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# CLINICAL USE CASES FOR RMT

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## USE CASE: WEANING FROM MECHANICAL VENTILATOR

**Benefits:** Quicker time to ventilator liberation and trach decannulation

A majority of LTAC patients are 'hard to wean from mechanical ventilator' / ventilator dependent. Of those patients with COPD, 50% belong in this category. Prolonged mechanical ventilation leads to high resource utilization, increased complication and a tenfold higher rate of in-hospital mortality.

A great application would be to use Breather to strengthen respiratory muscles to facilitate quicker time to ventilator liberation and trach decannulation.

### CLINICAL EVIDENCE

- In patients who fail to wean from mechanical ventilation after surgery, RMT significantly increases the chance of successful liberation from 47% to 71% (1).
- Weaning success correlates with diaphragm thickness. RMT increases diaphragm thickness and reduces diaphragm asymmetry, contributing to weaning success (2).
- Research from LTAC specialty hospitals show that inspiratory muscle strength is an independent determinant of long-term survival of ventilator-weaned patients (3). Application of the Breather for the increase in respiratory muscle strength would therefore also greatly contribute to patient QOL and long-term survival.

## USE CASE: CHRONIC LUNG DISEASE

**Benefits:** Less dyspnea, improved quality of life, shorter length of stay.

In patients with chronic lung disease, respiratory muscle weakness contributes to dyspnea, reduced QOL, exercise intolerance, and higher morbidity and mortality. RMT through the use of The Breather will strengthen respiratory muscles to reduce dyspnea, improve QOL, mobility and exercise capacity, and lead to earlier discharges.

### CLINICAL EVIDENCE

- In COPD patients, RMT improves respiratory muscle strength, and reduces dyspnea. This improves exercise capacity, QOL and activities of daily living (ADL)(4).
- Where aerobic exercise is possible, RMT improves the effects of exercise and pulmonary rehabilitation (5)(6).
- RMT improves hyperinflation, a clinical prognostic marker correlating with disease progression and outcome, thereby reducing the risk of death (7).
- In patients with COPD and asthma, RMT led to optimized drug delivery by inhalation, reducing the frequency of bronchodilator use (8)(9).
- In COPD patients, RMT reduces hospitalizations and healthcare requirements by 30% (10).

## USE CASE: DYSPHAGIA

**Benefits:** Improved swallow function and airway clearance, reduced risk of pneumonia

Dysphagia is prevalent in elderly people and those with COPD and other respiratory muscle disorders, and increases to at least 25% of LTAC patients without, and to up to 81% of those with neuromuscular disease such as stroke or Parkinson's. Dysphagia is associated with a 13% increase in mortality, mainly due to the increased risk of aspiration pneumonia. Patients with dysphagia have increased hospitalization rates and duration, and emergency department visits.

### CLINICAL EVIDENCE

- In patients with Parkinson's, RMT improves swallow function by strengthening the suprahyoid muscle and reduces the aspiration rate (11)(12).

## USE CASE: CONGESTIVE HEART FAILURE

**Benefits:** Improved symptoms and physiological causes of CHF

Congestive heart failure has been declared as emerging epidemic, with a prevalence of 5.8 million in the US, rising annually, and an associated economic burden of \$39 billion. CHF caused at least 550,000 hospitalizations per year, and 5-year survival rate lies at 50%. Risk factors for developing CHF include hypertension, obesity and smoking, and common comorbidities include COPD, asthma and other respiratory disorders, all contributing to the characteristic symptoms of dyspnea, exercise intolerance, and fatigue. Comorbidities also greatly contribute to the high readmission rate (69% within a year), as 68% of readmissions are non-CHF mediated.

RMT using the Breather has the potential to alleviate the symptoms of CHF, as well as to improve underlying causes such as hypertension, autonomic cardiac control and sympathetic nerve activity. Application is therefore effective in CHF patients and high-risk groups for developing CHF.

### CLINICAL EVIDENCE

- RMT improves many clinical outcomes related to the pathophysiological manifestations of CHF including dyspnea, QOL, peripheral blood flow, sympathetic nervous system activity, heart rate, respiratory rate, ventilation, and exercise performance, as analyzed by a systematic literature review (13).
- Beyond, RMT effectively lowers blood pressure and reduces hypertension, helping to prevent CHF in high-risk patients (14).

