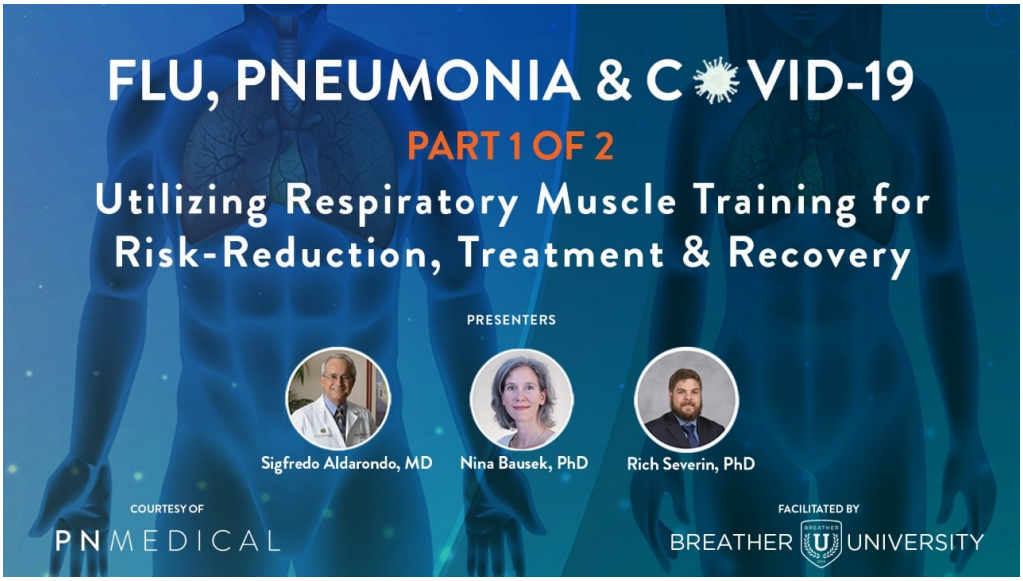
PNMEDICAL

FLU, PNEUMONIA & COVID-19 UTILIZING RESPIRATORY MUSCLE TRAINING FOR RISK-REDUCTION, TREATMENT & RECOVERY



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Respiratory muscles are not only critical elements for breathing, they also function as key components of the speech and swallow mechanisms, even support your posture, balance, and core strength.

What if respiratory muscles could also help to reduce the risk of respiratory infections, such as community viruses, the seasonal flu, or COVID-19?

Recently, Rich Severin, PT, DPT, CCS, from the Department of Physical Therapy at the University of Illinois at Chicago and his colleagues discussed the role of Respiratory Muscle Performance Screening for Infectious Disease Management Following COVID-19. In the article published in the American Journal of Medicine, the authors provided a model to incorporate screening for impaired respiratory muscle performance into the healthcare algorithm, and, most importantly provided recommendations, on how to intervene in order to improve respiratory muscle performance before morbidity escalates (Severin et al. 2020).

The COVID-19 pandemic sweeping the globe has provided the world with a rude awakening, demonstrating how a single virus can quickly overburden the healthcare systems, the economy, and disrupt large parts of our society, resulting in unemployment, poverty, and uncertainty about the best road to recovery.

Intensive care unit (ICU) resources in most countries, including the US, are heavily taxed at all times, and many are overwhelmed with the added burden of severely ill COVID-19 patients requiring mechanical ventilation. Dr Sigfredo Aldarondo, critical care pulmonologist in Orlando, FL, confirmed that the ICU patients census in his hospital system has experienced a "several-fold increase particularly those requiring mechanical ventilation" with the spike of COVID-19 cases. Easing the burden on the healthcare system in order to maintain the standard of care is, therefore, a priority to prevent it from being overwhelmed and potentially facing the prospect of rationing care (Ethical recommendations for triage of…).

Furthermore, while COVID-19 is in the spotlight, other respiratory infectious diseases such as seasonal influenza are not dormant, and may further expose the vulnerability of the critical care system, especially in areas experiencing higher incidence of cases. While most cases of respiratory infections follow a mild clinical course, they may lead to respiratory distress and, in rare cases, respiratory failure. Certain factors have been identified that increase the risk of a severe progression of COVID-19. These include age, lung disease, smoking, obesity, and cardiovascular disease. However, these factors and other comorbidities do not completely account for many of the severe cases of COVID-19 and other respiratory infections, leaving room for additional contributors that so far have been overlooked and remain unidentified. According to Severin and his colleagues, decreased respiratory muscle performance may belong in this group.

