Published in final edited form as:

J Am Geriatr Soc. 2018 July ; 66(7): 1377–1381. doi:10.1111/jgs.15361.

Prognosis After Emergency Department Intubation to Inform Shared Decision Making

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Abstract

Objective: To inform the shared decision making process between clinicians and older adults and their surrogates regarding emergency intubation.

Design: Retrospective cohort study.

Setting: Multicenter, emergency department (ED)–based cohort from Vizient Clinical Data Base/Resource Manager™, formerly known as the University Health System Consortium.

Participants: We obtained de-identified data from 262 hospitals across the U.S. (>95% of U.S. non-profit academic medical centers). We included all adults aged ≥ 65 years who were intubated

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Author's Contribution: All authors meet the criteria for authorship stated in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals. Specifically, the authorship credits are based on the following: Conception and design (KO, GDJ, SH, NRG, ELA, RS, MAS, JAT, JDS, and DJP), acquisition of data (KO, GDJ, SH, MAS, and DJP), analysis and interpretation (KO, GDJ, MAS, and DJP), drafting and revising the article (KO, GDJ, SH, NRG, ELA, RS, MAS, JAT, JDS, and DJP), approval of the final manuscript (KO, GDJ, SH, NRG, ELA, RS, MAS, JAT, JDS, and DJP).

in the ED, from 2008–2015. We excluded patients with trauma and those with out-of-hospital intubation or cardiac arrest.

Measurements: Our primary outcome was age-specific in-hospital mortality. Secondary outcomes were age-specific odds of death after adjusting for race, comorbid conditions, admission diagnosis, hospital disposition, and geographic region.

Results: We identified 41,463 ED intubation encounters and included 35,036 in the final analysis. The majority (64%) were non-Hispanic whites, and 54% were female. The overall in-hospital mortality rate was 33% (95%CI 34–35%). 24% (24–25%) of patients were discharged to home, and 41% (40–42%) were discharged to a location other than home. The mortality rate was 29% (95%CI 28–29%) for age 65–74 years, 34% (33–35%) for age 75–79 years, 40% (39–41%) for age 80–84 years, 43% (41–44%) for age 85–89 years, and 50% (48–51%) for age 90 years.

Conclusion: After emergency intubation, 33% percent of older adults die during the index hospitalization. Only 24% of survivors are discharged to home. Simple, graphic representations of this information, in combination with an experienced clinician's overall clinical assessment, will support shared decision making regarding unplanned intubation.

Keywords

emergency department; mortality; intubation

Introduction

For older adults, whether to undergo intubation and mechanical ventilation is a momentous decision, for which patients need expert guidance. Since intubation in older adults is a high-risk intervention with uncertain or variable efficacy, shared decision making may be appropriate.¹ Shared decision making rests upon a foundation of data on the consequences of available actions. Lack of data on the prognosis of older patients intubated emergently limits clinicians' ability to help patients decide what to do at this critical moment.

Emergency intubation of older adults is becoming more frequent and is expected to double between 2001 and 2020.^{2,3} Older adults who are intubated may not survive, and when surviving, may have a very low quality of life.⁴ More than 70% of older adults with serious illness prioritize quality of life and quality of dying over longevity and consider some health states worse than death.⁵ Yet most (56–99%) older adults do not have advance directives available at the time of emergency department (ED) presentation.⁶

In 2016, the Society of Academic Emergency Medicine Consensus Conference released a consensus statement on the state of shared decision making in the ED,⁷ emphasizing that improving shared decision making in palliative and end-of-life care is paramount to improving emergency care. However, limited data are available to guide shared decision making in this setting. Prior studies of the prognosis after emergency intubation have been limited by: small sample sizes,^{8–10} lack of focus on older adults,¹¹ focus only on specific disease groups,^{12,13} and lack of inclusion of patients who died in the ED.¹⁵ Data specific to older adults in the ED setting are needed to inform shared decision making discussions. We

analyzed a large national dataset to ascertain in-hospital mortality and discharge dispositions for older adults intubated in the ED.

Methods

Study Design and Setting

We conducted a retrospective cohort study of older adults, using patient-level administrative data from Vizient, a consortium of >117 academic medical centers and >300 affiliated hospitals across the US, representing >95% of U.S. non-profit academic medical centers.¹⁶ Data were contributed by 262 hospitals and included demographics (age, sex, race, ethnicity), procedure codes, ICD-9 diagnosis codes, length of stay and in-hospital mortality. Participating institutions submitted all data monthly, and Vizient reviewed each submission for quality. Our IRB approved the study. We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines to ensure clear and complete reporting of our study design, conduct, and findings.¹⁷

Cohort Selection

We included all encounters with intubations in the ED for adults aged ≥65 years from 1/1/2008–12/31/2015 using the same procedure codes from prior studies.^{2,11} We excluded encounters with evidence of trauma in the admission diagnosis, and those with out-of-hospital intubation or cardiac arrest.

