

Timing of Intubation and Ventilator-Associated Pneumonia Following Injury

Heather L. Evans, MD, MS; David H. Zonies, MD, MPH; Keir J. Warner, BS; Eileen M. Bulger, MD; Sam R. Sharar, MD; Ronald V. Maier, MD; Joseph Cuschieri, MD

Hypothesis: In an emergency medical system with established rapid-sequence intubation protocols, prehospital (PH) intubation of patients with trauma is not associated with a higher rate of ventilator-associated pneumonia (VAP) than emergency department (ED) intubation.

Design: Retrospective observational cohort.

Setting: Level I trauma center.

Patients: Adult patients with trauma intubated in a PH or an ED setting from July 1, 2007, through July 31, 2008.

Main Outcome Measures: Diagnosis of VAP by means of bronchoscopic alveolar lavage or clinical assessment when bronchoscopic alveolar lavage was impossible. Secondary outcomes included time to VAP, length of hospitalization, and in-hospital mortality.

Results: Of 572 patients, 412 (72.0%) underwent PH intubation. The ED group was older than the PH group

(mean ages, 46.4 vs 39.1 years; $P < .001$) and had a higher incidence of blunt injury (142 [88.8%] vs 322 [78.2%]; $P = .002$). The mean (SD) lowest recorded ED systolic blood pressure was lower in the ED group (102.8 [1.9] vs 111.4 [1.2] mm Hg; $P < .001$), despite similar mean injury severity scores in both groups (27.2 [0.7] vs 27.0 [1.1]; $P = .94$). There was no difference in the mean rate of VAP (30 [18.8%] vs 71 [17.2%]; $P = .66$) or mean time to diagnosis (8.1 [1.2] vs 7.8 [1.0] days; $P = .89$). Logistic regression analysis identified history of drug abuse, lowest recorded ED systolic blood pressure, and injury severity score as 3 independent factors predictive of VAP.

Conclusions: Prehospital intubation of patients with trauma is not associated with higher risk of VAP. Further investigation of intubation factors and the incidence and timing of aspiration is required to identify potentially modifiable factors to prevent VAP.

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THE DEVELOPMENT OF RAPID-sequence intubation (RSI) techniques with neuromuscular blockade has markedly reduced airway complications in the emergency department (ED) setting¹ and has enabled adoption of more aggressive, earlier definitive airway management in the prehospital (PH) setting. Despite data to support the safety and benefit of PH RSI in patients with trauma, particularly in those with traumatic head injury,^{2,3} several studies report a higher rate

regular practice, and quality assessment of PH intubation.⁸

The purpose of this investigation is to establish and compare the rates, timing, and microbiology of VAP in a cohort of patients with trauma undergoing intubation in the PH setting or after arrival in the ED of a regional tertiary care facility with a well-established emergency medical system and continuous quality improvement measures.

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of ventilator-associated pneumonia (VAP) in patients who undergo intubation before arrival at the hospital,^{4,5} even after successful PH RSI.⁶ There is variation in the delivery of PH care within the United States, particularly with regard to the dramatic difference in the rates of out-of-hospital procedures performed by PH personnel.⁷ The disparity in outcomes after PH RSI may be related to a lack of uniformity in training,

A retrospective review was conducted of all consecutive adult (aged ≥ 18 years) patients with trauma who underwent endotracheal intubation before inpatient admission at a level I trauma center from July 1, 2007, through July 31, 2008. All intubations were performed by PH health care providers trained in advanced airway management, emergency medicine attending physicians, or anesthesia providers under the immediate supervision of an attending anesthesiologist. The conduct of PH RSI has been previously described.⁹ Burned, asphyxi-

Author Affiliations: Departments of Surgery (Drs Evans, Zonies, Bulger, Maier, and Cuschieri and Mr Warner) and Anesthesiology (Dr Sharar), Harborview Medical Center, University of Washington, Seattle.

