# Early Albumin Infusion Is Associated with a Shorter Hospital Stay in Patients Hospitalized with Sepsis Who Develop Significant Acute Kidney Injury: **Real-World Evidence in the United States**

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### INTRODUCTION

- The incidence of sepsis<sup>1,2</sup> and the number of sepsis-related deaths are increasing.<sup>1,3,4</sup>
- Acute kidney injury (AKI) is a common complication in critically ill patients with sepsis/septic shock<sup>5-7</sup> and is associated with worse outcomes.<sup>8-10</sup>
- In ex-US studies, albumin is shown to be effective in the management of circulatory dysfunction in sepsis.<sup>11,12</sup>
- This study examined the impact of albumin infusion on hospital length of stay (LOS) for septic AKI patients.

## METHODS

- We used a nationwide Electronic Health Record data set (Cerner Health Facts) to examine real-world data on adult patients (>=18 years old) with sepsis/septic shock, admitted between January 1, 2013, and April 30, 2018, identified by International Classification of Disease (ICD-9/10) codes, and receipt of antibiotics.
- We reported significant AKI as stage 3 based on the Kidney Disease: Improving Global Outcomes (KDIGO) guidelines, excluding patients with history of end-stage renal disease or chronic kidney disease stage 5.
- We calculated the Charlson Comorbidity Index (CCI) and the Acute Physiology Score (APS) at baseline using laboratory data.
- Generalized linear models were implemented to assess the relationship between albumin and hospital LOS, especially accounting for timing of albumin infusion.

### CONCLUSION

Early albumin infusion was associated with a shorter hospital stay for patients with sepsis/septic shock who develop significant AKI, which may reduce the cost of hospitalization for critically ill patients.

Further research is being conducted to assess additional benefits of early albumin administration in this patient population.



# RESULTS

- We identified 1,421 unique visits for survivor patients with sepsis/septic shock and AKI stage 3 that met the inclusion criteria.
- Albumin was infused within 24 hours of admission ('early albumin') in 15%, after 24 hours ('late albumin') in 20%, and not administered in 65%.
- Both CCI and APS were higher, at presentation, in early albumin cases than late- or no-albumin cases (mean: 7.08 and 7.07, and 58.70 and 43.73, respectively).
- Unadjusted LOS was lower in patients receiving early albumin as compared to late- or no-albumin (12.94 days versus 13.41 days). A risk-adjusted analysis demonstrated a 7.01% reduction in LOS (95% Cl 0.28% - 13.29%, p = 0.0416) in patients who received early albumin.

#### **Table 1: Attrition and Patient Counts**

Inclusion Criteria	Exclusion Criteria	Unique Patients	Unique Visits*
ICD9 DX Codes: 995.92 OR 785.52 OR		241 002	272 774
998.02ICD10 DX Codes: R65.20 OR R65.21 OR T81.12XA		241,993	212,114
Patient 1st admission between 2013-2018 (through April 2018)		168,288	189,403
Patients ≥ 18 years old		164,045	184,756
Patients with an inpatient encounter during index visit		152,457	169,658
	Length of Stay (LOS) ≤ 48 hours AND LOS > 90th percentile (25.1826389 days)	123,817	136,660
	Patient transferred from another ICU	123,757	136,561
	No crystalloids** AND no albumin	72,297	78,274
	No antibiotics	51,877	55,176
	No serum creatinine (SCr) readings during index visit	30,449	32,074
	Gender not specified	30,446	32,070
	Non-acute hospital	30,431	32,047
	"Elective", "Not Specified", and "Other" admission types	29,102	30,646
	Deceased patients or hospice	20,766	21,948
Patients with AKI stage 3		2,249	2,314
	Patient with ESRD or CKD5	1,408	1,421
FINAL COHORT		1,408	1,421

