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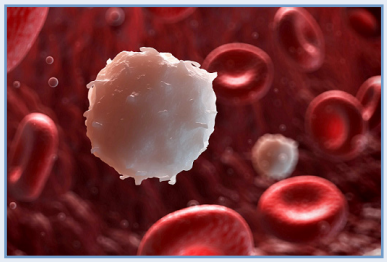
Statistics and Analysis From the Hospital Industry Data Institute

AUGUST 2016 ■ Sepsis Hospitalization Five-Year Trends in Kansas and Missouri



- Sepsis is a dangerous medical condition that is difficult to predict, diagnose and treat. Patients with sepsis are about eight times more likely to die compared to patients without sepsis.
- Sepsis hospitalizations are on the rise nationwide. Recent studies showed that hospitalization rates for sepsis have nearly doubled.
- In Kansas and Missouri, disparities exist across age, gender and admission type for sepsis hospitalizations.
- Measures of sepsis-related hospital mortality and length-of-stay are improving, possibly catalyzed by targeted interventions in Kansas and Missouri that stress early sepsis recognition and treatment, and heightened awareness of efficacious sepsis-related care.

HOSPITAL INDUSTRY DATA INSTITUTE
The Data Company of the Missouri Hospital Association

More than a million Americans are hospitalized with septicemia or sepsis each year. Hospitalizations for this dangerous and potentially deadly illness have nearly doubled from 2000, when approximately 625,000[i] individuals were hospitalized, to 2008, when approximately 1.1 million people were hospitalized. Kansas and Missouri are not outliers in septicemia and sepsis prevalence — the number of cases aligns with national trends. And, focused interventions by hospitals in both states, are resulting in reduced hospital length of stay and mortality.

Septicemia is a dangerous medical condition. It generally originates from a severe localized infection, such as pneumonia, or a kidney or urinary tract infection, which then enters the bloodstream and circulates throughout the body. Septicemia can lead to sepsis, which is a serious complication of septicemia. Sepsis is difficult to predict, diagnose and treat, and can result in a life-threatening systemic inflammatory response, septic shock, multiple organ failure and death.

Both septicemia and sepsis must be treated in a hospital setting. However, even with hospitalization, as many as one-half of patients may not survive.[ii] In fact, patients hospitalized with septicemia or sepsis are about eight times less likely to be discharged alive compared to patients without septicemia or sepsis.[i] Additionally, evidence suggests that an episode of severe sepsis can permanently degrade the immune system, potentially exposing survivors to a heightened risk of infection and death.[iii, iv]

Several national hospital-based initiatives to improve sepsis care and associated patient outcomes are underway. The Surviving Sepsis Campaign[v] defines a set of aggressive evidence-based sepsis care protocols with administrative guidelines requiring completion within hours of identification of the condition. Another high-impact national initiative, HEN 2.0, includes a standardized set of hospital-based septicemia and sepsis measures to support process improvement, which will be comprehensively addressed in the September 2016 edition of *Trajectories*.

Research indicates the proportion of patients hospitalized with septicemia or sepsis has dramatically increased.[i, vi] Researchers observed that hospitalizations with principal diagnoses of septicemia or sepsis increased more than twofold from 2000 to 2008, while hospitalizations with septicemia or sepsis included as the principal or secondary diagnoses increased by 70 percent during the same period.[i] Nearly all of the increase among adult hospitalizations lists septicemia or sepsis as the principal diagnosis, which suggests that community-acquired, rather than hospital-acquired sepsis, is driving the increase.[vii] Regardless of the source, the growth in prevalence is alarming.

Methods and Measures

Hospital Industry Data Institute researchers used a cross-sectional time-series study that deployed the Agency for Healthcare Research and Quality's PSI-13 parameters for ICD-10[viii] diagnoses that subsequently were translated to ICD-9 diagnoses in an effort to produce results maximally aligned with planned ICD-10-based studies and initiatives. One measure, designated *Sepsis*, includes adult hospitalizations with any secondary sepsis diagnosis. The other measure, designated *Hospital-Acquired Sepsis*, includes adult hospitalizations with any secondary sepsis diagnosis not present on admission. Prevalence of sepsis for the Hospital-Acquired Sepsis measure may be artificially high for critical access hospitals because the reporting of POA was optional for those hospitals before October 2015. The data included inpatient records submitted to the Kansas Hospital Association and Missouri Hospital Association, with discharge dates between Oct. 1, 2010, and Sept. 30, 2015. Prevalence calculations used all adult inpatient discharges from Kansas and Missouri hospitals as the denominator.

