The epidemiology of mechanical ventilation use in the United States*

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LEARNING OBJECTIVES

After participating in this educational activity, the participant should be better able to:

1. Interpret outcomes of critically ill patients requiring mechanical ventilation.
2. Evaluate costs associated with mechanically ventilated patients in intensive care units.

Unless otherwise noted, the faculty's, staff's, and authors' spouse(s)/life partner(s) (if any) have nothing to disclose.

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Objective: **Few contemporary population-based data exist about the incidence, patient characteristics, and outcomes of mechanical ventilation in acute care hospitals. We sought to describe the epidemiology of mechanical ventilation use in the United States.**

Design: **Retrospective cohort study using year 2005 hospital discharge records from six states. National projections were generated from age-, race-, and sex-specific rates in the cohort.**

Setting: **Nonfederal acute care hospitals.**

Patients: **All discharges that included invasive mechanical ventilation identified using International Classification of Diseases, 9th Revision, Clinical Modification procedure codes (96.7x).**

Interventions: **None.**

Measurements and Main Results: **Of 6,469,674 hospitalizations in the six states, 180,326 (2.8%) received invasive mechanical ventilation. There was a wide age distribution with 52.2% of patients <65 yrs of age. A total of 44.6% had at least one major comorbid condition. The most common comorbidities included diabetes (13.2%) and pulmonary disease (13.2%). Inhospital mortality was 34.5%, and only 30.8% of patients were discharged home from the hospital. Almost all patients received care in urban (73.5%) or suburban (23.6%) hospitals vs. rural hospitals (2.9%). Patients in urban hospitals experienced a higher number of organ dysfunctions, more dialysis and tracheostomies, and higher mortality compared with patients in rural hospitals. Projecting to national estimates, there were 790,257 hospitalizations involving mechanical ventilation in 2005, representing 2.7 episodes of mechanical ventilation per 1000 population. Estimated national costs were $27 billion representing 12% of all hospital costs. Incidence, mortality, and cumulative population costs rose significantly with age.**

Conclusions: **Mechanical ventilation use is common and accounts for a disproportionate amount of resource use, particularly in urban hospitals and in elderly patients. Mortality for mechanically ventilated patients is high. Quality improvement and cost-reduction strategies targeted at these patients are warranted. (Crit Care Med 2010; 38:1947–1953)**

KEY WORDS: mechanical ventilation; critical care; intensive care unit; epidemiology; United States

***See also p. 2067.**

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Acute respiratory failure occurs for a variety of reasons, including pulmonary disease, neuromuscular disease, shock, the need for airway protection, or the need for temporary respiratory support after major surgery (1). For patients with acute respiratory failure, invasive mechanical ventilation can be a life-sustaining intervention, yet mechanical ventilation is also labor-intensive and extraordinarily costly. The vast majority of mechanically ventilated patients require admission to an intensive care unit (ICU), and the daily incremental cost of mechanical ventilation for ICU patients is estimated at between $600 and $1500 per day (2, 3).

Several evidence-based therapies for patients receiving mechanical ventilation exist (4–7), and mechanically ventilated patients are a frequent target for large-scale quality improvement initiatives (8). Consequently, information about the incidence, patient characteristics, and outcomes of patients requiring mechanical ventilation is important from both a clinical and a health policy perspective. However, few current data exist about the epidemiology of mechanical ventilation. Prior studies are either limited to narrow geographic areas or relatively outdated with respect to current healthcare delivery (9–12). Additionally, few studies have examined how the scope and scale of mechanical ventilation vary in different clinical settings such as urban and rural areas or hospitals of varying size (13, 14). Contemporary, nationally representative data on the incidence and outcomes of mechanical ventilation use would aid clinicians and policymakers with resource

Table 1. Demographics and clinical characteristics of patients who received mechanical ventilation in six states[a]