This assumption is based on the role of respiratory muscles during breathing, where these are required to fully distend the alveoli, the bubble-shaped ends of the bronchi, where the gas exchange of oxygen (O2) and carbon dioxide (CO2) take place. Full inflation of the alveoli requires a pressure of approximately 40 cm H2O (cm water pressure). Quiet breathing during rest only requires 5 to 10 cm H2O. In contrast, inspiratory muscles of healthy men can generate a maximum pressure of 128 cm H2O, while average maximum pressure of women lies slightly lower at just under 100 cm H2O. Either way, the respiratory muscle capacity is severalfold higher than the demands for breathing under normal and exercise conditions, making breathing a very energy-efficient process.

This efficiency is reduced in the presence of comorbidities, for example in obesity. Here, the work of breathing is increased, demanding a higher workload of the respiratory muscles, which are often already compromised by disease and weakness.

This balance may tip even further in the case of respiratory infection and local inflammation, putting much higher demands on the respiratory muscles. Therefore, comorbidities that impact respiratory muscle performance may make the lungs more susceptible to task failure. When respiratory muscles are unable to meet the demand of the increased workload, patients may experience respiratory distress, or even failure, requiring mechanical ventilation. Acute respiratory distress syndrome (ARDS) and respiratory failure are two of the most challenging consequences of COVID-19, and are associated with worse outcomes and increased mortality risk. Furthermore, while mechanical ventilation offloads the respiratory muscle system, it is associated with rapid atrophy of the respiratory muscle, and ventilator-induced diaphragm dysfunction (VIDD). These sequelae of mechanical ventilation add to the burden of disease and increase the risk of delayed weaning, slow recovery, readmission, and downstream pulmonary complications.

Based on these findings, Severin and his colleagues proposed that building up respiratory muscle performance in a proactive manner may greatly contribute to reducing the risk of infection, as well as reducing the risk of further deterioration in the case of an infection. Stronger respiratory muscles should be able to sustain the increased work of breathing longer before fatiguing. Respiratory muscle training (RMT) is an effective method of strengthening the respiratory muscle system by working the muscles against resistance. Devices such as the Breather can be used to independently strengthen both sets of respiratory muscles, those for inhalation and those for exhalation;. Strengthening the inspiratory muscles builds up diaphragm strength and improves resilience of the respiratory muscle system against fatigue. Working on the expiratory muscles strengthens the cough function contributing to pulmonary hygiene, critical before, during and after respiratory infections. Whether preventive RMT can directly reduce the risk of respiratory failure during infection remains to be investigated, however, there is robust evidence for the benefits of RMT to reduce duration of mechanical ventilation, pulmonary complications, and hospital length of stay.

Based on the available evidence and their conclusion, the authors proposed a theoretical Risk Reduction Model to “improve outcomes and reduce the burden of future viral pandemics”:

1. Identify patients at increased risk of impaired respiratory muscle performance. These include people with comorbidities including
    a. Obesity
    b. Dyspnea
    c. Elderly
    d. Lung disease
    e. Physical inactivity

Screening and identification of at-risk patients could be part of routine annual health checks, as well as during vaccinations (eg for influenza). Early identification is important to optimize the benefits of RMT.

2. Measure respiratory muscle performance by assessing respiratory muscle strength and/or endurance. This can be done by measuring maximum inspiratory/expiratory pressure (MIP/MEP) or other protocols such as the test of incremental respiratory endurance (TIRE).

3. Initiate RMT in patients with impaired respiratory performance and monitor progress
This can be done during the initial visit, as well as via telehealth and remote monitoring. App-based devices greatly support this approach.

4. Implications of this Risk Reduction Model may include
    - Reduction in ICU and mechanical ventilation resources
    - Improved clinical outcomes

CONCLUSION

Respiratory pathogens such as COVID-19 impact our health, our society, and our economy. In order to improve our response to this and future respiratory viral outbreaks, we need to be prepared to protect especially those most vulnerable from infection and minimize the burden on the healthcare system. As respiratory distress and failure are the most challenging aspects of respiratory infections, conditioning of the respiratory muscle system may be an effective way to reduce the requirement and/or duration of mechanical ventilation, as well as mitigating the respiratory consequences and mortality. Respiratory muscle training (RMT) is a simple and effective way to improve respiratory muscle performance. Early identification of high risk patients and timely initiation of RMT may contribute to decreasing the burden of COVID-19 and other respiratory viral epidemics.