METHODS

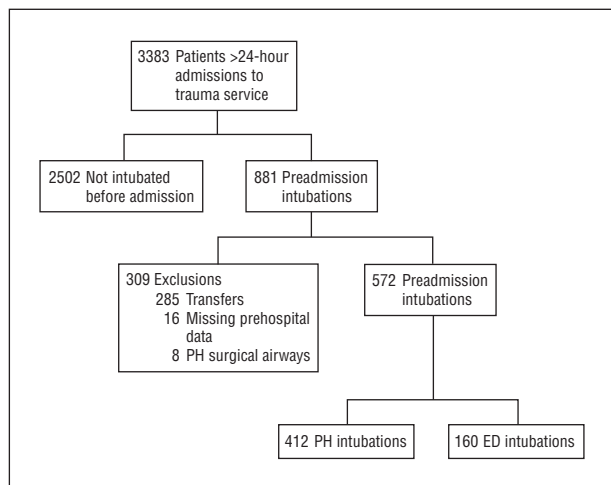


Figure 1. Flow diagram of study cohort. ED indicates emergency department; PH, prehospital.

Table 1. Baseline Characteristics of the Study Cohorts^a

	Intubation Location		P Value
	PH Group (n=412)	ED Group (n=160)	
Age, y, (SD)	39.1 (0.8)	46.4 (1.5)	<.001
Male sex	323 (78.4)	113 (70.6)	.05
Race			
White	281 (68.2)	117 (73.1)	.62
Black	55 (13.3)	20 (12.5)	
Asian	30 (7.3)	11 (6.9)	
Native American	5 (1.2)	3 (1.9)	
Other	35 (8.5)	7 (4.4)	
Unknown	6 (1.5)	2 (1.3)	
Comorbid disease			
Cardiac	13 (3.2)	20 (12.5)	<.001
Hypertension	41 (10.0)	29 (18.1)	.007
Pulmonary	15 (3.6)	15 (9.4)	.006
Hepatic	2 (0.5)	0	.38
Endocrine, diabetes	24 (5.8)	15 (9.4)	.13
Seizures	5 (1.2)	6 (3.8)	.05
Drug abuse	56 (13.6)	30 (18.8)	.12
Alcohol abuse	45 (10.9)	16 (10.0)	.75
Tobacco abuse	40 (9.7)	20 (12.5)	.33
Previous trauma	32 (7.8)	20 (12.5)	.08

Abbreviations: ED, emergency department; PH, prehospital.

^aUnless otherwise indicated, data are expressed as number (percentage) of patients. Percentages may not total 100 because of rounding.

ated, or drowned patients and those who died or were discharged within 48 hours were not included in the initial data set. Baseline characteristics, injury mechanism and severity, clinical diagnosis of pneumonia, length of stay, and in-hospital mortality were recorded. This data set was cross-referenced with a hospital quality database maintained to monitor intubations that occur outside of the operating room. Using these data sources and retrospective review of all available PH documentation, the groups intubated in the PH and ED, respectively, were defined; also, subsequent emergent reintubation, defined as unplanned intubation after the patient was discharged from the ED for hospital admission, was recorded. Transfers from other facilities, surgical airways obtained in the field or the ED, and patients without PH data were excluded from the analysis. The resulting data set was then cross-referenced with a separately maintained hospital quality database of all VAP diagnosed by

means of bronchoscopic alveolar lavage (BAL). Data were managed using commercially available software (FileMaker Pro 10, version 3; FileMaker Inc, Santa Clara, California).

Throughout the period studied, VAP was routinely diagnosed based on the findings of quantitative cultures obtained by BAL (10^4 colony-forming units [CFUs]) or brushing (10^3 CFUs). The decision to perform diagnostic BAL was made by the treating physician according to critical care unit protocols. In patients intubated for more than 48 hours, when clinical criteria suggested possible infection as delineated by Centers for Disease Control and Prevention guidelines,¹⁰ BAL or brush specimens were obtained in a standardized manner by a designated group of trained bronchoscopists. Lavage was performed by instillation of 5 aliquots of sterile saline solution, 10 mL each, in a wedged position in a subsegmental bronchus, followed by aspiration of this fluid. Clinical pneumonia was diagnosed at the discretion of the treating physician based on Centers for Disease Control and Prevention guidelines.