Outcomes

Our primary outcome was in-hospital mortality. Secondary outcomes were hospital and ICU length of stay, hospital disposition, and predictors of in-hospital mortality.

Predictors of Interest

Based on prior research, we determined *a priori* that the following were potential predictors of mortality: age,¹⁸ sex, race,¹⁹ co-morbidity present on admission (quantified by the Charlson Comorbidity Index [CCI]),¹⁵ origin (home, nursing home, hospice, another hospital),²⁰ admission diagnosis,^{13,21} and insurance status.

Statistical Analysis

In-hospital mortality was our primary outcome. We analyzed the bivariate association of each candidate predictor with this outcome, using χ^2 . Variables significantly associated with our outcome ($p < 0.05$) were included in the multivariable logistic regression model. These were: age, race, co-morbidity present on admission, origin, admission diagnosis, and geographic region. We categorized admission diagnosis according to a diagnostic grouping approach described previously.²² We used seven most frequent diagnostic categories: sepsis (038*, 995.9*, 785.52), gastrointestinal bleed (578*), congestive heart failure (428*), pneumonia (507*, 481*, 482*, 483*, 485*, 486*), respiratory failure (518*, 786*, 491*), altered mental status / seizure (780*), and cerebrovascular accident (430*, 431*, 432*, 433*, 434*, 436*, 437*).

We excluded variables that were collinear using the Variance Inflation Factor >10 in our multivariable model. We tested goodness-of-fit using the Hosmer–Lemeshow test. We excluded observations with missing variables in the multivariable model, but performed a sensitivity analysis in which we included those observations. Stata version 14.1 (StataCorp, Texas, U.S.A.) was used to perform all analyses.

Results

We identified 41,463 adults who were intubated in the ED, 54% female, 64% non-Hispanic white. We included 35,036 in the final analysis due to missing variables (Figure 1). The CCI was 3 for 51%. Most (75%) came to the ED from home. In this group, only 27% were discharged to home after the index hospitalization. In all comers, only 24% were discharged to home. The overall in-hospital mortality rate was 33%. The mortality rate ranged from 29% (95%CI 28–29%) in those aged 65–74, and 50% (48–51%) in those aged ≥90. Among survivors, 63% were discharged to locations other than home. The median length of stay was 9 days (IQR 5–15) for survivors, and the median time to death was 3 days (IQR 1–8) for decedents. Eighty-four percent of the decedents died within 10 days of intubation. Figure 2 is a graphical representation of these data, which will be useful for shared decision making discussions.

In our multivariable model, no variables were collinear (the mean Variance Inflation Factor=1.01), and the model fitness was appropriate (the Hosmer–Lemeshow test, $p=0.22$). As compared to those aged 65–74 years, those older than 89 had 2.6 times higher odds of death controlling for race, admission source, comorbid conditions, admission diagnosis, and geographical region (95%CI, 2.4–2.9). Those arriving from another hospital had 70% higher odds of dying in the hospital when compared to those arriving from home (95%CI, 1.5–1.9). Those with a CCI>4 had a 1.5 times higher (95%CI, 1.4–1.6) odds of death compared to those with a CCI=0, controlling for previously mentioned confounders. Admission diagnoses of cerebrovascular accident (OR=2.4; 95%CI, 2.2–2.6) and sepsis (OR=1.5; 95%CI, 1.4–1.6) were associated with greater in-hospital mortality when compared to all other admission diagnoses. Black patients had 20% lower odds of dying in-hospital as compared to white patients. Patients from the Midwestern Region had 10% lower odds of dying as compared to those from the Mid-Atlantic Region. Admission diagnoses of CHF (OR=0.5; 95%CI, 0.4–0.7), respiratory failure (OR=0.5; 95%CI, 0.5–0.6), and altered mental status/seizure (OR=0.7; 95%CI, 0.7–0.8) were associated with lower odds of dying in-hospital (Table 1.)

Observations missing key variables were excluded from the multivariable analysis: in-hospital mortality ($n=8$), geographical regions ($n=93$), and admission diagnosis category ($n=6334$). Our sensitivity analysis including the missing variables did not change the distribution of independent variables. Further, the p -values and odds ratios did not change in the multivariable analysis. Therefore, the missing variables are likely missing at random and did not influence our analysis.