Excess days were calculated as the propensity score-adjusted marginal average length of stay attributable to sepsis (or hospital-acquired sepsis) multiplied by the number of sepsis discharges for a given year. Excess deaths were estimated as the propensity score-adjusted marginal probability of in-hospital mortality multiplied by the number of sepsis discharges for a given year.

Analysis

In Kansas and Missouri, overall sepsis prevalence — sepsis as a secondary diagnosis — was approximately 6.7 percent across adult inpatient discharges reported from October 2014 to September 2015. Across the same timeframe, the prevalence of hospital-acquired sepsis was 0.69 percent. As recent as 2009, 4.2 percent of patients nationally had some diagnosis of sepsis during their hospitalization.[v] Concurrently, a 2016 study of policy and sepsis rates in California — tracking increases in all sepsis measures regardless of POA — found that rates had more than tripled to 6 percent between 2000 and 2010.[ix] Data from both of these studies frame the prevalence of sepsis across Kansas and Missouri hospital discharges. The methods included in this study attempt to accurately chart the historical frequency and prevalence of sepsis according to the AHRQ-defined ICD-10-based diagnoses in the PSI-13 quality indicator. What is clear from the contemporary research and this analysis is that sepsis, no matter its definition or POA status, is an issue on state and national levels.

As displayed in Table 1, observable disparities exist in sepsis prevalence in Kansas and Missouri by age, gender and admission type. From October 2014 to September 2015, sepsis prevalence for patients ages 18 to 39 was 2.73 percent, but for patients ages 40 to 64, and 65 and older, it was 7.10 percent and 8.74 percent, respectively. Similar disparities are seen for hospital-acquired sepsis, with patients ages 18 to 39 at .22 percent, ages 40 to 64 at .76 percent and ages 65 and over at .92 percent. The positive correlation between age and sepsis risk has been well established. Factors including elevated comorbidity prevalence, compromised health status associated with aging and institutionalization contribute to age-related disparities.[x] Analyzing sepsis prevalence by gender revealed that males experienced a higher rate of sepsis (8.04 percent) than females (5.81 percent). The findings were more disparate for hospital-acquired sepsis prevalence, where male prevalence of .92 percent was nearly double that of female patients at .53 percent. Research indicates that these prevalence disparities likely are due to multiple factors, including

Table 1: Observable Disparities in Sepsis Prevalence in Kansas and Missouri

	All Sepsis – Missouri/Kansas Federal Fiscal Year 2015	Hospital-Acquired Sepsis – MO/KS FFY 2015
Overall	6.72%	0.69%
Gender		
Male	8.04%	0.92%
Female	5.81%	0.53%
Age		
18-39	2.73%	0.22%
40-64	7.10%	0.76%
65+	8.74%	0.92%
Admit Type		
Emergency	9.64%	0.81%
Urgent	6.45%	0.80%
Elective	1.96%	0.40%
Trauma	4.57%	1.83%

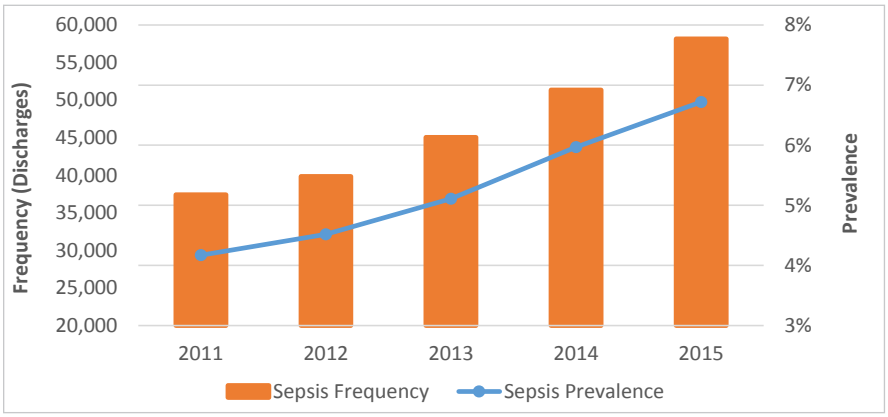
Source: Analysis of federal fiscal year 2011-2015 inpatient discharge data from the Kansas Hospital Association and Missouri Hospital Association

access to health care, economic and social factors, the type or source of infection, and hormonal differences.[xi] Lower rates of primary care utilization by males may influence or explain higher rates of hospitalizations and mortality.[xii] This is consistent with the theory that males may react slower to troublesome symptoms, where the delayed pursuit of care contributes to poorer outcomes and gender disparity in hospitalizations for sepsis. Significant disparities exist in the prevalence of sepsis by admission type (Table 1). Emergency admission for sepsis is most prevalent at 9.64 percent, followed by urgent at 6.45 percent, trauma at 4.57 percent and elective at 1.96 percent. Not surprisingly, trauma had the greatest prevalence of hospital-acquired sepsis at 1.83 percent, distantly followed by emergency at .81 percent, urgent at .80 percent and elective at .40 percent.

