Published in final edited form as:

J Crit Care. 2016 December ; 36: 134–139. doi:10.1016/j.jcrc.2016.06.030.

Impact of early do-not-attempt-resuscitation orders on procedures and outcomes of severe sepsis^{☆,☆☆}

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Abstract

Purpose—Do-not-attempt-resuscitation (DNAR) orders are common in severe sepsis, but the impact on clinical care is not known. Our primary objective was to determine the impact of early DNAR orders on in-hospital mortality and performance of key interventional procedures among severe sepsis hospitalizations. Our secondary objective was to further investigate what patient characteristics within the sepsis DNAR population affected outcomes.

Methods—Using the 2010–2011 California State Inpatient Dataset, we analyzed hospitalizations for adults admitted through the emergency department with severe sepsis. Our primary predictor was a DNAR order, and our outcomes were in-hospital mortality and performance of interventional procedures.

Results—Visits with early DNAR orders accounted for 20.3% of severe sepsis hospitalizations. An early DNAR order was a strong, independent predictor of higher in-hospital mortality (odds ratio [OR], 4.03; 95% confidence interval, 3.88–4.19) and lower performance of critical procedures: central venous line (OR, 0.70), mechanical ventilation (OR, 0.80), hemodialysis (OR, 0.61), and major operative procedure (OR, 0.46). Among those with early DNAR orders, older age and rural location were the strongest predictors for a lack of interventional procedures.

Conclusion—Although DNAR orders are not synonymous with “do not treat,” they may unintentionally limit aggressive treatment for severe sepsis patients, especially in older adults.

Keywords

Sepsis; Resuscitation orders; Hospital mortality; Advance directives; Medical futility; Procedures

1. Introduction

Severe sepsis requires high-intensity resource utilization and results in high short-term mortality and substantial long-term morbidity among survivors [1,2]. Clinical trials show

[☆]Presentations: Presented in abstract/poster form at the 2014 American College of Emergency Physicians Research Forum; Chicago, Ill.

^{☆☆}Sources of support: None to report.

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that protocol-based early goal-directed therapy in sepsis does not significantly improve mortality outcomes compared with usual care [3–5]. However, even if it is not protocol based, early aggressive supportive care is still recommended because it improves survival [6,7]. A do-not-attempt-resuscitation (DNAR) order, which is a legal document that respects the patient's wishes to avoid cardiopulmonary resuscitation in the event of cardiac or pulmonary arrest, could prevent the aggressive supportive care that patients in severe sepsis require to optimize clinical outcomes.

Research in different areas of medicine has found that a DNAR order is independently associated with increased mortality [8–10]. One explanation for this is that an early DNAR order may limit critical hospital interventions [11]. However, many DNAR patients and their families may still want treatment associated with improved mortality and quality of life including central venous lines for vasoactive medications, short-term mechanical ventilation for acute respiratory failure, and hemodialysis. Little is known regarding how treatment is affected in septic patients with an early DNAR order. A prior single-center study found that DNAR orders in severe sepsis were associated with higher mortality but similarly aggressive therapy [12]. However, whether a DNAR order influences critical interventions in patients with severe sepsis is unknown, as well as what patient-level characteristics among those with DNAR are associated with outcomes.

We sought to further compare treatment intensity and patient outcomes by early DNAR status among severe sepsis hospitalizations. The first objective of this study was to compare mortality and interventional procedures (mechanical ventilation, central catheter placement, hemodialysis, and operating room procedures) among severe sepsis patients who have or do not have an early DNAR order. The second objective was to determine characteristics associated with mortality and interventional procedures within the severe sepsis DNAR population.

2. Methods

We performed a cross-sectional analysis of the 2010–2011 California State Inpatient Dataset (SID) from the Healthcare Cost and Utilization Project. This data set includes all inpatient discharges in the state annually. California was selected for this analysis because of its large, diverse population and the unique presence of an early DNAR order as a variable. The Colorado Multiple Institutional Review Board approved this study as “not human subjects” research.

