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RTRC Partners:
University of Iowa
University of North Carolina
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rtrc-inquiry@uiowa.edu/www.ruraltelehealth.org
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Research & Policy Brief

Low-Volume Emergency Departments are More Likely to Use Telehealth for Sepsis Care in a National Rural Telehealth Network

Nicholas M. Mohr, MD, MS[1]; Tracy Young, MS[1]; Allison R. Schuette, MS[2]; Fred Ullrich, BA[3]; Luke J. Mack, MA[4,5]; Katie DeJong, DO[4]; Amanda Bell, MHA[4]; Mark Pals, BS[4]; Carlos A. Camargo, Jr, MD, DrPH[6]; Kori S. Zachrison, MD, MSc[6]; Krislyn M. Boggs, MPH[6]; Adam Skibbe, MS[7]; Dan M. Shane, PhD[3]; Knute D. Carter, PhD[8]; Kimberly A.S. Merchant, MA[3]; Marcia M. Ward, PhD[3]

[1]Department of Emergency Medicine, University of Iowa, Iowa City, Iowa; [2]Department of Pediatrics, Division of Critical Care, University of Utah, Salt Lake City, Utah; [3]Department of Health Management and Policy, University of Iowa, Iowa City, Iowa; [4]Avel eCare, Sioux Falls, South Dakota; [5]Department of Family Medicine, University of South Dakota Sanford School of Medicine, Sioux Falls, South Dakota; [6]Department of Emergency Medicine, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts; [7]Department of Geographical and Sustainability Sciences, University of Iowa, Iowa City, Iowa; [8]Department of Biostatistics, University of Iowa, Iowa City, Iowa.

Introduction and Background

Sepsis is an expensive disease that is responsible for over 270,000 deaths in the U.S. annually.[1] Early and aggressive treatment with antibiotics and hemodynamic resuscitation have been associated with improved outcomes, but many sepsis patients do not receive guideline-concordant care. Patients treated in low-volume emergency departments (EDs) have 38% higher mortality than those in high-volume departments, suggesting that volume is associated with some elements of care that improve survival.[2]

Key Findings

- Telehealth was used in 5.5% of sepsis cases, but there was substantial variation in telehealth use for emergency department (ED) sepsis care between rural hospitals.
- Providers in the lowest volume EDs use telehealth more frequently for sepsis care.
- Providers were more likely to use telehealth with ED patients who had complex sepsis (e.g., multi-system organ failure).

Provider-to-provider telehealth has been one strategy proposed to improve sepsis care in low-volume EDs. In provider-to-provider ED-based telehealth (tele-ED), local ED staff can request consultation with a remote physician and nurse who can connect using a 24-hour on-demand high-definition video connection allowing remote staff to see a patient, review records, provide advice, arrange for inter-hospital transfer, and provide clinical documentation. By connecting a clinician in a high-volume hospital with a care team in a low-volume hospital, rural sepsis patients and providers may benefit from high-volume experience and training even in a local rural facility.

Prior studies of sepsis telehealth applications have been small-scale evaluations of EDs in single hospital systems, often in newly created telehealth networks. The function and outcomes of larger and more mature networks, however, may be different than smaller pilot programs. Furthermore, the effect of telehealth may vary across EDs, by patients, or by providers with different characteristics.

Purpose

Avera eCARE is an established rural tele-ED network based in Sioux Falls, South Dakota. This network spans 166 nonfederal hospitals in 13 states and has well-developed sepsis screening protocols that we have studied previously.[3-5] Increasing telehealth use for sepsis care has been a quality improvement priority in this network,

with other focus areas of trauma, cardiac, and stroke care. Avera eCARE is participating in a larger project to link Medicare claims data with Avera eCARE call log data to measure the effect of tele-ED care on costs and outcomes of sepsis care. The purpose of this study was to (1) report on the prevalence of tele-ED use for sepsis care across the network, (2) quantify variation in use between hospitals, and (3) identify predictors of tele-ED consultation in tele-ED-capable hospitals.