The primary outcome was the diagnosis of VAP. Secondary outcomes included time to diagnosis of VAP, length of hospital stay, and mortality. Time to diagnosis of VAP was calculated by subtracting the date of BAL from the date of intubation. Early VAP was defined as that occurring fewer than 4 days after initial intubation. Multiple VAP episodes were defined by multiple BAL cultures with positive findings that were at least 14 days apart or had microbiologically different results. Univariate analysis was performed using the Pearson χ^2 or the Fisher exact test for categorical variables and the 2-tailed Student *t* test or the Wilcoxon rank sum test for continuous variables. A binary multivariable logistic regression model with VAP as the dependent variable was created using candidate variables selected a priori (age, sex, race, tobacco abuse, alcohol abuse, other drug abuse, previous trauma, trauma mechanism, Injury Severity Score [ISS], chest Abbreviated Injury Score, lowest systolic blood pressure, and drug screen result). The criterion for the backward stepwise elimination was $P > .20$. Significance was set by a 2-tailed α of .05. All results reported in the final logistic model are reported as odds ratios with 95% confidence intervals. Goodness of fit of the model was assessed by the Hosmer-Lemeshow test, and the C statistic was calculated to assess discrimination. Analyses were performed using commercially available statistical software (STATA, version 10; StataCorp LP, College Station, Texas).

RESULTS

From July 1, 2007, through July 31, 2008, 3383 adult patients with trauma were admitted to our level I trauma center for at least 48 hours (**Figure 1**). Of these, 881 underwent intubation before admission. We excluded 285 transferred after intubation at other hospitals, 16 with missing the PH data, and 8 with surgical airways (performed either in the PH setting or after arriving in the ED). The remaining 572 patients (16.9%) constituted the study cohort.

Most of the study patients (412 [72.0%]) underwent PH intubation performed by paramedics at the scene of injury; of these, 226 (54.9%) underwent intubation by PH personnel who had completed University of Washington paramedic training followed by ongoing continuous quality assessment of their intubation performance through the Seattle and King County fire departments. The PH intubation group had a lower mean age, a higher percentage of male patients, and a lower incidence of cardiac and pulmonary comorbidities (**Table 1**). Although blunt trauma predominated in both groups, it was less common in the PH group than in the ED group (322

Table 2. Injury Characteristics of the Study Cohort

Mechanism of Injury	Intubation Location, No. (%)		P Value
	PH Group (n=412)	ED Group (n=160)	
MVC	166 (40.3)	77 (48.1)	.003
Pedestrian MVC	30 (7.3)	13 (8.1)	
Fall	69 (16.7)	35 (21.9)	
Other blunt trauma	57 (13.8)	17 (10.6)	
Penetrating GSW	43 (10.4)	5 (3.1)	
Penetrating stab wound	45 (10.9)	9 (5.6)	
Other penetrating trauma	2 (0.5)	4 (2.5)	

Abbreviations: ED, emergency department; GSW, gunshot wound; MVC, motor vehicle crash; PH, prehospital.

Table 3. Severity of Illness in the Study Cohort^a

	Intubation Location		P Value
	PH Group (n=412)	ED Group (n=160)	
ISS	27.2 (0.7)	27.0 (1.1)	.94
Maximum AIS	4.0 (0.1)	3.9 (0.1)	.46
Chest AIS	1.8 (0.2)	1.8 (0.1)	.30
Lowest PH SBP, mm Hg	122.4 (1.9)	125.5 (3.0)	.41
Lowest ED SBP, mm Hg	111.4 (1.2)	102.8 (1.9)	<.001
PH GCS	4.1 (0.1)	11.6 (0.4)	<.001
ED GCS	14.4 (0.1)	14.6 (0.1)	.16
Blood alcohol level, mg/dL	92.8 (5.7)	50.5 (7.9)	<.001
Positive drug screen finding, No. (%)	142 (40.2)	50 (37.3)	.35

Abbreviations: AIS, Abbreviated Injury Score; ED, emergency department; GCS, Glasgow Coma Score; ISS, Injury Severity Score; PH, prehospital; SBP, systolic blood pressure.

^aUnless otherwise indicated, data are expressed as mean (SD).

[78.2%] vs 142 [89.3%], respectively; $P = .002$), motor vehicle crashes accounted for 43.5% of the admissions (**Table 2**). The PH-intubated patients had a substantially lower average Glasgow Coma Score in the field, as well as a higher mean blood alcohol level (**Table 3**). There was no difference in Glasgow Coma Score measured in the ED, but this variable had a substantial amount of missing and internally inconsistent data. History of drug (other than alcohol) abuse and previous trauma were more common among patients intubated after arrival in the ED compared with patients intubated in the field, but this finding did not reach statistical significance. The lowest recorded ED systolic blood pressure was significantly lower in patients intubated in the ED, despite similar ISS and Abbreviated Injury Scores. Of the patients intubated in the PH setting, 164 (39.8%) had blood alcohol levels above the legal limit of 80 mg/dL compared with only 33 (20.6%) who underwent ED intubation.