2.1. Inclusion and exclusion criteria

We identified our cohort of severe sepsis patients using explicit *International Classification of Disease, Ninth Revision* hospital discharge diagnosis codes for severe sepsis (995.92) and septic shock (785.52) in any of the 25 listed fields that were listed as present on admission. There were 135 215 visits for severe sepsis or septic shock visits during the 2 years. We excluded children (age <18 years; n = 720) and visits not admitted through the emergency department (ED; n = 17 611) such as direct transfers to the inpatient setting. Emergency department visits that resulted in discharge or death before inpatient admission are not

included in the SID. After excluding $n = 11$ additional hospitalizations with missing early DNAR status, the final sample size for the analysis was 116 873 visits.

2.2. Primary outcome and covariate definitions

Our primary outcome was in-hospital mortality. Our secondary outcomes were performance of critical procedures based on their *International Classification of Disease, Ninth Revision* codes: central venous line (38.93, 89.62, 38.95, 38.97), mechanical ventilation (96.70, 96.71, 96.72, 96.04, 96.05, 93.90, 93.91), hemodialysis (38.95, 39.95), and major operating room procedures (coded explicitly in SID). Central venous line placement and vasoactive medications are a mainstay of aggressive management of septic shock [7]. Mechanical ventilation is a key intervention for acute respiratory failure, and hemodialysis is crucial for recovery for patients with acute kidney injury from septic shock. Lastly, operating room procedures are recommended for adequate source control.

Our primary explanatory variable was establishment of a DNAR order within the first 24 hours of hospitalization, coded explicitly in California SID (could be a new DNAR order or reordering of an established order). The database did not include whether or not the patient expressed other limitations of care along with the DNAR order. Our key covariates included age, sex, race/ethnicity, primary payer source, median household income, hospital urban-rural location, comorbidities, weekend admission, and admission from skilled nursing facility.

2.3. Statistical analysis

We first analyzed key variables stratified by DNAR status using descriptive statistics. Next, we performed a multivariable logistic regression with DNAR status as the primary independent variable and demographics, comorbidities, hospital urban-rural location, weekend admission, and admission from skilled nursing facility as covariates. Each outcome of interest was modeled separately, including inhospital mortality, central venous line, mechanical ventilation, hemodialysis, and operating room procedures. In the mortality model, we also included the procedure outcomes as independent variables. As secondary analyses, we also performed multivariable models for these outcomes restricted only to the subgroup with an early DNAR order to evaluate the characteristics within the DNAR population that is associated with their mortality and procedural outcomes. All hospitalizations in California were included in the data set; thus, no sample weighting was necessary. The analyses were performed using Stata 12.1 (Statacorp, College Station, TX).

3. Results

Among 116 873 California adult ED visits in 2010 to 2011 hospitalized for severe sepsis and septic shock, 23 770 (20.3%) visits had an early DNAR order. Patients hospitalized with an early DNAR order were more likely older, female, non-Hispanic white, with Medicare, and admitted from a skilled nursing facility (Table 1). Comorbid conditions that were more common among early DNAR visits included congestive heart failure, lymphoma, metastatic cancer, renal failure, and solid tumors without metastasis.

Among visits with early DNAR orders, 46.3% died in the hospital compared with 21.2% of patients without DNAR orders (Table 2). Visits with an early DNAR order, compared with those without, also had lower performance of critical procedures including central venous line (37.6% vs 50.7%), mechanical ventilation (32.6% vs 41.4%), hemodialysis (6.3% vs 13.1%), and major operating room procedure (6.2% vs 15.5%), as well as shorter hospital length of stay and total charges (Table 2).