Variable	All Patients	By Hospital Location: Rural	Suburban	Urban	p^b	By Hospital Size[d]: <100 beds	100–199 Beds	200–299 Beds	≥300 Beds	p^b
Number					—					—
Hospitals, n	690	87	203	401		177	237	132	144	
Hospitalizations, n	180,326	5229	42,588	132,509		7898	39,620	45,162	87,463	
Age					<.001					<.001
1–19	3.0	0.1	2.8	3.2		2.8	0.9	2.9	4.0	
20–64	44.8	41.3	47.5	44.1		43.7	42.1	43.1	47.0	
65–79	31.4	37.3	32.1	30.9		33.2	34.1	31.7	29.8	
≥80	20.8	21.3	17.6	21.9		20.3	22.9	22.3	19.2	
Male sex	51.5	50.0	52.3	51.3	.001	49.5	49.4	51.8	52.5	<.001
Race					<.001					<.001
White, non-Hispanic	57.7	67.6	59.5	56.7		62.4	61.3	57.0	55.9	
Black	16.5	8.6	8.4	19.5		10.2	14.4	15.8	18.4	
Hispanic	10.5	10.8	12.7	9.8		9.8	8.6	8.9	12.3	
Other	15.3	13.0	19.4	14.1		17.6	15.7	18.3	13.4	
Comorbidities, no.					<.001					<.001
0	55.4	48.7	55.8	55.5		53.9	53.4	55.3	56.5	
1–2	42.5	48.6	41.9	42.5		44.1	44.4	42.6	41.5	
≥3	2.1	2.7	2.4	2.0		2.0	2.2	2.2	2.0	
Specific comorbidities										
AMI	1.7	1.8	1.7	1.6	.57	1.9	1.7	1.7	1.6	.008
Dementia	0.5	0.5	0.4	0.5	<.001	0.6	0.5	0.5	0.5	.043
Pulmonary disease	13.2	20.4	15.1	12.3	<.001	16.8	15.5	13.4	11.8	<.001
Diabetes	15.4	20.1	15.9	15.0	<.001	17.4	17.2	15.3	14.4	<.001
Chronic renal failure	3.4	3.7	3.1	3.5	.001	2.4	3.4	3.8	3.3	.006
Chronic liver disease	3.8	3.2	3.7	3.9	.035	3.5	3.3	3.7	4.1	<.001
Metastatic cancer	4.2	3.7	3.4	4.4	<.001	3.3	3.9	4.2	4.3	.005
HIV	1.7	0.5	0.8	2.0	<.001	0.9	1.1	1.5	2.1	<.001
Primary diagnosis										
Trauma	1.7	0.6	2.4	1.5	<.001	1.7	0.5	1.7	2.3	<.001
Surgical, nontrauma	27.3	24.2	28.1	27.2	<.001	23.4	24.0	25.5	30.1	<.001
Medical, nontrauma	71.0	75.2	69.5	71.3	<.001	74.9	75.6	72.7	67.6	<.001
Organ dysfunction										
Cardiac	18.4	16.0	17.2	18.9	<.001	15.4	18.8	18.7	18.4	.71
Hematologic	7.5	5.4	6.8	7.8	<.001	6.0	6.9	7.0	8.1	<.001
Hepatic	1.9	1.6	1.8	1.9	.061	2.0	1.8	1.7	2.0	.004
Neurologic	7.3	6.8	7.7	7.2	.001	7.1	8.1	7.7	6.8	<.001
Renal	20.7	16.0	17.8	21.8	<.001	16.5	20.2	20.6	21.4	<.001
Procedures										
Dialysis[c]	6.2	4.3	5.2	6.6	<.001	3.1	5.4	6.1	6.8	<.001
Tracheostomy	7.5	3.9	6.9	7.8	<.001	5.1	6.3	7.8	8.1	<.001
Length of mechanical ventilation					<.001					<.001
<96 hrs or unknown	59.5	71.0	64.0	57.7		64.7	62.1	60.7	57.4	
>96 hrs	40.5	29.0	36.0	42.3		35.3	37.9	39.3	42.6	

AMI, acute myocardial infarction.

[a]All values for characteristics are percents; [b]*p* values are for chi-square test or chi-square test for trend; [c]includes dialysis for acute renal failure as well as dialysis provided during the hospitalization for chronic renal failure; [d]excludes 183 hospitalizations missing information on bed number.