The overall rate of pneumonia in this cohort of intubated patients with trauma was 17.7%. Whether VAP was diagnosed by means of quantitative culture obtained by BAL or by clinical means, the rate and timing of pneumonia were similar between the groups (**Table 4**). Length of hospital stay, in-hospital mortality rate, and the proportion of patients with brief intubations (<24 hours) were also simi-

Table 4. Outcomes of Interest by Location of Intubation^a

	Intubation Location		P Value
	PH Group (n=412)	ED Group (n=160)	
VAP	71 (17.2)	30 (18.8)	.67
Clinical	20 (4.9)	8 (5.0)	.94
BAL culture proven	51 (12.4)	22 (13.8)	.66
Time of VAP diagnosis, mean (SD), d	7.8 (1.0)	8.1 (1.2)	.89
Early VAP	33 (8.0)	16 (10.0)	.45
Multiple VAP episodes	9 (2.2)	0	.07
Hospital LOS, mean (SD), d	16.6 (1.0)	16.1 (1.1)	.79
Hospital mortality	32 (7.8)	10 (6.3)	.53
Intubated less than 24 h	117 (28.4)	39 (24.4)	.33
Subsequent intubation	42 (10.2)	3 (1.9)	.001

Abbreviations: BAL, bronchoscopic alveolar lavage; ED, emergency department; LOS, length of stay; PH, prehospital; VAP, ventilator-associated pneumonia.

^aUnless otherwise indicated, data are expressed as number (percentage) of patients.

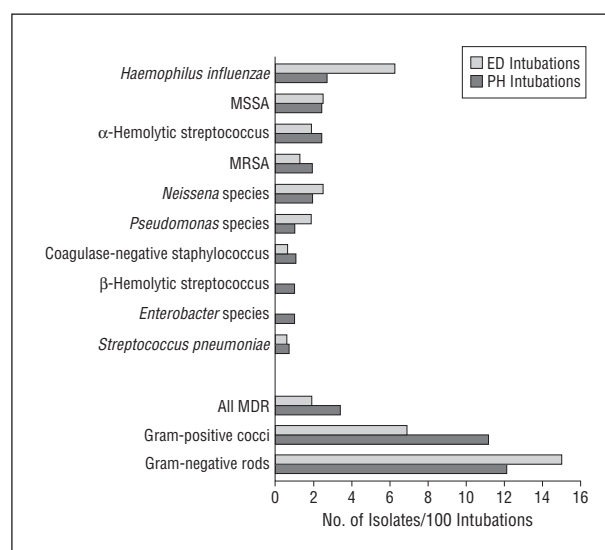


Figure 2. Causative organisms isolated from quantitative cultures of bronchoscopic alveolar lavage specimens by location of intubation. Bars represent the number of isolates that met the diagnostic threshold per 100 intubations, which may have been multiple per episode of pneumonia. ED indicates emergency department; MDR, multiple drug-resistant organisms; MRSA, methicillin-resistant *Staphylococcus aureus*; MSSA, methicillin-sensitive *S aureus*; and PH, prehospital.

lar. Nine patients in the PH group had more than 1 episode of VAP, whereas the ED group had none ($P = .06$). The rate of subsequent emergent intubation in the PH group was more than 5-fold higher than in the ED group (42 [10.2%] vs 3 [1.9%]; $P = .001$).

On average, BAL cultures yielded 1.7 different organisms in quantities sufficient for diagnosis of VAP. The top 10 causative organisms from the BAL cultures compared by location of intubation (**Figure 2**) and timing of diagnosis (**Figure 3**) are summarized along with broad categories of pathogens. *Haemophilus influenzae* was by far the most common organism isolated. Gram-negative pathogens were more common in general, except among early-onset VAP, in which *Staphylococcus* and *Streptococcus* spe-