3.1. Predictors of in-hospital mortality and critical procedures

After adjusting for patient characteristics and clinical conditions, an early DNAR order was a strong, independent predictor of in-hospital mortality (odds ratio [OR] 2.95; 95% confidence interval [CI], 2.85–3.05) (Table 3). Including clinical procedures in the model strengthened the association between early DNAR order and in-hospital mortality (OR, 4.03; 95% CI, 3.88–4.19).

We also found that even after adjusting for demographics and co-morbidities, an early DNAR order was strongly associated with a lower performance of the following critical procedures: central venous line (OR, 0.70; 95% CI, 0.67–0.72), mechanical ventilation (OR, 0.80; 95% CI, 0.77–0.83), hemodialysis (OR, 0.61; 95% CI, 0.58–0.65), and operative procedure (OR, 0.46; 95% CI, 0.43–0.49) (Table 4). Females and visits with age greater than or equal to 90 years were also less likely to receive mechanical ventilation, hemodialysis, and operative procedures than males.

3.2. Predictors of outcome among hospitalizations with DNAR orders

We next looked specifically within the subpopulation of hospitalizations with DNAR orders to determine predictors of in-hospital mortality and performance of critical procedures (Table 5). Among patients with early DNAR orders, older age, underinsured (self-pay or Medicaid), and several chronic conditions were independently associated with higher risk of in-hospital mortality. There was no association of sex or race/ethnicity with in-hospital mortality.

Older age, metastatic cancer, and rural hospital location were the strongest predictors for a lack of critical procedures among those with early DNAR orders (Supplemental Digital Content—Table 1). We also found several differences by demographic characteristics (sex, race/ethnicity, and insurance), with racial/ethnic minorities and underinsured being more likely to receive critical procedures.

4. Discussion

We found that an early DNAR order is common among patients with severe sepsis. In our large, representative cohort, we confirmed prior work that an early DNAR order is indeed a strong, independent predictor of in-hospital mortality [8,13]. However, in contrast to a prior single-center study [12], we found that an early DNAR order was associated with less aggressive utilization of critical procedures, including central venous line placement, hemodialysis, mechanical ventilation, and operating room procedures. A number of differences in demographic and clinical characteristics for early DNAR orders, associated procedures, and in-hospital mortality indicate disparities, perhaps intended or unintended.

Our results are consistent with studies in other conditions (e.g., cardiac arrest, stroke, general surgeries) demonstrating that DNAR orders tend to result in less use of invasive therapeutic interventions [9–11]. Although some patients and surrogate decision makers may request other limitations to care, by definition, a DNAR order itself only restricts cardiopulmonary resuscitation. A DNAR order should not necessarily be synonymous with less aggressive care.

Advanced directives may play an important role in risk-adjusting quality metrics. Our findings also support prior research suggesting that an early DNAR order should be used in administrative databases to improve observational comparative effectiveness methodology [8,13]. Further research is required to determine the extent to which patients with DNAR orders also express wishes to limit other procedures. These data will inform if and how to adjust for DNAR orders in measuring and reporting quality metrics.

Our study advances prior literature on the DNAR-mortality association in severe sepsis by specifically investigating which patients with DNAR orders are more likely to receive less aggressive care. We found that among hospitalizations with early DNAR orders, older age was the strongest predictor for a lack of critical invasive procedures. Perception of medical futility influence recommendations that proposed therapies should not be performed if they will not improve the patient's medical condition [14]. Previously, it has been shown that physicians with less experience tend to use age as a factor in deciding to perform a medical intervention [15], as older persons appear more vulnerable and frail. Although the reasons for these observations cannot be inferred from this study, we speculate that physicians may sometimes be biased toward less aggressive care in older patients, particular those with a DNAR order. Other possible explanations for limited care in patients with DNAR orders may include a higher severity of underlying comorbid conditions, contraindications for aggressive treatment, a limited potential for clinical improvement, or patient desire for limited interventions. One of our limitations is that we do not know under what circumstances the DNAR order was placed in and if the patient expressed wishes to limit other types of invasive care.