Other than the hospitals and hospitalizations variable, which are numbers, all variable numbers are percents.

allocation decisions and help prioritize efforts to improve health outcomes and reduce healthcare costs.

The purpose of this study was to examine the epidemiology of mechanical ventilation use in the United States. We used a large, nationally representative database constructed of discharge data from six states to describe the incidence, patient characteristics, and outcomes of mechanical ventilation and compare these variables across key practice settings. Participants in this CME activity will be better able to explain both the outcomes in patients with mechanical ventilation and the costs associated with mechanical ventilation in critically ill patients.

MATERIALS AND METHODS

Study Design and Data Sources. We performed a retrospective cohort study using the 2005 hospital discharge records from six US states: Maryland, Massachusetts, New Jersey, New York, Texas, and Washington. Data were obtained from the Agency for Healthcare Research and Quality's Healthcare Costs and Utilization Project, which maintains a clearinghouse of state hospital discharge data for research purposes (www.hcup-us.ahrq.gov/sidoverview.jsp). These states were chosen as a result of the size and quality of their state discharge records, including the availability of codes that allow accurate identification of specific hospitals and patient-level ICU use. Data for 2005 were chosen as a result of the ready availability of data from this year at the start of the analyses period (2007). Together these states comprise 23.4% of the US population, including a broad range of urban and rural regions of varying socioeconomic status. The records contain complete administrative data on inpatient hospitalizations, including patient demographic information, resource use, and International Classification of Diseases, 9th Revision, Clinical Modification diagnostic codes. For hospital characteristics, data were obtained from the 2005 Centers for Medicare and Medicaid Inpatient Prospective Payment Impact File and from the Centers for Medicare and Medicaid Healthcare Cost Reporting Information System. Population estimates for 2005 were obtained from the US Census Bureau.

Patients and Variables. All patients undergoing mechanical ventilation in the six states during hospitalization were eligible for the analysis. We excluded neonates because the indications and outcomes of neonatal acute respiratory failure vary markedly from respiratory failure in other patients (15). We identified patients undergoing mechanical ventilation by the International Classification of Diseases, 9th Revision, Clinical Modification procedure codes 96.70, 96.71, and 96.72 (mechanical ventilation–time unspecified, <96 consecutive hours, and ≥96 consecutive hours, respectively) (16). ICU admission was defined using critical care-specific resource use codes, including intensive care, coronary care, or intermediate care (17). Patient demographics and outcomes were obtained directly from the discharge records. Clinical characteristics were obtained using International Classification of Diseases, 9th Revision, Clinical Modification diagnosis and procedure codes. Comorbidities were defined using the Deyo modification of the Charlson comorbidity score (18, 19), and other key diagnoses and procedures, including trauma, major surgery, dialysis and organ dysfunctions, were defined using Diagnosis Related Groups or other diagnosis and procedure codes as previously described (20). Classifying acute organ dysfunction is particularly challenging with debate over the choice of measurements and the number of systems to measure. We constructed our system as previously used by Angus et al (20) by selecting International Classification of Diseases, 9th Revision, Clinical Modification codes suggestive of new-onset dysfunction and excluded gastrointestinal failure (other than hepatic failure) because it is difficult to define.

Outcomes of interest included hospital mortality, hospital length of stay, discharge destination, and total hospital costs. We grouped discharge destination as home, other acute hospital, skilled care facility, or other. We estimated total costs by multiplying total charges by the hospital-specific cost-to-charge ratios derived from the 2005 Centers for Medicare and Medicaid Impact file (21). Hospitals were classified by hospital location (urban, suburban, or rural according to Centers for Medicare and Medicaid designation) and hospital size based on number of hospital beds (<100, 100–199, 200–299, ≥300).