Discussion

Shared decision making between clinicians and patients/surrogates depends upon the availability of information regarding the predicted outcomes. This study demonstrates that 33% of older adults intubated in the ED die in the hospital, with mortality increasing markedly with age, reaching 50% among those aged ≥ 90.

Prior studies of post-intubation mortality have not focused specifically on older adults,¹¹ only analyzed patients with specific diagnosis (e.g., acute respiratory distress syndrome),¹³ and used older data.¹⁵ Our study investigated the mortality specifically for older adults with various diagnoses who were intubated, using a large and most recent nationally-representative dataset (2008–2015). Our results are confirmatory of findings demonstrated in several previous studies, showing that high in-hospital mortality is common among older adults requiring intubation (20%–60%).¹³ We focused specifically on how to graphically communicate this baseline risk of mortality to older adults to facilitate the shared decision making process.

A quarter of patients survived the hospitalization and were discharged home. More than half of survivors were discharged to a location other than home. The proportions of survivors who were discharged to locations other than home ranged from 35% to 43% across age groups. A prior study showed that as many as 13% of survivors would require prolonged mechanical ventilation.²³ In older adults requiring prolonged mechanical ventilation, 35% will never meet the criteria for weaning from the ventilator and have 65% probability of dying in a long-term care facility, with median survival ranging from 2.1 to 4.4 months.¹⁴ Even if successfully weaned from the ventilator, 40% will have a severe functional disability after hospital discharge unless the baseline functional status was completely normal.²⁴ Most (74%) of older adults would not choose treatment if the anticipated survival comes with severe functional impairment, and many would consider a state of serious functional debility worse than death.²⁵ Our graphical representation of baseline mortality data combined with clinical information synthesized by an experienced clinician may improve the shared decision making process.

Limitations

Use of administrative data is subject to potential inaccuracy in the coding of diagnoses and procedures. We used the same method as prior similar studies to identify our cohort,¹⁵ yet non-differential misclassification may exist if intubations were not coded accurately in the medical records. Our dataset only provided information on discharge location; important post-hospitalization outcomes, including functional status, mortality, or readmission, are unknown. No information is available for patients in whom intubation was considered but not performed. Several additional clinical parameters, such as pre-ED frailty, acute illness severity, precise admission diagnoses, and ED-based treatment variables, can be strong predictors of mortality after critical illness; the lack of such information in our database was a limitation. Future studies with these clinical parameters will likely improve the predictability yet would not have the generalizability of our study. Further, we developed our tool to provide a simple, graphic representation of the baseline risk of mortality. Using our

tool, experienced clinicians can incorporate acute clinical parameters in their overall clinical assessments during the shared decision making conversations. Our data had a significant number of observations with missing admission diagnoses (n=6334); however, our sensitivity analysis did not reveal any bias attributable to missingness.

Conclusion

Clinicians in the fields of primary care, oncology, palliative care, and emergency medicine may find themselves discussing goals of care with patients and their caregivers, and whether or not to undergo intubation should it become indicated is one important consideration. During shared decision making, patients aged 65 and their surrogates can be informed that, after intubation, the overall chance of survival and discharge to home after the index hospitalization is 24%. There is a 33% chance of in-hospital death, and a 67% chance of survival to hospital discharge. The chance of in-hospital death is especially high in patients aged 90 and with an admission diagnosis of cerebrovascular accident. Of survivors, 67% will be discharged to a location other than home. Data presented graphically, combined with experienced clinicians' overall clinical assessment, will be informative during shared decision making.

Acknowledgements

There is no conflict of interest or sponsor for any of the authors to be disclosed for this manuscript.

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Impact Statement:

We certify that this work is confirmatory of recent novel clinical research.

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Our study adds to the existing literature that:

1. After including patients intubated in the emergency department, the in–patient mortality for older adults placed on mechanical ventilation remains high.
2. Our shared decision making tool for clinicians can facilitate advance care planning discussions with older adults and their surrogates.

Figure 1.
Cohort Selection

Older adults can expect the following after an emergency department intubation:

Images created by Iconarray.com. Risk Science Center and Center for Bioethics and Social Sciences in Medicine, University of Michigan. Accessed 2017.06.02

Figure 2.
Shared Decision Making Tool for Clinicians
♣ Survive and return home
♣ Survive and discharge to nursing home
♣ Die in the hospital

Table 1:

Demographic and clinical predictors of in-hospital death in older adults intubated in the ED, 1/1/2008–12/31/2015 [Point Estimate (95%CI)]