Early in the course of hospitalization, aggressive intervention such as central venous line placement in shock and mechanical ventilation for acute respiratory failure can be life-saving in critically ill septic patients but should reflect goals of care. One solution is to discuss individualized treatment options with patients in order to tailor goals of therapy and avoid assumptions. Additionally, patients should be encouraged to identify someone to aid in decision making should they become incapacitated. Tools like the POLST help outpatient providers initiate conversations about specific goals of care in advance of critical illness, but such tools have not been specifically developed and validated for initiation in the acute setting [16,17]. Prior data suggest that emergency providers have difficulty interpreting that may lead to care that is not concordant with patient wishes [18].

Similar to previous work, we also found that patients in rural hospitals were more likely to obtain DNAR orders [19]. However, we also found that among hospitalizations with severe sepsis, rural hospital location was strongly associated with a lower likelihood of receiving critical procedures. We speculate that this could be due to a shortage in available personnel

or resources that lead to limiting procedures performed in DNAR patients, relative to urban settings. However, the actual cause of this finding requires further investigation because our data set does not allow us to analyze local institutional capacity for procedures nor patient wishes to avoid transfer to a higher level of care.

The strength of our study is its large, diverse sample, which allows for robust comparisons by demographic and clinical characteristics, as well as focusing difference within the early DNAR subgroup. Our study also has limitations. The analysis was visit level and the Healthcare Cost and Utilization Project does not provide variables for hierarchical clustered analysis. Thus, the analysis did not account for clustering at patient, provider, hospital, or geographic levels, which may lead to modest overrepresentation among some of these groups. We were also limited to outcomes that were included in the administrative database. Other sepsis process measures such as timely intravenous fluids and antibiotics, which are critical to improved sepsis outcomes, were not available. Furthermore, the SID does not provide granular detail on the timing of DNAR order placement. Specifically, a preexisting DNAR order at the time of admission or a DNAR order placed during hospitalization would be coded similarly, but may have different implications on patient wishes for intensity of care. We also did not know the indications for the procedures and whether this was differential by DNAR status. In addition, we were not able to account for other patient-requested limitations in care, such as a “do not intubate” order or the decision to not undergo hemodialysis. Thus, we were unable to determine concordance of intensity of care with individual patient’s wishes. However, with large effect sizes that we observed, we propose that additional prospective work should further characterize the underlying causes of these observed associations.

5. Conclusion

We found a markedly lower rate in the performance of several critical procedures, which may reflect other goals of care limiting these procedures, unintentional limitations on more intensive care, or both. Particularly among patients with a DNAR order, older patients and hospitalizations in rural hospital locations were less likely to receive aggressive treatment. Because DNAR orders are not synonymous with “do not treat,” the hypothesis that DNAR orders may unintentionally limit aggressive treatment for severe sepsis patients requires further evaluation.

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Table 1

Characteristics of severe sepsis visits with and without early DNAR orders

Characteristics	No DNAR		DNAR	
	n	%	n	%
Total	93 103	79.7	23 770	20.3
Demographics				
Age (y), median (IQR)	69	(57–81)	82	(72–87)
18–59	28 283	30.4	2432	10.2
60–69	18 970	20.4	2727	11.5
70–79	20 216	21.7	4862	20.5
80–89	22 068	23.7	10 662	44.9
90	3552	3.8	3087	13.0
Female sex	45 455	48.9	12 708	53.5
Race/Ethnicity				
Non-Hispanic white	49 394	55.2	15 801	68.6
Non-Hispanic black	9323	10.4	1315	5.7
Hispanic	20 430	22.8	3409	14.8
Asian or Pacific Islander	8509	9.5	2162	9.4
Other	1895	2.1	355	1.5
Expected primary payer				
Private insurance	14 275	15.3	2012	8.5
Medicare	58 889	63.3	19 527	82.2
Medicaid (Medi-Cal)	14 651	15.7	1774	7.5
Self-pay	2796	3.0	225	1.0
Other	2487	2.7	231	1.0
Median household income				
1st quartile	27 050	29.7	5079	21.7
2nd quartile	23 464	25.7	5802	24.8
3rd quartile	22 992	25.2	6379	27.3
4th quartile	17 695	19.4	6148	26.3
Hospital location				
Large urban	74 214	80.5	18 700	79.6
Small urban	17 107	18.6	4391	18.7
Rural	902	1.0	396	1.7
Clinical				
Chronic medical conditions, median (IQR)	7	(5–10)	8	(5–10)
Alcohol abuse	6105	6.6	989	4.2
Congestive heart failure	26 278	28.2	7535	31.7
Chronic lung disease	25 944	27.9	6449	27.1
Diabetes mellitus	37 127	39.9	7852	33.0
Liver disease	8617	9.3	1638	6.9
Lymphoma	1861	2.0	519	2.2

