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Education

EMERGENCY MEDICINE RESIDENTS' KNOWLEDGE OF MECHANICAL VENTILATION

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☐ **Abstract—Background: Although Emergency physicians frequently intubate patients, management of mechanical ventilation has not been emphasized in emergency medicine (EM) residency curricula. Objectives: The objective of this study was to quantify EM residents' education, experience, and knowledge regarding mechanical ventilation. Methods: We developed a survey of residents' educational experiences with ventilators and an assessment tool with nine clinical questions. Correlation and regression analyses were performed to evaluate the relationship between residents' scores on the assessment instrument and their training, education, and comfort with ventilation. Results: Of 312 EM residents, 218 responded (69.9%). The overall correct response rate for the assessment tool was 73.3%, standard deviation (SD) ± 22.3. Seventy-seven percent (n = 167) of respondents reported ≤ 3 h of mechanical ventilation education in their residency curricula over the past year. Residents reported frequently caring for ventilated patients in the ED, as 64% (n = 139) recalled caring for ≥ 4 ventilated patients per month. Fifty-three percent (n = 116) of residents endorsed feeling comfortable caring for mechanically ventilated ED patients. In multiregression analysis, the only significant predictor of total test score was residents' comfort with caring for mechanically ventilated patients (F = 10.963, p = 0.001). Conclusions: EM residents report caring for mechanically ventilated patients frequently, but receive little education on mechanical ventilation. Furthermore, as residents' performance on the assessment tool is only correlated with their self-reported comfort with caring for ventilated patients, these results demonstrate an opportunity for increased educational focus on mechanical ventilation management in EM residency training.** © 2015 Elsevier Inc.

☐ **Keywords—mechanical ventilation; critical care; education; residents**

INTRODUCTION

Although emergency physicians frequently intubate critically ill patients in the emergency department (ED), management of mechanical ventilation traditionally has

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not been emphasized in emergency medicine (EM) practice and residency training curricula (1–4). Nonetheless, management of positive-pressure ventilation can influence outcomes of critically ill patients for several conditions commonly encountered in EM practice (5–10). For example, patients with asthma, once intubated, are at high risk of complications and deterioration (7). Low-tidal-volume ventilation improves mortality in patients with acute respiratory distress syndrome (ARDS) (11). Careful management of oxygenation and ventilation by emergency care providers has been shown to improve outcomes in intubated patients with traumatic brain injury (12,13). Furthermore, due to hospital crowding, emergency physicians may be primarily responsible for prolonged management of mechanically ventilated patients (14–16). Even for patients who are in the ED only briefly, evidence suggests that ventilator-induced lung injury can occur in as little as 20 min (17).

We designed this study to quantify EM residents' experience and knowledge regarding mechanical ventilation. We surveyed EM residents to assess how frequently they receive education on mechanical ventilation, frequency with which they care for mechanically ventilated patients in the ED, and their subjective comfort with managing patients on mechanical ventilation. In addition, we created an assessment tool to characterize residents' application of knowledge regarding mechanical ventilation involving common emergency scenarios. We hypothesized that the residents with the most experience in managing mechanical ventilators in the ED would perform superiorly on the knowledge assessment tool.

MATERIALS AND METHODS

Survey Instrument Development

To quantify EM residents' training experiences, we developed a 5-point Likert scale survey tool to assess residents' level of training, hours of education on mechanical ventilation, and exposure to the topic at local and national conferences (Appendix). The survey also queried residents regarding the frequency with which they care for mechanically ventilated patients and their comfort with managing ventilators. Survey responses were dichotomized as affirmative or negative: the responses "often" and "frequently" were defined as affirmative responses, whereas "never," "rarely," or "don't know" were defined as negative. Any responses left blank were scored as "don't know."

Assessment Instrument Development

A literature review did not identify preexisting assessment tools for assessing EM residents' knowledge regarding clinical issues involving mechanical ventilation. We identified one validated test with a focus on management of mechanical ventilation in the intensive care unit (ICU) designed for Internal Medicine residents, and this test served as a foundation for development of our assessment tool. A project team with backgrounds in EM and critical care, and experience in educational survey development, generated an assessment instrument with questions specific to EM (18–20). We created a series of questions involving key principles consistent with outlined objectives for resident education in mechanical ventilation, and similar in style and content to the validated test for internal medicine residents (18,21). These principles included respiratory physiology, modes of mechanical ventilation, and complications of mechanical ventilation (18,21).

The content was modified to be relevant to management of mechanically ventilated patients in the ED. Specific clinical scenarios emphasized emergency management of ventilated patients with asthma, ARDS, and traumatic brain injury, as evidence supports the importance of conscientious ventilator management in these clinical scenarios (5,7,10–12,22–28).

Our assessment tool was formatted using multiple-choice questions, an accepted means of assessing clinical competence, following guidelines recommended by the National Board of Medical Examiners (29–32). To enhance validity, candidate questions were reviewed and edited by subject experts in an iterative fashion to optimize content, length, and relevance to the assessment tool's goals. Eleven faculty members from multiple institutions, with backgrounds ranging from community EM, academic EM, pulmonology/critical care, trauma surgery, anesthesiology, and critical care medicine, critically reviewed the survey and assessment tool. The faculty provided further comment, review, and editing of the questions.

To assess validity regarding the response process, the survey and assessment tool were then piloted with faculty and senior EM residents to assess question clarity, to determine survey length, and identify potentially redundant questions (33,34). After piloting, the project was reviewed for final approval by EM faculty with critical care fellowship training who were not originally involved in the first two iterations of the survey development.

Study Protocol

The finalized versions of the survey and assessment tool were administered anonymously using Research Electronic Data Capture (REDCap, Nashville, TN) tools hosted at Massachusetts General Hospital (35). REDCap is a secure, Web-based application designed to support