An obvious upward trend is observable in overall sepsis and hospital-acquired sepsis throughout the last five federal fiscal years of Kansas and Missouri inpatient data (Figures 1 and 2). The increase in sepsis prevalence has outpaced sepsis frequency 61 percent to 55 percent, respectively. The rate of increase is markedly slower for the hospital-acquired sepsis frequency of 21 percent and prevalence of 25 percent during the same period. Interestingly, the overall sepsis prevalence trend continued in the recently established direction and magnitude (Figure 1), but the hospital-acquired sepsis trend plateaued beginning in FFY 2014 (Figure 2).

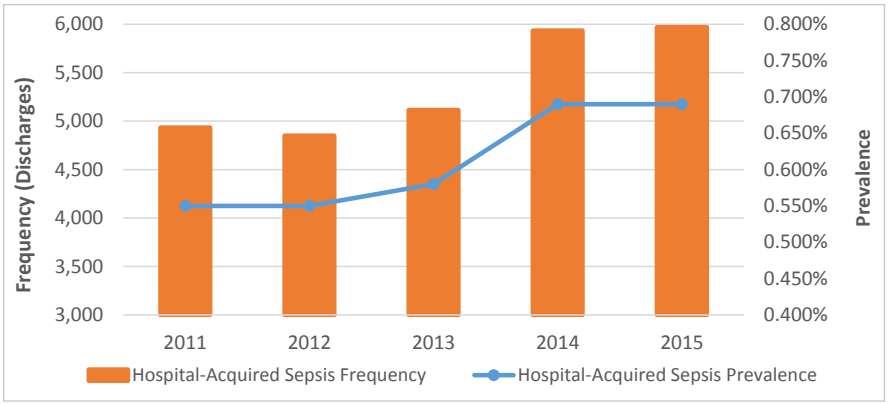
Recent prevalence and frequency trends appear stable across the previously discussed sepsis and hospital-acquired sepsis variables, such as age groupings and gender (Panel 1). As expected, based on the hospital-acquired trend, recent generalized trend flattening is evident among hospital-acquired sepsis age and gender categories.

Figure 1: Sepsis Prevalence and Frequency in Inpatient Hospital Discharges in Kansas and Missouri, FFYs 2011-2015



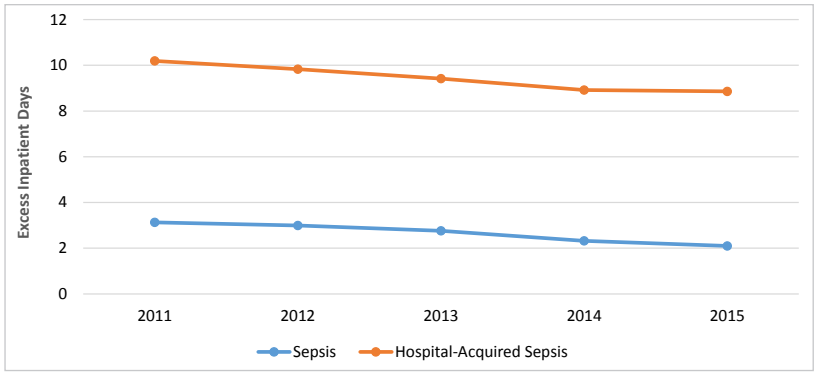
Source: Analysis of federal fiscal year 2011-2015 inpatient discharge data from the Kansas Hospital Association and Missouri Hospital Association

Figure 2: Hospital-Acquired Sepsis Prevalence and Frequency in Inpatient Hospital Discharges in Kansas and Missouri, FFYs 2011-2015



Source: Analysis of federal fiscal year 2011-2015 inpatient discharge data from the Kansas Hospital Association and Missouri Hospital Association

Figure 3: Days of Excess Inpatient Hospital Days per Discharge in Kansas and Missouri, FFYs 2011-2015



Source: Analysis of federal fiscal year 2011-2015 inpatient discharge data from the Kansas Hospital Association and Missouri Hospital Association

While the prevalence of sepsis in Kansas and Missouri hospitals is increasing, the number of days sepsis patients are hospitalized is declining (Figure 3). In FFY 2011, patients with sepsis experienced 3.1 additional days of hospitalization than a typical hospitalization without sepsis. By FFY 2015, the excess hospitalization associated with sepsis was reduced to 2.1 days. Similarly, average excess hospitalization days for hospital-acquired sepsis declined from approximately 10.2 days in FFY 2011, to 8.9 days by 2015. Using FFY 2011 sepsis excess hospitalization days as a benchmark, Kansas and Missouri have reduced sepsis hospitalization by nearly 100,000 days through FFY 2015, including 15,300 days associated with hospital-acquired sepsis (Table 2).