Methods

Study Design, Setting, and Population

This was a multicenter, retrospective, claims-based study of tele-ED use. We included all age-qualifying Medicare beneficiaries who presented with sepsis to one of the 166 rural hospital EDs subscribing to eCARE services from 2017 through 2019. To exclude those with inpatient sepsis only, we included only those with both an inpatient diagnosis of explicit or implicit sepsis and an ED diagnosis of either explicit sepsis or infection. To be consistent with a currently accepted quality metric (SEP-1), we excluded those with hospital length-of-stay greater than 30 days. We classified sources of infection and organ failure as we described previously.[7]

Definitions

We defined sepsis using explicit sepsis codes or an implicit definition of sepsis, including co-existing infection and organ dysfunction, using International Classification of Diseases, 10th edition, Clinical Modification (ICD-10-CM) diagnosis codes, as described previously.[6] Comorbidities were defined using the Elixhauser methodology, which identifies a set of 31 comorbid conditions from claims data.[8, 9] Rural ED location was defined based on the ED ZIP code and was classified according to the 2010 Rural–Urban Commuting Area Codes (RUCA) published by the U.S. Department of Agriculture.[10]

Analysis

We measured the relationship between predictors and tele-ED consultation (dichotomous) using a generalized estimating equation (GEE) model (logit link), clustered on presenting hospital. *A priori*-defined variables were considered for model inclusion, including patient-level predictors (age, sex, race, comorbidities, infection source, organ dysfunction) and hospital-level predictors (annual ED visits, annual facility inpatient days, population density [population per square mile], distance to nearest city of 100,000 people, RUCA codes) as primary predictors. Variables were selected for final inclusion in the multivariable GEE model based on statistical criteria from univariate analysis ($p < 0.20$) or clinical relevance, and continuous variables were modeled in categories defined by quintiles. All statistical tests were considered significant at $p < 0.05$ using two-tailed tests, and analyses were conducted using SAS 9.4 (Version 9.4, SAS Institute, Cary, NC).

Findings

Between 2017 and 2019, 13,611 sepsis patients presented to a tele-ED capable hospital, with 746 (5.5%) receiving tele-ED consultations. There was a large range in consultation rates between hospitals (0–67%). Low-volume hospitals were more likely to have greater tele-ED utilization (**Figure 1**). Annual ED visits and inpatient volume were collinear, so only annual ED visits was retained in the analysis. Population density was collinear with RUCA, so only population density was retained.

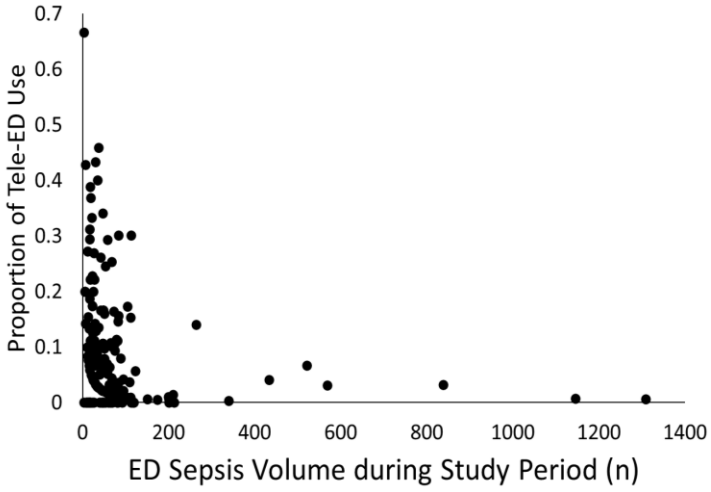

Figure 1. Proportion of tele-ED use in age-qualifying Medicare beneficiaries, by site, 2017-2019. Hospitals with low ED sepsis volume had the highest proportion of patients for whom tele-ED was used.

