscles strength,

respiratory muscle strength, we may not need as many rest breaks, we may do better in physical therapies. So it really affects all of the disciplines that our patients would see for therapy. And we see the reduced quality of life. Now the consequences of respiratory muscle strength weakness, you'll have increased risk of exacerbations if we have a patient with COPD. What you'll see with those increased risk of exacerbations, the readmission rates go up for these individuals, and their length of stay is increased. So it's a bad combination. You'll see increased risk of dysphasia, silent aspiration, pneumonia and reduced quality of life. When we're looking at respiratory muscle weakness and different disorders where you will see this in combination, definitely you'll see it with the COPD individual. You'll see it with children and adults who suffer from asthma.

Definitely you'll see it in the Parkinson's patients or stroke patients, patients with dysphasia. When we have somebody who is short of breath, they have a real hard time closing or protecting the airway during the swallow. And we've seen improvements with respiratory muscle strength training in patients who have diagnosed dysphasia. Spinal cord injuries, sleep apnea, hypertension congestive heart failure, muscular dystrophy, multiple sclerosis, myasthenia gravis, your vocal fold pathology, vent/trach weaning, and we see this a lot with our patients who are being treated for COVID.

They just have a really hard time coming off of the vent or being able to eliminate the trach. Other disorders, I believe maybe we had Parkinson's twice there, I apologize for that. Definitely you'll see I studies on cystic fibrosis. There have been benefits for the individual who diagnosed with cystic fibrosis with respiratory muscle strength training. The vocal cord dysfunction, the exercise induced laryngeal obstruction, and pompe syndrome, which is a genetic disorder. And with that genetic disorder, you'll see muscle weakness and trouble breathing. Now, other populations who have no health issues. Definitely, these individuals would benefit with respiratory muscle strength training as well. Healthy athletes; there's a lot of studies out there on professional athletes, college

athletes, high school athletes, swimmers. Instrumentalists; there's a number of studies out there with different types of wind instruments, brass instruments. Professional Voice Users, or teachers, or lecturers and their a singers. So the healthy individual can also benefit from respiratory muscle strength training. When we're looking at the RMT, what we're doing is putting a workload on those respiratory muscles. So you're breathing against resistance. Depending on the tool that you're using, you're either inhaling against resistance or you're exhaling against resistance. And in some tools, you can do both. So we're activating the respiratory muscles, the same as we would activate our skeletal muscles when we go to the gym and we're doing the ellipticals and the treadmill and weightlifting and that type of thing. What you'll see is muscle hypertrophy.

You'll see an increase or growth in the size of the muscle cells because of the exercise. And you'll see an improvement in muscle speed, the endurance the patient has for exercise or ADLs, and the muscle power output. So when we're looking at resistance training, we're going to, with these devices, increase the amount of effort that is required. So we start out very easy, and then over the training period, we're just going to increase the workload. So, when we're doing the training, you're going to see a decrease in shortness of breath.

As we said, we see an improvement in swallow, speech and enduring, so we're taking your lungs to the gym, basically. Now these numbers really surprised me. Respiratory muscle weakness is highly prevalent underrecognized and undertreated. So when we take a look at these statistics, 30 to 50% of individuals who have been diagnosed with congestive heart failure, have respiratory muscle weakness. When we're looking at patients with acute heart failure, 76%. 50% of your patients who have moderate to severe COPD have respiratory muscle weakness. One of the patients that I'm seeing now had horrible exacerbations of COPD, and he's done much better with staying out of the hospital with respiratory muscle strength training, and I see a big difference in his

oxygenation, his endurance level in physical therapy and just a better mindset, he's not as anxious. When we're looking at the institutionalized elderly, up to 100% will have respiratory muscle strength weakness. So, you'll see this with individuals going for OT. They don't have the endurance to dress themselves without taking how many breaks. You'll see the same thing with the physical therapist working with an individual, they need to take breaks as they're doing the walk down the hall or their are different exercises. So, we can increase the poor strength when we're doing respiratory muscle strength training, and you'll see differences in improvements in all of the therapy disciplines. I found this to be surprising as well; 30% reduction of diaphragm strength within six days when you're on mechanical ventilation.