	Unadjusted Mortality Rate	Odds of In-Hospital Mortality			
		Unadjusted OR		Adjusted OR [†]	
Age Group					
65–74 years (n=18,901, 46%)	29% (28–29%)	Reference		Reference	
75–79 years (n=7,708, 19%)	34% (33–35%)	1.3 (1.2–1.3)	p < 0.001	1.3 (1.2–1.4)	p < 0.001
80–84 years (n=6,877, 17%)	40% (39–41%)	1.7 (1.6–1.8)	p < 0.001	1.7 (1.6–1.8)	p < 0.001
85–89 years (n=5,167, 12%)	43% (42–44%)	1.9 (1.8–2.0)	p < 0.001	1.9 (1.8–2.1)	p < 0.001
90+ years (n=2,810, 7%)	50% (48–51%)	2.5 (2.3–2.7)	p < 0.001	2.6 (2.4–2.9)	p < 0.001
Race					
White (n=26,471, 64%)	36% (35–37%)	Reference		Reference	
Black (n=9,718, 23%)	30% (29–31%)	0.8 (0.7–0.8)	p < 0.001	0.8 (0.8–0.8)	p < 0.001
Other (n=5,274, 13%)	36% (35–38%)	1.0 (1.0–1.1)	p = 0.603	1.0 (0.9–1.1)	p = 0.916
Admission Source					
Home (n=30,912, 75%)	34% (33–34%)	Reference		Reference	
Different Hospital (n=1,748, 4%)	45% (43–47%)	1.6 (1.5–1.8)	p < 0.001	1.7 (1.5–1.9)	p < 0.001
Nursing Home (n=2,832, 6%)	36% (34–38%)	1.1 (1.0–1.2)	p = 0.033	1.0 (1.0–1.1)	p = 0.123
Other (n=5,971, 14%)	36% (35–37%)	1.1 (1.0–1.2)	p = 0.004	1.1 (1.0–1.2)	p = 0.003
Charlson Comorbidity Index					
0 (n=4,032, 10%)	31% (30–33%)	Reference		Reference	
1–2 (n=16,277, 39%)	35% (34–36%)	1.2 (1.1–1.3)	p < 0.001	1.3 (1.3–1.4)	p < 0.001
3–4 (n=12,730, 31%)	34% (33–35%)	1.1 (1.0–1.2)	p = 0.007	1.2 (1.1–1.3)	p < 0.001
4 (n=8,424, 20%)	37% (36–38%)	1.3 (1.2–1.4)	p < 0.001	1.5 (1.4–1.6)	p < 0.001
Admitting Diagnosis					
CVA (n=3,471, 10%)	54% (53–56%)	2.5 (2.3–2.7)	p < 0.001	2.4 (2.2–2.6)	p < 0.001
Sepsis (n=3,920, 11%)	43% (42–45%)	1.5 (1.4–1.6)	p < 0.001	1.5 (1.4–1.6)	p < 0.001
Gastrointestinal Bleed (n=500, 1%)	38% (33–42%)	1.1 (1.0–1.4)	p = 0.154	Excluded	Excluded
Congestive Heart Failure (n=505, 1%)	23% (20–27%)	0.6 (0.5–0.7)	p < 0.001	0.5 (0.4–0.7)	p < 0.001
Pneumonia (n=1,211, 3.5%)	33% (30–35%)	0.9 (0.8–1.0)	p = 0.126	Excluded	Excluded
Respiratory failure (n=11,073, 32%)	26% (25–26%)	0.5 (0.5–0.7)	p < 0.001	0.5 (0.5–0.6)	p < 0.001
AMS/Seizure (n=5,259, 15%)	29% (27–30%)	0.7 (0.7–0.8)	p < 0.001	0.7 (0.7–0.8)	p < 0.001
Region					
Mid-Atlantic (n=7,276, 18%)	35% (34–36%)	Reference		Reference	
Mid-Continent (n=8,237, 20%)	36% (34–37%)	1.0 (1.0–1.1)	p = 0.449	1.0 (1.0–1.2)	p = 0.003
Midwestern (n=9,770, 24%)	33% (32–34%)	0.9 (0.9–1.0)	p = 0.002	0.9 (0.8–0.9)	p = 0.004
New England (n=4,809, 12%)	35% (34–35%)	1.0 (0.9–1.0)	p = 0.976	0.9 (0.9–1.0)	p = 0.593
Southeastern (n=6,307, 15%)	35% (33–36%)	1.0 (0.9–1.1)	p = 0.506	1.0 (1.0–1.1)	p = 0.202
Western (n=4,971, 12%)	36% (35–38%)	1.0 (1.0–1.1)	p = 0.167	1.0 (0.9–1.1)	p = 0.66

[†]We included age, race, the source of admission, Charlson Comorbidity Index, and region in the adjusted analysis. The analysis for the cause of admission was adjusted for all the above-mentioned variables.