Factor	Unadjusted Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)
Age		
65 - 74	Ref	Ref
75-84	0.82 (0.68 - 0.98)	0.80 (0.65 - 0.97)
85 and older	0.60 (0.49 - 0.74)	0.58 (0.46 - 0.72)
Sex		
Female	Ref	Ref
Male	1.30 (1.09 - 1.55)	1.20 (1.02 - 1.42)
Race		
White	Ref	Ref
Other/Unknown	1.57 (0.87 - 2.83)	1.41 (0.82 - 2.44)
Infection source		
Pneumonia	Ref	Ref
Urinary	0.92 (0.71 - 1.19)	0.92 (0.70 - 1.21)
Septicemia/Bacteremia	1.77 (1.32 - 2.36)	1.82 (1.42 - 2.34)
Other/Unknown	0.94 (0.69 - 1.28)	1.07 (0.81 - 1.41)
More than one source	0.89 (0.64 - 1.24)	1.05 (0.81 - 1.36)
Organ dysfunction		
Respiratory	Ref	Ref
Renal	1.44 (1.01 - 2.06)	1.32 (0.92 - 1.89)
Neurologic	1.91 (1.09 - 3.34)	1.63 (0.96 - 2.77)
Metabolic	1.16 (0.82 - 1.65)	1.25 (0.87 - 1.79)
Cardiac	2.13 (1.39 - 3.25)	1.62 (1.07 - 2.48)
Other/Unknown	2.02 (1.39 - 2.94)	1.34 (1.03 - 1.73)
Multiple Organs	1.72 (1.31 - 2.27)	2.05 (1.53 - 2.74)
Hospital factors		
Annual ED visits		
1966 or fewer	7.75 (3.19 - 18.84)	7.00 (2.73 - 17.97)
1967 - 4167	7.28 (2.93 - 18.09)	7.01 (2.78 - 17.67)
4168 - 9812	4.12 (1.44 - 11.83)	3.87 (1.46 - 10.28)
9813 - 17881	1.65 (0.60 - 4.50)	1.71 (0.57 - 5.12)
17882 or more	Ref	Ref
Population density (pop./sq. mile)		
22 or fewer	3.11 (1.69 - 5.71)	1.08 (0.51 - 2.29)
23 - 217	1.48 (0.48 - 4.50)	1.12 (0.49 - 2.58)
218 - 416	0.47 (0.18 - 1.25)	0.45 (0.19 - 1.09)
417 - 1,071	1.75 (0.93 - 3.30)	0.72 (0.36 - 1.44)
1072 or more	Ref	Ref
Comorbidities		
Congestive heart failure	0.84 (0.67 - 1.03)	1.05 (0.83 - 1.34)
Cardiac arrhythmia	0.81 (0.67 - 0.98)	0.97 (0.82 - 1.16)
Diabetes mellitus	0.97 (0.82 - 1.15)	0.86 (0.64 - 1.14)
Hypothyroidism	0.62 (0.46 - 0.83)	0.86 (0.64 - 1.16)
Hypertension without complications	0.77 (0.63 - 0.93)	0.83 (0.67 - 1.02)
Hypertension with complications	0.70 (0.55 - 0.89)	0.94 (0.66 - 1.35)
Chronic pulmonary disease	0.72 (0.57 - 0.90)	0.87 (0.71 - 1.05)
Renal failure	0.76 (0.59 - 0.97)	0.91 (0.58 - 1.41)
Obesity	0.66 (0.42 - 1.05)	0.88 (0.72 - 1.09)
Fluid/electrolyte disorders	0.82 (0.67 - 1.00)	1.02 (0.87 - 1.20)

Table 1. Predictors of tele-ED consultation among sepsis patients in tele-ED-capable hospitals.

Members of the tele-ED group were more likely to be younger, male, and to present to a hospital with low annual ED visits. Tele-ED patients were also more likely to have septicemia/bacteremia as the infection source and multiple organ dysfunctions. After adjusting for age, sex, and race, septicemia/bacteremia was still more prevalent in the tele-ED group (adjusted odds ratio [aOR] = 1.82, 95% confidence interval [CI] 1.42 – 2.34).

(**Table 1**). Tele-ED use was also more prevalent in low-volume EDs in our adjusted model (aOR 7.00, 95%CI 2.73 – 17.97).

Discussion

In this analysis, the vast majority (95%) of sepsis patients in telehealth-capable EDs were managed without the use of telehealth. However, there was substantial variation in telehealth utilization practices between hospitals, with telehealth use ranging from 0–67% of sepsis cases. We also observed that telehealth was more likely to be used for complex patients in smaller hospitals.

There could be many reasons for low sepsis telehealth use. First, sepsis is a relatively common condition with familiar treatment pathways in many EDs. This may mean that local rural providers do not feel that they need additional guidance to manage these patients, and we have shown previously that inter-hospital transfer is a factor associated with many sepsis telehealth cases.[4] Second, sepsis can be difficult to diagnose in patients with vague symptoms, which may limit the use of telehealth for management. Finally, local clinicians may be able to access remote consultation without using the telehealth service (for instance, by telephone). This may mean that consultation can be provided by multiple communication modalities.

Conclusion

Telehealth consultation for rural sepsis care was low (5.5%), and the smallest hospitals were more likely to use tele-ED for rural sepsis patients. Patients with the highest illness complexity and served in the smallest hospitals were most likely to have telehealth used for their care.

Notes

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