- Based on respiratory muscle weakness as a common denominator of CHF and many comorbidities, RMT provides a holistic therapeutic approach to the complex clinical syndrome of CHF.

## USE CASE: POSTOPERATIVE PULMONARY COMPLICATIONS

**Benefits:** Reduction of PPC and length of hospital stay after major surgery

Postoperative pulmonary complications such as pneumonia and atelectasis are the leading cause of morbidity and mortality after major cardiac or abdominal surgery. PPC increase the duration of hospitalization and healthcare costs.

Preoperative RMT using the Breather reduce the risk of PPC, morbidity and mortality and decrease the length of stay.

### CLINICAL EVIDENCE

- Preoperative RMT reduces PPC by 50% in patients undergoing coronary artery bypass graft surgery.
- RMT reduces postoperative pneumonia by 59% (15).
- Meta-analysis of pooled data confirms the effect of RMT to reduce postoperative pneumonia, atelectasis and duration of hospital stay (16).

# FINANCIAL IMPACT FROM ABOVE USE CASES

## BETTER PATIENT OUTCOMES

### POTENTIAL SAVINGS

Important patient outcomes in LTAC, especially for those patients with respiratory muscle weakness, include more effective rehabilitation and/or stabilization of disease, better quality of life, reduction of dyspnea, better mobility or exercise capacity, improvements in ADL, reduced risk of postoperative complications, and better speech and swallow function. Improvements of these outcomes reduces utilization of healthcare resources, ED visits and hospitalization rates.

Research has documented that RMT significantly improves all of these patient outcomes across patient populations and different disorders, contributing to the reduction of the financial burden of LTAC patients.

### EXAMPLES

- PPCs after major surgery raise average costs by 30% from \$20,430 to \$26,683, amounting to a total added cost of \$611 million per year. A reduction of PPC by 50% due to preoperative RMT is associated with potential savings of \$305.5 million per year on a national level (17).
- Average cost of a dyspnea episode lies at \$6958 per patient, and dyspnea is the reason for 3.7 million ED visits per year. The significant reduction of dyspnea caused by RMT across patient populations can be expected to reduce ED visits. A 10% reduction in ED visits translates to potential annual national savings of \$2.57 billion (18)(19).

## SHORTER LENGTH OF STAY (LOS)

### POTENTIAL SAVINGS

Hospitalization represents the most important cost variable in the economic burden of long-term chronic disease. Reducing LOS significantly impacts on the financial burden of LTAC.

### EXAMPLES

- In COPD, hospitalization accounts for 45% to 50% of the total direct costs, which are estimated around \$30 billion per year (20). RMT has been shown to reduce hospitalization by 30%, resulting in potential savings of \$10 billion per year (10).
- Patients requiring prolonged mechanical ventilation account for more than 13% of ventilated patients and 37 % of

intensive care unit (ICU) costs nationally. The number of ICU patients transferred to LTACs for weaning is expected to increase substantially and will cost billions of dollars. The shorter weaning time of one technique over the other represents significant costs in terms of patients' length of stay. Based on the stated number of 11,000 ventilator-dependent patients treated by Select each year and the average cost of an ICU day with ventilator of \$5,666, reducing mechanical ventilation by just 1 day equals potential annual savings of \$62,326,000.

- Preoperative RMT reduces PPC and can significantly reduce LOS. Based on published data following lung cancer surgery, postoperative LOS was reduced from 10.7 to 6.9 days. A 4-day reduction would indicate a cost saving of around \$7512 per patient, based on average costs (21)(22).

## IMPROVED QUALITY OF LIFE

### POTENTIAL SAVINGS

QOL is an important patient outcome in LTAC. In chronic disease such as COPD, QOL directly correlates with disease severity, frequency of exacerbations, hospitalization, health care expenditure and mortality. Research among COPD patients has shown that patients with poorer QOL had higher direct medical costs (23). Improved QOL can therefore reduce disease severity, leading to reduced health care and resource utilization, directly alleviating the financial burden.

Potential savings due to improved QOL can be defined by an increase in quality-adjusted life years (QALY). Financial impact of a plus in QALY can be seen by increased productivity of patient or carers, labor productivity gains where the working age population is concerned, and reduced health-care utilization. Utilities to determine the financial impact of QALY are disease-specific and have to be determined.

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