So when we think of the individuals who have been treated with COVID through mechanical ventilation, they've been on the vent for a long time. So, if we can end up with a 30% reduction in diaphragm strength after 6 days, imagine what happens after the 30 days or the 25 days. So there is a place for respiratory muscle strength training with those individuals. When we have an individual that becomes anxious with their breathing, there is a way that we can work through the tool and have them inhale and exhale at the lowest setting, and that will kind of reboot the respiratory pattern and help decrease the anxiety.

So there is ways we can work whether individuals when they are becoming anxious. What they found is, impaired oxygen intake and excretion of carbon dioxide affects the cardiac muscles. So, now we have a cardiac output problem. So, when we're looking at the system, cardiac and respiratory are so intertwined. They really impact each other. Maximum inspiratory pressure or MIP, and you'll see that throughout part one and part two slides, when that is less than 70% of what is the predicted value for an age group, that is when you're considered to have respiratory muscle weakness. So there are a number of places you can go to look up that information, bottom line, I'm going to look at my doctor, my pulmonologist, and get that information. But there's

ways that you can test that for yourself, and we'll talk about that in part two. Okay, a lot of issues with COVID. Everything that I've read and seminars that I've attended, they are suggesting that when we're working with the COVID patient who is recovering, the concept, the rationale for respiratory muscle strength training is the same as we would use for anyone else that has respiratory muscle weakness. Whether it's severe hypoxia, respiratory muscle fatigue, the therapy program is the same.

However, it is contraindicated when you're in the acute phase. It's just not a good idea to get involved at that point. It's been suggested that you start respiratory muscle strength training when they have been extubated, when the work of breathing has decreased, or they no longer need extraordinary oxygen supplementation, then it would be appropriate to begin using the tools with those. Now, what you need to recognize, when a patient is doing respiratory muscle training, they are inhaling and they are exhaling. So there is aerosols being produced. And when they use the muscle strength training tools, they're creating more aerosols than they do when they talk. So it's been strongly recommended that once you are in the room and you do the training, you show them, you demonstrate, you explain this is what we do with the tool, the minute they start using it, you're not in the room anymore because of the aerosols that are being produced.

So it's been recommended that you don't go in that room for at least 21 or more days from the known infection. So you do your therapy remotely, either through telepractice; you're looking through the window of the room or you're looking through the window on the door, but you should not be in the room because of the aerosols that are being produced when we're doing muscle strength training with the tools, inspiratory/expiratory. When we're looking at the impact on cognitive function, there have been some studies that found, if you did muscle strength training for the respiratory system, it did improve cognitive function. When we have reduced respiratory function, we end up with inadequate oxygenation of the brain. And that can

contribute to the cognitive decline that we see in our elderly. Now, we're not going to blame cognitive decline entirely on inadequate oxygenation, but it could play a role. So, when they've done respiratory muscle strength training with individuals who have a cognitive function deficit, they found that there was more oxygenation and it could slow down the cognitive decline. They do have studies that have shown improved cognitive function when they looked at abstraction, mental flexibility, when they've done respiratory muscle training. We talked about the pompe disease. And they are using respiratory muscle training with enzyme replacement therapy. So, you really need to do both of those. And what they found, if you did this treatment, you coordinated respiratory muscle training and the enzyme replacement, it actually improved the maximum inspiratory pressure and the maximum expiratory pressure in the first year.

And over the course of two years, it's stabilized those pressures, and also the forced vital capacity or the amount of air that you can forcibly exhale. So, there is the thought, if we can use respiratory muscle training with this particular population, it might prevent or slow down the long term respiratory muscle degeneration. When we're looking at the COPD patient, we'll see improved respiratory muscle strength inspiration, we'll see better endurance, that breathlessness that they have is reduced, they have better capacity for exercise, quality of life is improved.