Analysis. We performed three main analyses: an analysis of patient characteristics and outcomes by hospital type; an analysis of incidence, clinical outcomes, and costs by patient age; and a national estimation of the incidence and costs of mechanical ventilation use extrapolating from the six-state sample. We summarized patient characteristics and outcomes using percentages, means with SDs, and medians with interquartile ranges as appropriate. We compared patient demographics, clinical characteristics, and outcomes across hospital types using analysis of variance for continuous variables and chi-square tests for categorical variables. We graphically ana-

Table 2. Outcomes for patients who received mechanical ventilation in six states

Variable	All Patients (n = 180,326)	By Hospital Location: Rural (n = 5229)	Suburban (n = 42,588)	Urban (n = 132,509)	p^a	By Hospital Size[b]: <100 Beds (n = 7898)	100–199 Beds (n = 39,620)	200–299 Beds (n = 45,162)	≥300 Beds (n = 87,463)	p^a
Died in hospital, %	34.5	31.2	32.3	35.3	<.001	29.0	34.6	35.4	34.5	<.001
Discharge location										
Home	30.8	30.2	34.7	29.6	<.001	30.6	28.1	30.0	32.4	<.001
Skilled nursing	28.2	23.9	26.2	29.0	<.001	23.7	28.5	28.3	28.5	<.001
Other acute hospital	4.6	13.4	4.8	4.3	<.001	14.7	6.8	4.6	2.8	<.001
Other/unknown	1.9	1.4	2.0	1.9	.001	2.0	2.0	1.8	1.9	.041
Hospital LOS, days										
All patients	14.1 ± 16.9	9.8 ± 10.8	12.2 ± 14.2	14.8 ± 17.7	<.001	12.5 ± 17.7	12.8 ± 14.9	13.8 ± 16.2	14.9 ± 17.9	<.001
Survivors	15.3 ± 16.6	10.4 ± 10.8	13.6 ± 14.2	16.1 ± 17.4	<.001	13.7 ± 18.9	13.7 ± 14.5	15.1 ± 16.1	16.2 ± 17.4	<.001
Nonsurvivors	11.8 ± 17.1	8.4 ± 10.7	9.3 ± 13.7	12.6 ± 18.1	<.001	9.8 ± 13.8	11.1 ± 15.4	11.4 ± 16.2	12.4 ± 18.5	<.001
Total costs, thousands										
All patients	34.2 ± 40.6	23.5 ± 29.3	30.4 ± 35.1	35.9 ± 42.4	<.001	30.1 ± 37.8	29.9 ± 34.4	32.5 ± 36.8	37.4 ± 44.5	<.001
Survivors	35.7 ± 40.0	23.5 ± 29.1	32.2 ± 35.6	37.5 ± 41.7	<.001	31.3 ± 38.1	30.8 ± 33.3	34.2 ± 36.8	39.1 ± 44.0	<.001
Nonsurvivors	31.4 ± 41.3	22.0 ± 29.7	26.7 ± 33.6	33.1 ± 43.5	<.001	27.2 ± 36.8	28.3 ± 36.4	29.4 ± 36.8	34.2 ± 45.5	<.001

LOS, length of stay.

[a]*p* values are for chi-square test or chi-square test for trend (died in hospital/discharge location), Student's *t* test (hospital length of stay and total costs by bed size), and one-way analysis of variance (hospital length of stay and total costs by hospital location); [b]excludes 183 hospitalizations missing information on bed number. All values are percents or mean ± SD.

lyzed variation in mortality and costs by patient age after categorizing patients into 5-year age groups. We calculated the population-based incidence of mechanical ventilation use for the six states using population data from the 2005 US Census stratified by age. For national projections, we extrapolated from the incidence of mechanical ventilation in the six states' data using age, race, and sex for direct standardization for the entire United States. Approximately 20% of patients who received mechanical ventilation did not receive intensive care. Therefore, we performed a sensitivity analysis of the outcomes (hospital mortality, hospital length of stay, and total hospital costs stratified by both hospital location and size of the hospital) excluding this group to confirm that our findings were robust when examining only patients who received intensive care. We constructed the databases in Foxpro and conducted analyses in Excel and Stata 10.0. This research involved secondary analyses of deidentified data and was reviewed and considered exempt by the Columbia University Institutional Review Board.

