Components of Risk and Modifiable Factors in Chronically Mechanically Ventilated Patients: Have We Fully Defined Them?

In our modern health care society, issues of enhanced quality of care in patients with highly complex medical needs is of utmost importance. The population of chronically ventilated patients using home mechanical ventilation (HMV) is growing and merits further evaluation. In a 5-year review of subjects on HMV via tracheostomy, Edwards et al¹ identified an 80% survival and 24% liberation rate from HMV. This high-risk population experiences higher rates of hospital readmission.²⁻⁴ In analyzing the clinical outcomes of children post-tracheostomy, Berry and colleagues⁵ identified that children with associated neurologic injury were at overall higher risk of readmission. However, no previous studies have specifically assessed ICU readmission prior to hospital discharge at the time of the index hospitalization.

In this issue of *RESPIRATORY CARE*, Kun and colleagues present rapid response team utilization rates and outcomes in this vulnerable population.⁶ In a detailed retrospective chart review of children requiring positive-pressure ventilation via tracheostomy while hospitalized in a non-ICU respiratory care unit, they assessed the rates of rapid response and code events. They note an increase in event rates when compared to the general hospital rapid response/code rates. Although the article by Kun et al⁶ provides an excellent initial assessment of a complex patient population, it does not elucidate the unique features that led to the event, nor does it identify possible modifiable causes or interventions that could be implemented to assist in this disparity.

This important article identifies a comparison population of “all other hospitalized children”—which presumably includes previously healthy children who were admitted for a variety of medical and surgical reasons. Thus, this population may not be the most ideal for comparison to such a high-risk group. Other populations, such as patients with complex congenital heart disease or HMV patients who did not have a rapid response/code event may represent a better comparison cohort because these popu-

lations may serve to highlight unique aspects of medically complex and vulnerable children who require HMV. In the future, it will be important to identify the characteristics of those HMV patients who, with early recognition, can be identified for intervention to prevent acute decompensation and/or escalation of care. To achieve this goal, greater detail must be obtained related to the time period before a

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rapid response/code event and the post-ICU transfer escalation of care provided. While the pediatric early warning score (PEWS) has not been shown to be predictive of mortality,⁷ it has been validated as an early warning of acute patient deterioration⁸ and is applicable in a wide range of patient populations.^{9,10} One could speculate that there may be a role for specific modifications to PEWS to prevent unplanned pediatric ICU admissions for HMV patients.

Another limitation of this study is the original time period of data collection, which concluded > 5 years ago. With advances in home ventilator technology since that time, one could wonder whether the authors' findings remain true today. In light of the fact that more than half of rapid response calls were resolved with ventilator adjustments, one must wonder whether these adjustments would have been necessary with more recent ventilator models (ie, advanced modes and increased alarm capabilities). The article by Kun et al⁶ also does not describe the common home ventilators used within their hospital system, which may further limit the generalizability of the results.

In fully describing HMV patients who had a rapid response/code event, it would be pertinent to include the post-ICU transfer data, including length of ICU stay after a rapid response/code event and specific ICU interventions initiated. As the article notes, children on HMV awaiting initial hospital discharge were at greatest risk for rapid response/code events despite being “stable” on the portable home ventilator for a period of days.⁶ It would be interesting to note whether there is a minimum number of days on home ventilation prior to transfer to the respiratory care unit that may affect rapid response/code events, and whether adjustments to the ventilator settings had been made on the respiratory care unit that may have precipi-

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tated the rapid response/code event. Children with intermittent mandatory ventilation are at higher overall risk of hospital readmission, and it would be interesting to note whether this also contributes to ICU readmission on the index hospital admission.⁵

As a related thought, medical homes have been shown to be of benefit in decreasing readmission rates, morbidity, and overall mortality,¹¹ although further study is needed. Development of complex care medical homes with integrated general medical, surgical, and subspecialty services, as well as ancillary care specialists and home medical supply groups along with quality of life and social support would represent a goal to strive toward in support of these patients and families. Extension of the medical home to the in-patient and ICU wards for fully integrative and comprehensive continuity of care would be the ideal.

We commend Kun and co-workers⁶ for highlighting the unique needs of this HMV population, which is only increasing in size and in the burden it places on our modern health care system. The selection of such a large non-ICU-based HMV population adds to the strengths of this study. Particularly with regard to rapid response/code events and pediatric ICU transfer rates, there is an obvious disparity in events when compared to the general hospital population. This population represents a high-risk group that merits this level of specific study to further describe identifiable and modifiable risk factors that may minimize clinical decompensation on a respiratory care unit and bounce back to the ICU.

With the continued growth of this vulnerable pediatric patient population, it will be important to continue to identify those who are at greatest risk for acute clinical decompensation. A modified PEWS algorithm for chronically ventilated children, which potentially includes baseline oxygen requirements, number of required suction events, and ventilator alarms over time, may be a valuable outcome of future studies in this area, and we highly encourage such research endeavors. We recognize that these children represent not only an increased utilization of the medical system, but additionally a high emotional and financial burden on families. In addition to hospital systems that can support their medical needs and minimize high-risk transfers of care, it will be important to identify measures to minimize readmission to the hospital and, just

as important, to help provide adequate support to families to care for their children at home with the ultimate goal of improving their overall quality of life.

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