And they can become less anxious. So again, when we use the tools, when they become anxious because they're short of breath, if we take the tool to the lowest setting, and they do several installations/exhalations that kind of reboots the system and helps them oxygenate, and that anxiety tends to tamp down just a little bit for them. They found that when they did respiratory muscle training, with the COPD patients, it was more effective than just your traditional physical therapy exercise. It reduced the frequency of their exacerbations, the number and duration of hospital stay is also decreased. So, this is a great way to keep your patients at home if they have COPD. You're working in home health, it's very beneficial. There has been studies with

patients who have had strokes. And they found that using the muscle training, it improved the respiratory musculature that was weakened after the stroke and it improved their cough. So with a more functional cough, if something did penetrate into the airway, they were able to cough that out, which was great, certainly helps. When we're looking at asthma clients, again, adults as well as children, there is a role for respiratory muscle strength training in children as well. What they found was, with this training, it actually reduced the frequency of the asthma attacks. It improved their ability to perform their daily tasks of living in both adults and children. In some patients, it actually alleviated the asthma symptoms, it reduced the need for bronchodilators or inhalers, and reduced their symptoms, both daytime and nighttime.

With a congestive heart failure patients, again because we have respiratory and cardiac very intertwined, we ended up with general improvement of muscle strength. They found that the blood flow improved to the limbs in patients who had congestive heart failure. It reduced their level of fatigue and depression. And it directly improved the heart rate.

So, it seemed to be tackling the underlying cause of the disease. When we're looking at Parkinson's patients, there's a lot of studies on this particular population. We're working on inspiratory and expiratory muscles. These patients in my experience tend to have sarcopenia. They don't have a strong enough cough, so that exploratory force for a good cough is not there. So, if you can't breathe in sufficiently, you don't have the air that's required for that forceful cough, plus, you don't have the strength to do the forceful cough, let alone the air. We see improved speech support, which we talked about, improved their lung function, their airway defense, prevented the aspiration, reduced the pneumonia risk, and we found that the ribcage flexibility actually improved. So because that flexibility increase, they were able to have a greater lung volume, and it helped with that inhalation before a swallow. The cough reflex was improved, so we have better airway clearance and there was the ability to prevent

aspiration in these individuals. Plus, we're doing the retraining of that breathing and swallowing pattern. with individuals who have MS, this is considered to be a complimentary therapy in addition to everything else that they're doing. It increases the expiratory muscle strength for that forceful cough. And what I found interesting, it significantly improve the cost efficacy in patients who had advanced MS. It's not just beneficial in the early stages, it did have a significant difference for the patient who had the advanced MS. So the aspiration, pneumonia respiratory failure, the reduced risk was there. We have better control of airway obstructions.

Sometimes mucus plugs get in the way for multiple different disorders, better ability to clear that. When we're looking at the individual who has dyspnea, what they found was, even though the pulmonary rehab with respiratory muscle strength training is effective, they found that only 17% of patients with COPD who could benefit from this tool had access to it. So, that's really sad, that we've got a tool that's relatively inexpensive, it is not a medication and we can't get it into our patients hands. Now, there are a number of facilities that are purchasing these tools, and that's just part of the rehab plan.