Characteristics	No DNAR		DNAR	
	n	%	n	%
Metastatic cancer	4655	5.0	2015	8.5
Obesity	12 427	13.4	1565	6.6
Renal failure	30 036	32.3	7760	32.7
Solid tumor without metastasis	3747	4.0	1224	5.2
Weekend admission	25 077	26.9	6516	27.4
Admission from skilled nursing facility	14 786	15.9	6136	25.8

IQR indicates interquartile range.

Table 2

Comparison of outcomes of severe sepsis visits with and without DNAR order

Outcomes	No DNAR		DNAR	
	n	%	n	%
Total no. of procedures, median (IQR)	7	(5–10)	8	(5–10)
Central venous line	47 168	50.7	8934	37.6
Mechanical Ventilation	38 499	41.4	7746	32.6
Dialysis	12 222	13.1	1496	6.3
Major operation room procedure	14 458	15.5	1480	6.2
Hospital length of stay (d), median (IQR)	7	(4–13)	5	(2–8)
Discharge location				
In-hospital death	19 701	21.2	11 005	46.3
Routine	24 986	26.8	2219	9.3
Home health care	12 292	13.2	2577	10.9
Transfer to short-term hospital	6242	6.7	586	2.5
Transfer to SNF or other facility	28 499	30.6	6988	29.4
Other/Unknown	1370	1.5	389	1.6
Total charges, median (IQR)	110 611	(60 095–212 067)	66 648	(36 712–124 901)

IQR indicates interquartile range; SNF, skilled nursing facility.

Table 3

Multivariable models for in-hospital mortality among severe sepsis hospitalizations