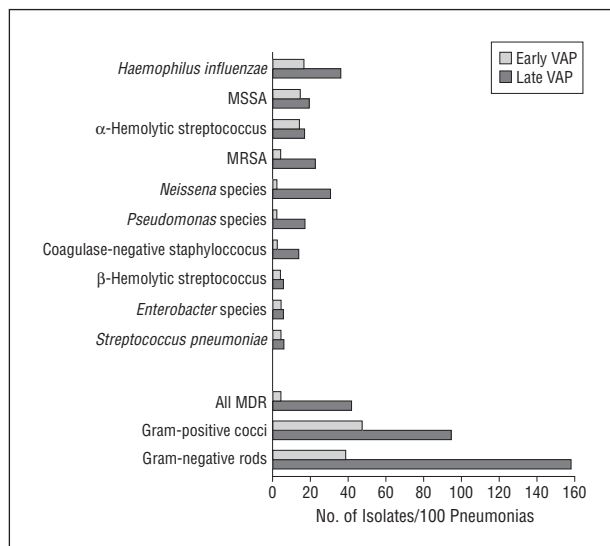


Figure 3. Causative organisms isolated from quantitative cultures of bronchoscopic alveolar lavage specimens by timing of diagnosis of ventilator-associated pneumonia (VAP). Early VAP is defined as that diagnosed after less than 4 days of mechanical ventilation. Bars represent the number of isolates per 100 pneumonias that met the diagnostic threshold, which may have been multiple per episode of pneumonia. MDR indicates multiple drug-resistant organisms; MRSA, methicillin-resistant *Staphylococcus aureus*; and MSSA, methicillin-sensitive *S aureus*.

Table 5. Univariate Comparisons of Groups With and Without Culture-Proven VAP^a

	VAP (n=73)	No VAP (n=499)	P Value
Mechanism of injury, No. (%) blunt	69 (94.5)	395 (79.2)	.002
ISS	35.5 (1.7)	25.9 (0.6)	<.001
Maximum AIS	4.5 (0.1)	3.9 (0.1)	<.001
Chest AIS	2.7 (0.2)	1.7 (0.1)	<.001
PH GCS	6.7 (0.6)	6.1 (0.2)	.28
ED GCS	13.6 (0.3)	14.6 (0.1)	<.001
Lowest PH SBP	127.3 (4.6)	122.6 (1.7)	.32
Lowest ED SBP	96.0 (3.1)	110.9 (1.1)	<.001
Hospital LOS, d	33.0 (2.6)	14.1 (0.7)	<.001
Hospital mortality, No. (%)	4 (5.5)	38 (7.6)	.51
Intubated less than 24 h, No. (%)	0	156 (31.3)	<.001
Subsequent reintubation, No. (%)	21 (28.8)	24 (4.8)	<.001

Abbreviations: AIS, Abbreviated Injury Score; ED, emergency department; GCS, Glasgow Coma Score; ISS, Injury Severity Score; LOS, length of stay; PH, prehospital; SBP, systolic blood pressure; VAP, ventilator-associated pneumonia.

^aUnless otherwise indicated, data are expressed as mean (SD).

cies predominated. There were a number of multiple drug-resistant pathogens in patients intubated in PH and ED settings, the most common of which was methicillin-resistant *Staphylococcus aureus*. There were only 2 early VAP cases in which the final BAL culture included a drug-resistant organism; both organisms were methicillin-resistant *S aureus* pneumonias.

Univariate comparison of the groups that did and did not develop pneumonia is summarized in **Table 5**. This analysis and the subsequent logistic regression were also performed after excluding patients with clinically diagnosed pneumonia, and the results were unchanged. Patients with VAP were more apt to have been admitted for

Table 6. Independent Predictors of Ventilator-Associated Pneumonia^a

Independent Predictor	OR (95% CI)
Male sex	0.51 (0.25-1.06)
Drug abuse	2.42 (1.00-5.83)
Previous trauma	0.37 (0.10-1.34)
Penetrating mechanism of injury	0.40 (0.12-1.38)
ISS ^a	1.04 (1.02-1.06)
Lowest ED SBP	0.99 (0.97-0.99)
Positive drug screen findings	0.52 (0.25-1.09)

Abbreviations: CI, confidence interval; ED, emergency department; ISS, Injury Severity Score; OR, odds ratio; SBP, systolic blood pressure.

^aC=0.74; P=.86 (Hosmer-Lemeshow test).

treatment of blunt traumatic injury, and their injury was substantially more severe as measured by the ISS and Abbreviated Injury Score. In addition, the mean (SD) chest Abbreviated Injury Score was statistically higher in the patients who developed VAP (2.7 [0.2] vs 1.7 [0.1]; $P < .001$). The mean lowest systolic blood pressure measured in the ED was lower among patients who developed VAP; in contrast, there was no difference in the mean lowest systolic blood pressure measured in the PH setting. As for outcomes, the length of stay averaged almost 18 days longer in the patients who developed VAP, but their rate of in-hospital mortality was similar to those who never developed pneumonia. Although no patient intubated for less than 24 hours developed VAP, only 31.3% of patients who did not develop VAP were intubated less than 24 hours. Ventilator-associated pneumonia was associated with a higher rate of subsequent emergent reintubation (21 [28.8%] vs 24 [4.8%]; $P < .001$).