RESULTS

Of a total of 6,469,674 acute care hospitalizations recorded in the six states in 2005, we identified 180,326 (2.8%) patients who received invasive mechanical ventilation. Patient characteristics are shown in Table 1. Patients were generally older with 52.2% ≥65 yrs of age. The most common comorbid conditions were pulmonary disease (13.2%) and diabetes (15.4%), although 55.4% of patients had no major comorbid conditions. Nonrespiratory organ dysfunctions were also common, led by renal (20.7%) and cardiac (18.4%) dysfunction.

Patient comparisons by hospital type are also shown in Table 1. The vast majority of patients received care in urban or suburban hospitals; only 2.9% of patients received care in rural hospitals. In contrast, 4.4% of all hospitalizations occurred in rural hospitals. Mechanically ventilated patients in rural hospitals tended to be older and less racially diverse than patients in suburban hospitals. They were more likely to have major comorbid conditions, including cardiac disease, renal disease, respiratory disease, and diabetes. However, they were less likely to experience nonrespiratory organ dysfunctions, receive dialysis, or undergo tracheostomy. Similar relationships were found in large vs. small hospitals. Patients in smaller hospitals (<300 beds) were more likely to be ≥65 yrs of age and white, tended to have more comorbid conditions, but were less likely to experience nonpulmonary organ dysfunctions, receive dialysis, or undergo tracheostomy.

Clinical outcomes and costs are shown in Table 2. Overall inhospital mortality was 34.5% with lower mortality in rural and suburban hospitals compared with urban hospitals. Mean length of stay was 14.1 (±16.9) days, accounting for 7.1% of hospital days in the six states during the study period. Length of stay was shorter in rural and smaller hospitals not only among all patients, but also when separated between survivors and nonsurvivors. Mean hospitals costs were $34,257 (±40,559) with lower average costs in rural and small hospitals. Sensitivity analysis, restricting the cohort to patients who received mechanical ventilation and also received intensive care (n = 158,899 [88.1%]), demonstrated similar outcome patterns across hospitals by location and size (see Appendix). Mean costs per patient showed a bimodal distribution with relatively high costs among pediatric patients and patients aged 40 to 65 yrs (Fig. 1*A*), which was a consistent pattern among both survivors and nonsurvivors. Yet, as a result of higher incidence, cumulative costs were largely driven the by elderly population; 50.5% of total costs were attributable to patients aged ≥65 yrs, and 81.4% of total costs were attributable to patients aged ≥45 yrs (Fig. 1*B*). Both population incidence and inhospital mortality also rose significantly with age (Fig. 2).