Some home health agencies are purchasing the tools and utilizing it. And as I said, you have benefits not only for speech, but PT and OT. So, all of the disciplines are vary involved in respiratory muscle strength training. In my practice, I have started providing the tool for my patients. And while I divide the cost of the tool over the therapy sessions, it's just a matter of a few dollars. So it really does make a big difference in their health. Not everybody can afford that, but a lot of facilities have gone to providing the tools knowing that the patients can't barely afford copays. They found that the dyspnea has been reduced in the patients who have COPD, asthma, the respiratory muscles have strengthened, they were able to improve their tolerance to exercise and quality of life. You start to see a pattern here with the studies. When we're looking at myasthenia gravis, it improved the chest wall mobility, the respiratory patterns, and

reduced or delayed the need for mechanical ventilation. You'll few patients with ALS that may actually be able to remain trade free if you can do respiratory muscle strength training. When we're looking at the paradoxical vocal fold motion, we have the exercise induced issue here. So we have the acute shortness of breath. They can't tolerate the exercise that they want to perform or the sport. Now, here, they were looking at inspiratory muscle training, not expiratory. So when they did the inspiratory muscle training, it increased the maximum inspiratory pressure, and it decreased the dyspnea ratings, during that time that they were in treatment and also when they were discharged.

Now in part two, we're going to talk about some dyspnea rating scales that are out there for you to take a look at. They didn't see any change when there was the discharge. Now, we do need to recognize that when we're doing respiratory muscle strength training, you need to have a functional maintenance program put in place for this individual, because we don't want to lose ground. So, all of the tools that we're going to talk about next time, they talk about a maintenance program. Now, it may not be as intense, you know, X number of days per week, but they recommend that you continue to do it at least three days a week instead of five or six.

When we're looking at the individual who has dysphasia, we get a better cough, we improve the expiratory muscle strength, and that's going to help with the penetration aspiration scale scores. And you'll see that when you review the studies, the penetration aspiration skills score has improved over the course of their treatment. Cough improved, the acceleration, the strength behind that cough improved with the training. There was some interesting information on vent and trach weaning in these studies. 10 to 15% of individuals who are on mechanical ventilation have a failure to wean, they just can't get off mechanical ventilation. And what they found is, one of the significant contributors to that is reduced respiratory muscle strength. So, you go back to what we talked about with the weakness of the diaphragm, after six days on

mechanical ventilation, we've got that 30% reduction. This makes a difference. So we have the diaphragm weakness and it worsens our outcomes. Now here they were looking at doing inspiratory muscle strength training, and that significantly improved the maximum inspiratory pressure. What they found was, when they introduced muscle strength training for the respiratory system, it's significantly improved the waning success rate, as when they paired the individuals who went through the training with those who are in the control group, big different. 71% were able to be weaned successfully when they had the muscle strength training for respiration versus 47% that were in the control group.

There was a study where they looked at patients who had been on mechanical ventilation for an average of 72 days. And they enrolled them in this respiratory muscle strength program, and they received daily inspiratory muscle training. And they assessed maximum inspiratory pressure weekly. They also performed regular unassisted breathing trials. And their definition of successful weaning, is when the patient was able to breathe unassisted for 48 hours. So everyone that they had involved in this study showed significant increases in maximum inspiratory pressure, and they were able to wean off mechanical ventilation within nine to 28 days. So, the literature is suggesting that, by using this technique, it greatly supported successful weaning.

With your spinal cord injury individuals, we tend to have poor airway clearance, we have pneumonias, obstructive sleep apnea. So with respiratory muscle training, it improved the weakness, improve the cough function. Now what they did in this particular group, is they had two blocks of four weeks of the training. And there was a two week rest period in between. So we have four weeks of training, two weeks rest, and then four weeks of training. And what they found was, respiratory muscle strength improved, hypopnea-apnea index improved, and the patient's perception of the quality of their sleep also improved. They have some information out there on back pain, and

the diaphragm is involved in your postural control. So, low back pain creates reduced stability and respiratory fatigue. So they put together an eight week program for respiratory muscle training. And they found that patients had improved stability on unstable surfaces, decreased the over utilization of the ankles, we had improved use of the back for postural stability, and it actually did improve the severity of the low back pain. With sleep apnea patients, we know that elderly individuals have a lot of issues with sleep disorders. So, when we're looking at respiratory muscle training, it improved the sleep quality, the quantity of their sleep, it reduced the number of night time awakenings, it significantly improve their sleep apnea and the desaturation of REM and NREM sleep waves.