Using backward stepwise logistic regression and the variables defined a priori (including location of intubation as a variable of interest), a final logistic model was created that identified the following 3 independent factors highly associated with development of VAP: lowest ED systolic blood pressure, history of drug abuse, and ISS (**Table 6**).

COMMENT

Ventilator-associated pneumonia is one of the key complications of critical illness, affecting as many as 27% to 44% of patients who sustain injury.¹¹ Although the attributable mortality of VAP in patients with trauma remains controversial,¹² VAP continues to contribute significant morbidity and cost, and its prevention is a focus of best practices in modern critical care. Numerous epidemiologic reviews have identified trauma as an independent predictor of the development of VAP.^{13,14} This unique susceptibility to VAP is perhaps because of increased risk of aspiration through a combination of the inability to protect the airway, immobilization, and bronchopulmonary injury, because severity of injury, emergent intubation, and decreased level of consciousness have all been implicated.¹⁵⁻¹⁸

In 1991, a prospective series¹⁸ documenting the incidence of pneumonia in patients with trauma established that emergent intubation was an independent predictor of the development of VAP, but the authors did not discriminate among intubated that occurred in the field, the ED,

or the intensive care unit. Eckert and colleagues¹⁹ performed a retrospective review of 571 patients, most of whom underwent intubation in the ED, and found that PH intubation in their emergency medical system was associated with higher rates of pneumonia (35% vs 23%) and was an independent predictor of VAP. Unlike our study, in which 412 PH intubations were performed in a year, there were only 117 PH intubations conducted during 4.5 years, and the analysis included surgical airways (n=28) and hospital transfers (n=131), implying a considerable amount of heterogeneity in PH airway management. Furthermore, the severity of injury was significantly higher in the PH-intubated group, as was also the case in 2 other reports of increased VAP rates in PH-intubated patients with trauma, which may have served to skew the results.^{5,6}

In the present yearlong study of patients with trauma undergoing emergent intubation before admission to a level I trauma center, we observed a baseline VAP rate of 17.6%. Although 72.3% of the observed VAP was diagnosed by invasive means, the rate of VAP is markedly lower than in most previously published studies^{5,6,19,20} of patients with trauma requiring emergent intubation. Furthermore, comparison of the outcomes after PH and ED intubations failed to demonstrate significant differences in the rate of pneumonia, whether VAP was diagnosed by quantitative BAL cultures or by clinical features. It is unlikely that the high rate of PH intubation was owing to excessive triage in the field because there was no difference in the percentage of brief intubations, and severity of illness measures were similar between groups. This finding is particularly notable because the severity of injury was fairly high in both groups (mean ISS >25), whereas the level of consciousness was significantly lower in the PH intubation group. We did observe a higher incidence of subsequent emergent reintubation in PH-intubated patients. This may be related to a higher incidence of head injury and alcohol intoxication in this group, conditions that can complicate the assessment of readiness for and success of extubation.^{21,22}

In comparing patients who did and did not develop pneumonia, we found that VAP was associated with a longer hospital stay, but mortality rates were similar between groups. Not unexpectedly, there was a higher percentage of blunt trauma and greater injury severity in the group that developed VAP. In particular, there was a greater severity of chest trauma in the group with VAP, and it is possible that there may have been a bias toward more bronchoscopy in this patient group because of changes on chest radiography and signs consistent with the systemic inflammatory response syndrome. Croce and colleagues²³ have long argued for raising the quantitative culture threshold to diagnose pneumonia, based on the difficulty of distinguishing between pneumonia and the systemic inflammatory response owing to trauma. It has been the practice at our institution to use 10⁴ CFUs as the quantitative diagnostic threshold, so this was used in our study definitions. In the patients who developed VAP, we also observed a higher rate of subsequent emergent reintubation, but we did not investigate the timing of reintubation with respect to the diagnosis of VAP; it may be that the need for mechanical ventilation was indeed because of the development of pulmonary infection and associated respiratory failure. We observed an expected distribution of com-

munity-acquired organisms in early-onset VAP, and more health care-associated organisms and multiple drug-resistant organisms in the late-onset VAP. Although only descriptive statistics were possible because of the small number of cultures, the microbiology of VAP appeared similar between ED- and PH-intubated groups.