Predictor variables	Model 1, OR (95% CI)	Model 2, OR (95% CI)
DNAR	2.95 (2.85–3.05)	4.03 (3.88–4.19)
Demographics		
Age (y)		
18–59	Reference	Reference
60–69	1.20 (1.15–1.26)	1.29 (1.23–1.36)
70–79	1.36 (1.29–1.43)	1.62 (1.53–1.71)
80–89	1.59 (1.51–1.67)	2.29 (2.17–2.42)
90	1.67 (1.55–1.79)	2.85 (2.64–3.07)
Female sex	1.00 (.98–1.03)	1.07 (1.04–1.11)
Race/Ethnicity		
Non-Hispanic white	Reference	Reference
Non-Hispanic black	1.09 (1.03–1.14)	0.99 (0.94–1.05)
Hispanic	1.05 (1.01–1.09)	1.02 (0.97–1.06)
Asian or Pacific Islander	1.08 (1.02–1.13)	0.98 (0.93–1.03)
Other	1.17 (1.06–1.30)	1.05 (0.94–1.17)
Expected primary payer		
Private insurance	Reference	Reference
Medicare	1.05 (1.00–1.10)	1.03 (0.98–1.09)
Medicaid (Medi-Cal)	1.30 (1.23–1.37)	1.19 (1.12–1.26)
Self-pay	1.48 (1.34–1.64)	1.47 (1.32–1.64)
Other	0.99 (0.88–1.10)	0.93 (0.83–1.05)
Median household income		
1st quartile	1.26 (1.21–1.32)	1.15 (1.10–1.21)
2nd quartile	1.14 (1.09–1.19)	1.08 (1.03–1.14)
3rd quartile	1.06 (1.02–1.11)	1.03 (0.99–1.08)
Skilled nursing facility	1.13 (1.09–1.17)	1.01 (0.97–1.05)
Clinical		
Chronic medical conditions	0.98 (0.98–0.99)	0.96 (0.95–0.97)
Alcohol abuse	1.40 (1.32–1.50)	1.30 (1.21–1.39)
Congestive heart failure	1.27 (1.23–1.32)	1.05 (1.01–1.09)
Chronic lung disease	0.94 (0.91–0.97)	0.82 (0.79–0.85)
Diabetes mellitus	0.85 (0.82–0.87)	0.87 (0.84–0.90)
Liver disease	2.05 (1.95–2.15)	2.15 (2.03–2.27)
Lymphoma	1.94 (1.77–2.13)	2.16 (1.96–2.39)
Metastatic cancer	2.62 (2.48–2.77)	3.49 (3.28–3.71)
Obesity	0.80 (0.76–0.84)	0.76 (0.72–0.80)
Renal failure	1.09 (1.05–1.12)	1.10 (1.06–1.14)
Solid tumor without metastasis	1.47 (1.38–1.57)	1.67 (1.56–1.80)
Weekend admission	0.99 (0.96–1.02)	0.97 (0.93–1.00)

Predictor variables	Model 1, OR (95% CI)	Model 2, OR (95% CI)
Hospital location		
Large urban	Reference	Reference
Small urban	1.07 (1.03–1.11)	1.15 (1.10–1.19)
Rural	0.86 (0.75–0.99)	1.03 (0.89–1.19)
Procedures		
Central venous line	–	1.09 (1.05–1.12)
Mechanical ventilation	–	6.51 (6.29–6.75)
Dialysis	–	1.89 (1.80–1.99)
Major operation room procedure	–	0.66 (0.63–0.69)

Model 1 does not include procedures.