And they found that it could also lower the blood pressure. So, for those individuals who really don't like their CPAP, this may be another opportunity to improve the muscle strength. Not that it might get rid of CPAP altogether, but it could certainly improve their situation.

With high blood pressure, they found that with training, the blood pressure was significantly lowered when they had inspiratory muscle training. The daytime blood pressure was reduced. So it is thought that if inspiratory muscle training reduced your daytime blood pressure, this could be a possible nonpharmacological treatment option in managing hypertension. The benefit to the patient for this is, it's a medication they don't need to take anymore. It eliminates potential medication interactions. You remove one medication, that can change things with the group of meds that they're taking at one time. It's one less copay. So there are some real benefits to the individual. There are a number of studies out there on children and respiratory muscle weakness. So, you can use it with children. And each tool that we talked about has recommendations on the ages when you can start this. But it is beneficial for the child who has asthma, chronic lung disease, there has been studies on cystic fibrosis, neuromuscular diseases, cardiac conditions, muscular dystrophies, they found that it actually reduced

the perceived effort of breathing in these kids, it preserved respiratory function in kids who had neuromuscular diseases, so they believe it is an effective tool for these children. And again, each tool is going to have their protocols for use in children. When we're looking at pulmonary hypertension, when we look at both inspiratory and expiratory muscle strength, we had an improvement, fatigue was significantly reduced, and their ADL performance significantly improved. So this is a person that may not need as many breaks or any breaks at all during their activities of daily living, which is a huge benefit to the individuals in our facilities and those individuals living at home being serviced through home health agencies. A lot of issues with postoperative pulmonary complications, you'll end up with post operative pneumonia many times that can cause a death.

And what they found with respiratory muscle training, it actually reduced the incident rates of the postoperative pneumonia and atelectasis. So that is either a partial or a complete collapse of either the entire lung or the lobe. And what will happen, is the alveoli become deflated, or the other end of the spectrum is they fill up with alveolar fluid. And this is one of the most common respiratory complications after surgery. So a lot of my patients will end up coming back from the hospital with the incentive spirometer or their flutter valve or the acapella valve, and that is to work on clearing the mucus from the bronchioles.

So they found that if we did inspiratory muscles strength training, that was very safe and cost effective methods to reduce the pulmonary complications after those cardiac or abdominal surgeries. Anytime you have comorbidities, it can get a little sticky. There's a lot of things that like to travel together. You'll have cardiovascular disease and COPD, sleep apnea, asthma. Take a look at our patients charts, how many of them have page one, page two, page three of disorders, diseases, etc. So, this could be a holistic approach to help with a variety of issues, health issues that your patients have. This one surprised me, the chronic kidney disease. They found that if an individual

needs dialysis, they often develop uremic syndrome, and that's associated with impairment of respiratory function. We have a loss of the peripheral or respiratory muscle mouth and strength, and we have low cardio respiratory conditioning. So, when they've used respiratory muscle training with patients with chronic kidney disease, it was more effective than breathing exercises to improve the muscle strength, lung function, and their quality of life. There is so many disorders out there that we don't understand or recognize all the symptoms or the systems it can affect. They found that using respiratory training, muscle training in palliative care, could help reduce the risk of respiratory failure. It helps improve the airway clearance. So you see a reduced risk of pneumonia, aspiration, improved quality of life, and it did see in the studies that the depression level in these patients was not as great.

So, a lot of overflow in helping with the depression our patients suffer from. When we're looking at reflux disease, we have a lot of problems with the esophagogastric junction. And when that sphincter is not doing its job, we have GERD. So what they've done is try respiratory muscle strength training with these individuals, and they found that it actually did strengthen the diaphragm, it helped improve the pressure and motility at that junction. It significantly improved the regurgitation of the acid, heartburn, acid exposure, helped with the lower esophageal sphincter relaxations, and also with the heart rate variability.