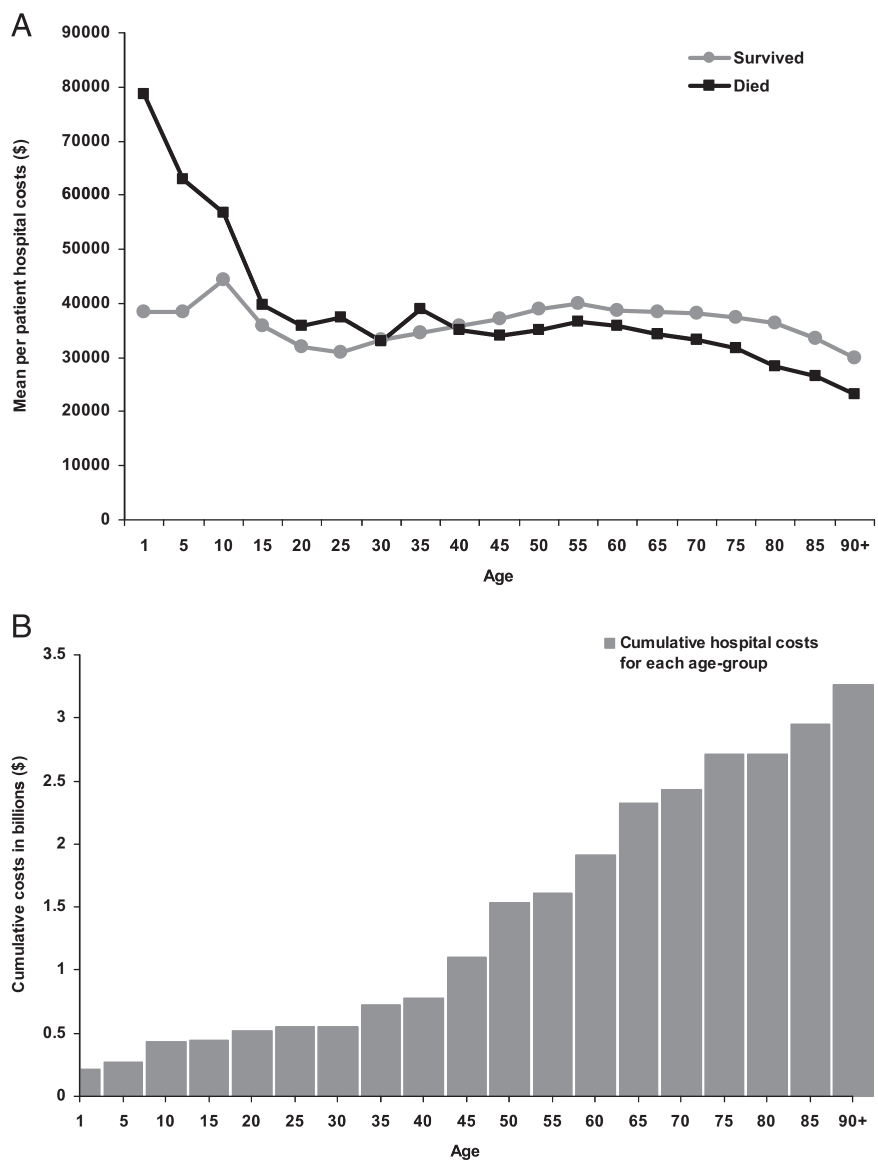

Figure 1. *A*, Age-specific mean hospital costs per patient stratified by survival status at hospital discharge for patients receiving invasive mechanical ventilation. *B*, Total (cumulative) hospital costs by age-group for patients receiving invasive mechanical ventilation (for six US states).

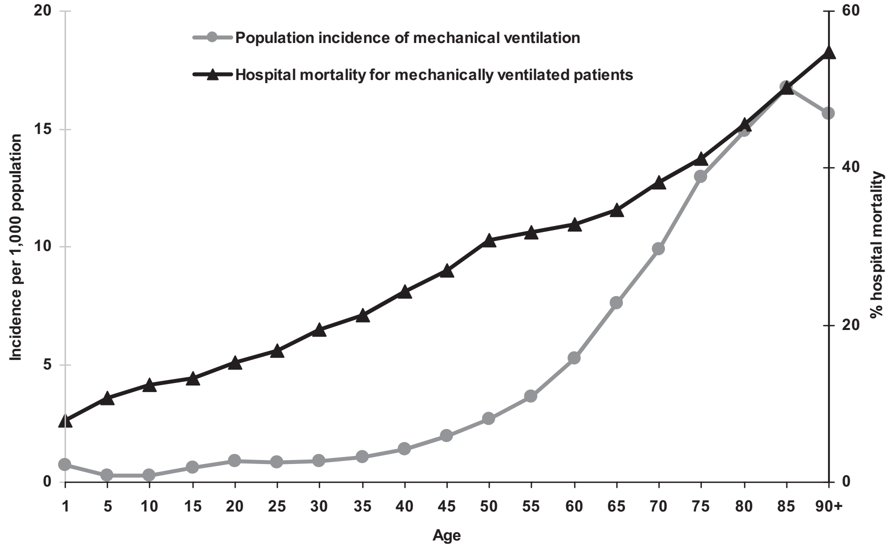

Figure 2. Age-specific incidence (per 1000 population) and inhospital mortality for patients receiving invasive mechanical ventilation.

Table 3. National estimates for mechanical ventilation use in 2005

Variable	National Estimates
Total US population	296 million
Total MV hospitalizations	790,257
MV hospitalizations per 1,000 population	2.7
Total hospital deaths with MV	273,412
Deaths per 1000 population	0.9
Total hospital costs	$27.0 billion

MV, mechanical ventilation.