\*Analysis conducted at the visit level

\*\*Crystalloid administration as any type of intravenous crystalloid infusion used for volume expansion with at least one order delivered in a container > 250 ml (i.e., 500 ml or 1000 ml bags) to exclude potential carriers (e.g. for vasoactive or sedative drugs)

	Figure 1: Mean Charlson Comorbidity Index (CCI) – Early Albumin Vs. Late/No Albumin			Figure 2: Mean Acute Physiology Score (APS) – Early Albumin Vs. Late/No Albumin			Figure 3: Mean Length of Stay (LOS) – Early Albumin Vs. Late/No Albumin	
	Visits: N=212	Visits: N=1,209		Visits: N=212	Visits: N=1,209		Visits: N=212	Visits: N=1,209
25.0	CCI: Mean=7.1, SD=3.3	CCI: Mean=7.1, SD=3.5	140.0	APS: Mean=58.7, SD=26.3	APS: Mean=43.7, SD=25.9	30.0	LOS: Mean=12.9, SD=5.7	LOS: Mean=13.4, SD=6.0
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#### Table 2: Sepsis/Septic Shock Patients Who Develop Significant AKI – Early Albumin Vs. Late or No Albumin

	Early Albumin (≤24 hours) N = 212	Late (>24 hours) / No Albumin N = 1,209	Standardized Mean Difference
Male	114 (53.8%)	602 (49.8 %)	-0.08
Age (in years)	61.3 ± 15.1	62.2 ± 15.3	-0.058
18-29	8 (3.8%)	73 (3.1%)	
30-49	32 (15.1%)	283 (16.1%)	
50-64	78 (36.8%)	840 (33.8%)	
65+	94 (44.3%)	1,472 (47.0%)	

Numbers are presented as either n (%) or mean ± standard deviation

#### Table 3: Definition of Antibiotics as Extracted from Cerner EHR Database

Medication Class				
Penicillins	Quinolones			
Cephalosporin	Antituberculars			
Beta-lactams antimicrobials, other (including -penems)	Methenamine salts antimicrobials			
Chloramphenicol	Nitrofurans antimicrobials			
Erythromycins/ macrolides	Sulfonamide/ related antimicrobials			
Tetracyclines	Anti-infectives, other			
Aminoglycosides	Carbapenems			
Lincomycins	Zosyn			

#### Table 4: KDIGO, 2012 Guidelines

AKI Stages	Serum Creatinine (SCr) Levels / Criteria
1	Increase in SCr $\geq$ 0.3 mg/dL (in 48 hours) OR 1.5 to 1.9 times the baseline (in 7 days)
2	2.0 to 2.9 times the baseline SCr (in 7 days)
3	3.0 or more times the baseline (in 7 days) OR increase in SCr $\geq$ 4.0 mg/dL (in 48 hours) OR Renal Replacement Therapy

#### Table 5: Generalized Linear Model – **Changes in Hospital Length of Stay Due to Select Study Variables**

	_		Exponential of			
Parameters	Parameter Estimate	Standard Error	Parameter Estimate	Exponential of 95% Confidence Limits		n-value
	Lotinate	Enor	LStimate	Lower Limit	Upper Limit	pvalue
Female vs Male	-0.0234	0.0241	0.9769	0.9318	1.0242	0.3322
Age 30-49 vs 18-29	-0.0856	0.0663	0.9180	0.8061	1.0454	0.1969
Age 50-64 vs 18-29	-0.0475	0.0604	0.9536	0.8470	1.0736	0.4321
Age 65+ vs 18-29	-0.0755	0.0633	0.9273	0.8191	1.0498	0.2334
CCI	-0.0051	0.004	0.9949	0.9871	1.0028	0.2026
APS	-0.0001	0.0006	0.9999	0.9987	1.0012	0.9337
Early vs Late/No Albumin	-0.0727	0.0357	0.9299	0.8671	0.9972	0.0416*

\*Statistically significant at alpha level of 0.05



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18.2

13.0

8.5

0.0