So, takeaways that we have from today, before we get into part two and talk about the tools and the protocols. We know that the respiration system and the cardiac functions are tied together. The thoracic and abdominal muscles, those are very important when we're looking at core strength, posture and respiration. So, anytime we have impaired oxygen intake, it impacts our patients in many different levels. It impacts their ability to walk safely, we have a higher risk of falls if we have reduced oxygenation, and the posture, if those muscles don't work very well. It helps with your ADL, you don't have to do as many breaks. So your endurance for activity and taking care of yourself

improves. So with muscle strength training of the respiratory system, whether we're looking at inspiratory, expiratory, or the combination, it is a nonpharmacological treatment which is a boon for a lot of our individuals, no pills to take, no copays, it's inexpensive, and it works on both sets of muscles, inspiratory and expiratory. Alright, so, I'm going to throw it back to Amy.

- [Amy] Sure, hi. Let's go ahead and address some of the questions that are coming in. And I invite others, if you have questions at this time, certainly feel free to go ahead and send those our way. Okay, first question is, does wearing a mask during cardio walking help to strengthen the lungs?

- [Denise] When you're doing the respiratory training?

- [Amy] Yeah, Kathleen, if you could maybe provide a little bit more information, that would help be able to answer the question. See, during ADLs?

- [Denise] All right, when you're doing ADLs, you're not going to be doing the respiratory muscle strength training during ADLs, you're going to do that as a separate task and see the impact that it has over time. So, an OT could do respiratory muscle strength training prior to their ADL activities. The physical therapist could do respiratory muscle strength training, before they start any of the traditional physical therapy exercises that they would do. So, it is a tool that every discipline can utilize, and you'll see some improvements. It's not just strictly a speech tool.

- [Amy] Okay, thank you. Let's see this one is, even with PPE, which I understand is not 100% protective, it is still recommended that the SLP still provide EMST via telepractice, monitor, iPad, etc. Not being in the room. Oops, sorry. What are your recommendations for those patients, I lost part of the question, not diagnosed with cognitive deficits in COVID, who might benefit from other sensory stimuli?

- [Denise] I'm sorry, could you read that one more time?

- [Amy] Sure. So, even with PPE, it is still recommended that the SLP provide our MST via telepractice, etc, and not being in the room. What are your recommendations for those patients diagnosed with cognitive deficits and COVID who might benefit from other sensory stimuli?

- [Denise] Well, the reason why you're not in the room when the patient is doing respiratory training, is because of the aerosols. And they can't wear a mask when they're doing respiratory training, it just doesn't work. If they're not doing respiratory training and they have a mask, there's a product called Microsure that we use in home health that provides a barrier on your traditional face mask. So, we can do cognitive therapy in the room with them. Again, depending on your facility protocol, they may prefer that you're working outside of the room with teletherapy. It becomes a little bit tricky then how you provide stimulation for them. So, if you are able to work in the room with them with whatever therapy exercises you're doing for cognition, I think that depends on your protocol in your facility and your comfort level of being in the room with a patient who has COVID.

- [Amy] And then, who does the administration of the MST to patients still on a vent if the SLP should not treat those still on vent especially with COVID?

- [Denise] Yeah, if they're not on a vent, I wouldn't do respiratory muscle strength training.

- [Amy] Okay. Let me ahead. We have lots of questions coming in. So we will try to address as many as we can, and then just kind of go from there.

- [Denise] What I would recommend is that, if you're working with somebody who is recovering from COVID, you are very involved in an active discussion with the pulmonologist and the physicians that are treating, and they will give you their feedback on when they believe it's appropriate to begin.

- [Amy] Thank you. Okay, so when completing our MST, what could this be billed under for speech therapy?

- [Denise] It's a traditional therapy code. It would be used on your therapy session, the 92507.

- [Amy] Okay, perfect.

- [Denise] Or if you doing dysphasia, 92526. It's just another modality.