Table 4

Multivariable models for procedures among severe sepsis hospitalizations

Predictor variables	Central venous line, OR (95% CI)	Mechanical ventilation, OR (95% CI)	Dialysis, OR (95% CI)	Operative procedure, OR (95% CI)
DNAR	0.70 (0.67–0.72)	0.80 (0.77–0.83)	0.61 (0.58–0.65)	0.46 (0.43–0.49)
Demographics				
Age (y)				
18–59	Reference	Reference	Reference	Reference
60–69	0.89 (0.85–0.92)	0.94 (0.90–0.97)	0.84 (0.79–0.89)	0.98 (0.93–1.03)
70–79	0.73 (0.70–0.76)	0.83 (0.80–0.87)	0.56 (0.53–0.60)	0.85 (0.80–0.90)
80–89	0.56 (0.54–0.58)	0.63 (0.61–0.66)	0.30 (0.28–0.33)	0.60 (0.57–0.64)
90	0.39 (0.36–0.41)	0.44 (0.41–0.47)	0.13 (0.11–0.16)	0.37 (0.33–0.41)
Female sex	1.02 (0.99–1.04)	0.88 (0.86–0.91)	0.89 (0.86–0.93)	0.92 (0.89–0.95)
Race/Ethnicity				
Non-Hispanic white	Reference	Reference	Reference	Reference
Non-Hispanic black	1.06 (1.01–1.10)	1.13 (1.08–1.18)	1.44 (1.35–1.54)	1.04 (0.97–1.10)
Hispanic	0.95 (0.92–0.98)	1.02 (0.99–1.05)	1.62 (1.54–1.71)	1.08 (1.03–1.13)
Asian or Pacific Islander	1.05 (1.00–1.09)	1.17 (1.12–1.22)	1.51 (1.41–1.62)	0.95 (0.89–1.02)
Other	1.06 (0.97–1.15)	1.26 (1.15–1.37)	1.34 (1.16–1.54)	0.98 (0.87–1.12)
Expected primary payer				
Private insurance	Reference	Reference	Reference	Reference
Medicare	1.01 (0.97–1.05)	1.03 (0.99–1.07)	1.06 (0.99–1.13)	0.88 (0.84–0.93)
Medicaid (Medi-Cal)	1.14 (1.09–1.20)	1.31 (1.25–1.37)	1.09 (1.01–1.17)	0.96 (0.90–1.02)
Self-pay	1.10 (1.01–1.20)	1.22 (1.12–1.33)	0.93 (0.80–1.07)	1.16 (1.05–1.30)
Other	1.12 (1.02–1.22)	1.16 (1.06–1.26)	0.83 (0.71–0.98)	1.25 (1.12–1.40)
Median household income				
1st quartile	0.98 (0.95–1.02)	1.29 (1.24–1.35)	1.04 (0.98–1.11)	1.02 (0.96–1.08)
2nd quartile	0.99 (0.95–1.03)	1.18 (1.13–1.22)	0.99 (0.93–1.06)	1.06 (1.00–1.12)
3rd quartile	0.97 (0.93–1.00)	1.09 (1.05–1.14)	1.00 (0.94–1.06)	1.01 (0.96–1.07)
4th quartile	Reference	Reference	Reference	Reference
Skilled nursing facility	1.01 (0.98–1.05)	1.39 (1.34–1.43)	0.78 (0.74–0.83)	0.64 (0.61–0.68)
Clinical				
Chronic medical conditions	1.08 (1.07–1.08)	1.05 (1.05–1.06)	1.08 (1.07–1.09)	1.05 (1.04–1.06)
Alcohol abuse	1.09 (1.03–1.15)	1.34 (1.27–1.42)	0.96 (0.87–1.05)	0.75 (0.70–0.82)
Congestive heart failure	1.23 (1.20–1.27)	1.57 (1.52–1.61)	1.32 (1.26–1.38)	0.85 (0.82–0.89)
Chronic lung disease	0.90 (0.88–0.93)	1.34 (1.30–1.38)	0.65 (0.62–0.69)	0.69 (0.66–0.72)
Diabetes mellitus	0.90 (0.88–0.93)	0.86 (0.84–0.89)	1.01 (0.97–1.06)	0.95 (0.91–0.99)
Liver disease	1.27 (1.21–1.33)	1.08 (1.03–1.13)	1.42 (1.33–1.52)	0.75 (0.70–0.80)
Lymphoma	1.03 (0.94–1.12)	0.98 (0.90–1.07)	1.23 (1.08–1.40)	0.75 (0.66–0.85)
Metastatic cancer	0.78 (0.74–0.83)	0.85 (0.81–0.90)	0.55 (0.49–0.62)	0.81 (0.75–0.88)
Obesity	1.07 (1.03–1.11)	1.02 (0.98–1.06)	0.91 (0.86–0.97)	1.10 (1.05–1.16)
Renal failure	0.91 (0.89–0.94)	0.74 (0.72–0.77)	7.03 (6.70–7.37)	1.01 (0.97–1.05)

Predictor variables	Central venous line, OR (95% CI)	Mechanical ventilation, OR (95% CI)	Dialysis, OR (95% CI)	Operative procedure, OR (95% CI)
Solid tumor without metastasis	0.89 (0.84–0.95)	0.93 (0.87–0.99)	0.69 (0.62–0.78)	0.95 (0.87–1.04)
Weekend admission	1.02 (0.99–1.05)	1.06 (1.03–1.09)	0.94 (0.90–0.99)	0.97 (0.93–1.01)
Hospital location				
Large urban	Reference	Reference	Reference	Reference
Small urban	1.10 (1.06–1.14)	0.90 (0.87–0.93)	1.02 (0.97–1.08)	1.11 (1.06–1.16)
Rural	0.89 (0.79–1.00)	0.75 (0.66–0.85)	0.22 (0.14–0.33)	0.76 (0.62–0.92)