Projecting to national estimates, there were 790,257 hospitalizations with mechanical ventilation in 2005 (Table 3). This represents 2.7 episodes of mechanical ventilation per 1000 population and 0.9 deaths per 1000 population. National costs are estimated to total $27.0 billion, representing 12.0% of all hospital costs.

DISCUSSION

In a large, population-based sample of hospitalizations, invasive mechanical ventilation was common and associated with high mortality. Resource use among mechanically ventilated patients was also extremely high. Although patients receiving mechanical ventilation represent only a small proportion of hospitalizations, they account for a much larger proportion of hospital days and costs with the overall costs of care exceeding $27 billion. Our findings highlight the continuing need for efforts to improve clinical outcomes and reduce costs in this population and provide renewed justification for prioritizing acute respiratory failure and mechanical ventilation in national research and policy initiatives.

We found that the clinical and economic burden of mechanical ventilation is greatest in urban and suburban hospitals, where the vast majority of patients receive care. Many recent efforts to improve and standardize critical care delivery are focused on rural hospitals (22), especially ICU telemedicine, which is increasingly used to provide critical care expertise in small rural hospitals (23, 24). Our findings suggest that quality improvement efforts in urban areas are equally, if not more, important given the overwhelming numbers of urban mechanically ventilated patients. These results also provide some justification for urban-focused policy recommendations, especially when those recommendations carry substantial costs such as the efforts of the Leapfrog Group for Patient Safety to improve physician staffing of ICUs (25).

We found that the mortality and cumulative costs of mechanical ventilation increase dramatically with age. These higher costs may be largely driven by the complex interplay between case mix and the length of hospital stay. These results mirror other findings indicating that the incidence of critical illness syndromes such as sepsis and acute lung injury rises in older populations (14, 20). Indeed, the majority of patients in our sample were aged >65 yrs. These findings call attention to the importance of mechanical ventilation for Medicare, the largest purchaser of health care for elderly Americans. Policymakers seeking to curb Medicare spending might consider focusing on this high-cost patient group. Our results also highlight the need for better understanding of how severe acute illness impacts and is modified by the aging process (26, 27). Research into how aging increases susceptibility to critical illness and how critical illness effects the aging process is warranted (28).

A small proportion of patients in our sample required care in another acute care hospital. Data suggest that the majority of these patients are transferred to better-resourced hospitals (29). The transfer of such patients may contribute to the higher hospital mortality and increased resource use at large urban hospitals because patients who require transfer tend to have high severity of illness and mortality (30). A large number of patients receiving mechanical ventilation in our cohort also ultimately required care in a skilled care facility after discharge from an acute care hospital. Postacute hospital care plays an important role for patients recovering from critical illness, because patients frequently experience neuromuscular weakness, neurocognitive deficits, and emotional disability that limit the ability to function independently at home (31), yet postacute care is also extremely costly to the health system. A better understanding of the medical and social determinants of postacute care after mechanical ventilation as well as the development of potential strategies to reduce postcare use are needed.

Our work has several limitations. We identified mechanical ventilation use using International Classification of Diseases, 9th Revision, Clinical Modification procedure codes. Although prior studies demonstrated high sensitivity and specificity of these codes in hospitalized patients, we cannot rule out misclassification as well as potential biases in coding by physicians (16). Although this code is not used for patients receiving mechanical ventilation purely in an operating room, some patients may have received temporary ventilator support after surgery but outside the ICU. Indeed, approximately 20% of patients did not have concomitant ICU admission according to our definition. These patients might not have true acute respiratory failure as we might expect.