- [Amy] Sorry, some of these are longer, so I have to just pull them open a little bit. In an acute care setting should strength, I wanna say training, be initiated or wait for outpatient or home health? Is this something the RT would address in acute care?

- [Denise] Usually, my experience has been in a hospital environment, they're going to either do incentive spirometry, they're going to do the flutter valve or they're going to do the acapella valve. When they're discharged from the hospital in my area, they come to either the assisted living or the skilled nursing facility with those tools, or if they're direct discharged to home, they have those tools. Now, next time we'll talk about what the difference is between the flutter valve, the acapella valve and the respiratory muscle strength training. They're a little different. Usually, the acapella, the flutter valve, and there's a number of other tools, that is just to try to help clear the mucus, but it doesn't give you the respiratory workload that the traditional tools like the

EMST and the breather. They allow you to change the resistance overtime, and they develops the strength.

- [Amy] Okay, thank you. And then, do you know, is wearing a mask so much of the time affecting people's respiratory strength?

- [Denise] Yeah, I'm hearing from patients, even healthy individuals, that they feel like oxygen deprived wearing that mask all day. I wear it for an hour with the patient and then I am in my office and it's off, I noticed that there is a difference in my breathing. So, I think it can definitely impact the oxygenation that you're getting. I'm not sure if you're only using the mask for here and there during the day that is going to affect the strength, it could, depending on your health situation to begin with.

- [Amy] Great, all right. I'm gonna take just a couple more, and then if you do need to log off at this time, certainly feel free to do so. We have definitely met the one hour mark. So, if you have time to stick around for maybe one or two more questions, I can go ahead and ask a couple more.

- [Denise] There is a question about this spray, it is Microsure, M-I-C-R-O-S-U-R-E, is very expensive. When I purchase mine for my office, since we use it in home health, I wanted to use it in my office, I had a four gallon minimum, it was about $780. But the nice thing is, it allows you to use that mask for a longer period of time and it's a great disinfectant. So, you know, it was an expense.

- [Amy] Wow! That was very expensive.

- [Denise] It was.

- [Amy] Wow. You might have addressed this a little bit, but I'm going to go ahead and ask the question again. Can you discuss how the roles of respiratory therapists and SLPs overlap with regard to RSMMT? I also understand that some DOs with OMT and OMM training will also Engage in respiratory muscle strength training. Can you discuss how this overlaps with them as well? If all of these resources are available, to whom would you make recommendations to a patient?

- [Denise] My suggestion is, in the hospital environment, differ to the pulmonologist and respiratory therapy. What I've been reading and hearing about in the in-services on respiratory muscle strength training, is they're saying that the incentive spirometer is not your best tool, but a lot of my patients leave the hospital with that. It's believed based on the studies that, the Breather EMST 150 tend to be a better option. So, when the hospital was fitting them with the flutter or the acapella valve, that's usually what they're going to be discharged with or the incentives barometer. And then I need to make the decision. In addition to the flutter and the acapella, which is going to help move the mucus, we'll institute the respiratory muscle strength training.

- [Amy] Okay, perfect. And I think we'll go ahead and end there. I know there are a lot of questions coming in. I would be happy to go ahead and take those questions. And Denise, then if you have time to address any of them, you can always send those answers back to me and I can make sure that everybody gets the questions and answers. Does that sound like a good idea?

- [Denise] Absolutely, we'll do that.

- [Amy] Okay, great. All right, so let's go ahead and wrap it up there for today. Thank you so much for joining us and sharing your knowledge about this very important area right now. And to all of our participants, for asking really great follow up questions. I'm going to say what some others are already saying, I'm really looking forward to part

two which is next week. If you are unable to join us live, please know that it will be available as recorded course in our library.

- [Denise] Wonderful.

- [Amy] Wonderful. Okay, thank you so much. I hope everybody enjoys the rest of your day.

- [Denise] Bye bye.