Table 5

Multivariable models for in-hospital mortality among severe sepsis hospitalizations with an early DNAR order

Predictor variables	Model 1, OR (95% CI)	Model 2, OR (95% CI)
Demographics		
Age (y)		
18–59	Reference	Reference
60–69	0.94 (0.83–1.06)	1.03 (0.91–1.17)
70–79	0.81 (0.72–0.91)	0.95 (0.84–1.07)
80–89	0.77 (0.69–0.87)	1.08 (0.96–1.22)
90	0.77 (0.68–0.88)	1.17 (1.02–1.34)
Female sex	0.99 (0.93–1.04)	1.03 (0.97–1.09)
Race/Ethnicity		
Non-Hispanic white	Reference	Reference
Non-Hispanic black	1.18 (1.04–1.33)	1.07 (0.94–1.21)
Hispanic	1.15 (1.06–1.24)	1.06 (0.98–1.16)
Asian or Pacific Islander	1.06 (0.96–1.16)	0.97 (0.88–1.07)
Other	1.23 (0.99–1.52)	1.11 (0.88–1.39)
Expected primary payer		
Private insurance	Reference	Reference
Medicare	0.98 (0.88–1.09)	0.96 (0.86–1.07)
Medicaid (Medi-Cal)	1.30 (1.13–1.50)	1.20 (1.04–1.39)
Self-pay	1.85 (1.33–2.57)	1.66 (1.18–2.34)
Other	1.53 (1.13–2.07)	1.39 (1.01–1.91)
Median household income (zip code)		
1st quartile	1.20 (1.10–1.30)	1.11 (1.02–1.21)
2nd quartile	1.06 (0.98–1.15)	1.02 (0.94–1.11)
3rd quartile	1.03 (0.96–1.11)	1.02 (0.94–1.10)
4th quartile	Reference	Reference
Skilled nursing facility	1.01 (0.95–1.07)	1.02 (0.95–1.09)
Clinical		
Chronic medical conditions	0.91 (0.90–0.92)	0.91 (0.90–0.92)
Alcohol abuse	1.43 (1.23–1.67)	1.36 (1.16–1.60)
Congestive heart failure	1.23 (1.15–1.31)	1.10 (1.03–1.18)
Chronic lung disease	1.08 (1.02–1.15)	0.96 (0.90–1.03)
Diabetes mellitus	0.99 (0.93–1.06)	0.99 (0.92–1.05)
Liver disease	1.70 (1.50–1.91)	1.78 (1.57–2.02)
Lymphoma	1.77 (1.47–2.14)	1.92 (1.58–2.33)
Metastatic cancer	1.63 (1.47–1.81)	2.02 (1.82–2.25)
Obesity	0.94 (0.84–1.06)	0.90 (0.80–1.02)
Renal failure	1.14 (1.07–1.21)	1.16 (1.08–1.24)
Solid tumor without metastasis	1.25 (1.10–1.41)	1.30 (1.15–1.48)
Weekend admission	1.02 (0.96–1.08)	1.00 (0.94–1.07)

Predictor variables	Model 1, OR (95% CI)	Model 2, OR (95% CI)
Hospital location		
Large urban	Reference	Reference
Small urban	1.11 (1.03–1.19)	1.17 (1.09–1.26)
Rural	0.83 (0.67–1.04)	1.02 (0.81–1.28)
Procedures		
Central venous line	–	0.94 (0.88–1.00)
Mechanical ventilation	–	3.97 (3.72–4.24)
Dialysis	–	1.44 (1.27–1.64)
Major operation room procedure	–	0.68 (0.60–0.77)

Model 1 does not include procedures.