While history of drug abuse was an independent predictor of development of VAP, neither blood alcohol level nor positive urine screen results for drugs of abuse were retained in the final model. This finding is contrary to 2 recent reports^{24,25} that suggest these associations in patients with trauma and burns. Owing to our high rate of field intubations, it is conceivable that drugs administered by PH personnel may account for many of the positive drug screen findings we observed, rather than drugs consumed by the patients in our study.

This study has a number of limitations inherent to its retrospective nature and the quality of reporting available in emergency care environments. It should be acknowledged that the PH and ED groups have significant differences in baseline features and injury characteristics. Despite these differences, only severity of injury and low systolic blood pressure in the ED were independently predictive of the development of pneumonia. The analysis was constrained by the varying availability of specific data from intubation documentation and errors in the calculation of the Glasgow Coma Score in our ED. We did not attempt to characterize the reason for delayed intubation in the ED, but it is likely that this group consisted of patients whose condition deteriorated over time or required treatment, such as fracture reduction, that could not be conducted without airway protection. Furthermore, it was not possible to identify when the lowest systolic blood pressure was recorded in the ED; this recording may have been a result of, rather than a prompt to, intubation. Subgroup analysis based on the indication for intubation could increase our understanding of the risk factors for development of VAP. There was no attempt to quantify aspiration and its relationship to the act of endotracheal intubation because observations were nonstandardized and rare in the medical record, precluding any comparison between groups. However, most of the intubations were conducted by personnel trained in the same rigorous manner and monitored through continuous quality improvement. The Seattle Fire Department's Medic One paramedic training program, which requires 2200 hours of instruction, provides a robust, standardized didactic and clinical experience supported by the University of Washington's Department of Anesthesiology.²⁶ For 40 years, this program, in the setting of a unique coordination of city and surrounding county fire and rescue services, has been committed to maintaining a consistently high level of early definitive care through education and innovative research.^{2,27,28} This environment provides an opportunity for additional future data collection focusing on features of aspiration and intubation difficulties.

CONCLUSIONS

Location of the patient at the time of intubation was not found to be an independent predictor of VAP, whereas injury severity, ED hypotension, and history of abuse of drugs other

than alcohol were significant contributors. Our data suggest that PH intubation can be performed safely without conferring additional risk of development of pulmonary infectious complications. On the basis of our results, we conclude that the development of VAP depends on the nature and severity of the injury rather than the location of the patient at the time of intubation. An established protocol of BAL-guided VAP diagnosis and a regimented training program in RSI for PH providers using continuous quality improvement techniques to monitor processes and outcomes may have affected our results. Within this framework, future investigations will focus on the possible modifiable factors surrounding intubation that may contribute to subsequent development of VAP in the hopes of targeting specific interventions that can prevent this common complication.

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Correspondence: Heather L. Evans, MD, MS, Department of Surgery, Harborview Medical Center, University of Washington, Campus Box 359796, 325 Ninth Ave, Seattle, WA 98104 (hlevans@uw.edu).

Author Contributions: *Study concept and design:* Evans, Warner, Sharar, Maier, and Cuschieri. *Acquisition of data:* Evans and Warner. *Analysis and interpretation of data:* Evans, Zonies, Bulger, Maier, and Cuschieri. *Drafting of the manuscript:* Evans, Warner, and Maier. *Critical revision of the manuscript for important intellectual content:* Evans, Zonies, Warner, Bulger, Sharar, Maier, and Cuschieri. *Statistical analysis:* Evans, Zonies, and Cuschieri. *Obtained funding:* Maier. *Administrative, technical, and material support:* Evans, Warner, and Maier. *Study supervision:* Bulger, Maier, and Cuschieri.

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INVITED CRITIQUE

Stay and Play?

Dr Evans and colleagues have produced an important study that addresses the relative risk of PH intubation contributing to the in-hospital risk of subsequent VAP during the hospital stay of critically injured patients. Very few data are available regarding the relative

benefits of PH intubation, and even less is known about its associated risk. This well-written article examines the relative risk of future VAP among patients with trauma intubated in the ED of a large urban tertiary referral center and compares such patients with those who are intubated in the field.