We also chose to limit the stratification of mechanical ventilation. Many other potential descriptors exist that could be used to stratify hospitals and patients who receive mechanical ventilation. We chose to examine a few key descriptors of hospitals that we felt provided the most meaningful information regarding care patterns in the United States, such as hospital size and location, that would be of use in helping to target performance initiatives. Additionally, we examined mechanical ventilation in only six states. Although these states represent an extremely large population-based cohort, they may not be representative of the United States as a whole. The six states we used may, in particular, have some socioeconomic differences compared with other states with more rural areas. Our goal was to provide estimates of national rates of mechanical ventilation with sufficient detail to inform health policy, and we feel it is unlikely that these estimates would change dramatically with more detailed adjustment. Our data are limited to acute care hospitalizations, and we did not have information on mortality after hospital discharge. Finally, mechanical ventilation is an intervention, not a disease state. The patients in this cohort are heterogeneous with respect to their underlying cause of respiratory failure, and these data lack sufficient clinical detail to clearly delineate the indications for mechanical ventilation. Future studies are needed to examine the causes of respiratory failure in a population-based patient sample.

Overall our study confirms that mechanical ventilation use is an important healthcare issue associated with substantial mortality, morbidity, and resource use in the United States. Continuing efforts are warranted to understand the factors related to mechanical ventilation at the population level, examine the reasons underlying the high mechanical ventilation use at the end of life, and ultimate improve outcomes for this high-risk, high-cost patient group.

At the conclusion of this CME activity, participants will be better able to explain both the outcomes in patients with mechanical ventilation and the costs associated with mechanical ventilation in critically ill patients.

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Appendix. Distribution of outcomes for mechanically ventilated patients who also received intensive care services

Variable	All Patients (n = 158,899)	By Hospital Location: Rural (n = 4636)	Suburban (n = 39,275)	Urban (n = 114,988)	*p*	By Hospital Size[a]: <100 Beds (n = 6776)	100–199 Beds (n = 35,054)	200–299 Beds (n = 40,282)	≥300 Beds (n = 76,632)	*p*
Died in hospital, %	34.0	30.0	32.0	34.8	<0.001	29.1	34.2	34.9	33.8	<0.001
Discharge location										
Home	31.6	31.4	35.0	30.4	<0.001	32.1	28.6	30.4	33.5	<0.001
Skilled nursing	27.9	24.2	26.4	28.6	<0.001	23.2	28.3	28.3	28.0	<0.001
Other acute hospital	4.6	13.0	4.6	4.3	<0.001	13.4	6.9	4.6	2.8	<0.001
Other/unknown	2.0	1.3	2.0	2.0	0.005	2.1	2.1	1.8	2.0	0.028
Hospital LOS, days										
All patients	14.4 ± 16.8	10.1 ± 11.1	12.5 ± 14.1	15.2 ± 17.8	<0.001	11.2 ± 13.9	13.1 ± 15.0	14.2 ± 16.5	15.4 ± 17.9	<0.001
Survivors	15.6 ± 16.5	10.6 ± 11.0	13.8 ± 14.1	16.4 ± 17.4	<0.001	11.9 ± 14.0	14.0 ± 14.7	15.5 ± 16.3	16.7 ± 17.4	<0.001
Nonsurvivors	12.2 ± 17.2	8.8 ± 11.1	9.7 ± 13.7	13.0 ± 18.3	<0.001	9.5 ± 13.5	11.5 ± 15.5	12.0 ± 16.5	12.8 ± 18.6	<0.001
Total costs, thousands										
All patients	36.0 ± 41.5	23.9 ± 30.4	31.6 ± 35.3	38.1 ± 43.5	<0.001	29.4 ± 36.6	31.3 ± 34.7	34.0 ± 37.6	39.8 ± 45.8	<0.001
Survivors	37.3 ± 40.9	24.1 ± 30.0	33.3 ± 36.3	39.3 ± 42.7	<0.001	30.0 ± 36.1	32.0 ± 34.0	35.5 ± 37.4	41.3 ± 45.1	<0.001
Nonsurvivors	33.5 ± 42.4	23.2 ± 31.2	28.0 ± 32.9	35.6 ± 45.1	<0.001	27.9 ± 37.8	29.9 ± 36.1	31.1 ± 37.7	36.9 ± 47.1	<0.001

LOS, length of stay.
[a]n = 155 patients missing information on bed size of hospital. All values are percentages or means ± SD.