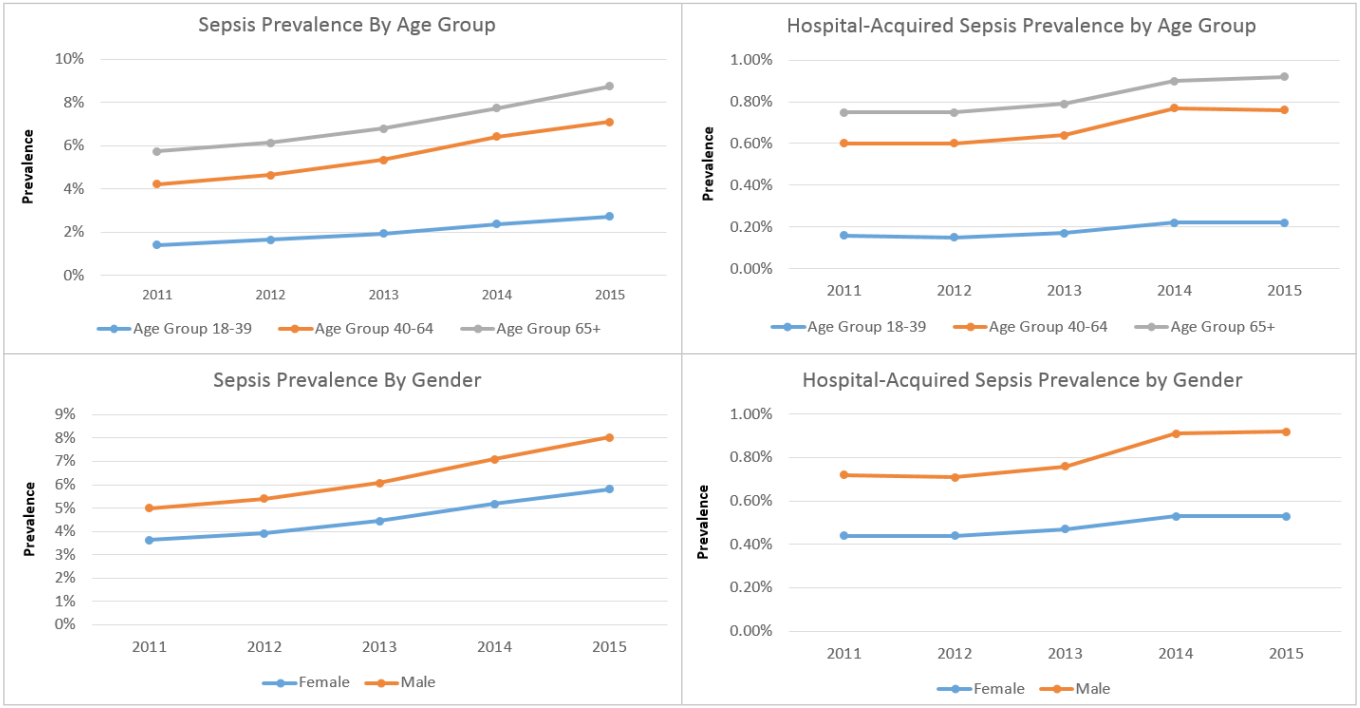
Also on the decline in Kansas and Missouri, is a patient's likelihood of experiencing sepsis-related mortality in a hospital setting. In FFY 2011, individuals hospitalized with sepsis in a Kansas or Missouri hospital experienced a 9.29 times greater chance of dying in the hospital versus individuals with otherwise similar non-sepsis hospitalizations (Panel 2). By the end of FFY 2015, this mortality odds ratio was reduced to 6.16. In FFY 2011, a patient hospitalized with hospital-acquired sepsis had a 22.31 times greater chance of dying in the hospital than otherwise similar non-sepsis hospitalizations, but in FFY 2015, this factor has improved slightly to 20.19.

Table 2: Excess Length of Stay for Sepsis Hospitalizations in Kansas and Missouri, FFYs 2011-2015

	Sepsis		Hospital-Acquired Sepsis	
	Average Excess Days Saved Versus 2011 Benchmark	Total Excess Days Saved Versus 2011 Benchmark	Average Excess Days Saved Versus 2011 Benchmark	Total Excess Days Saved Versus 2011 Benchmark
2012	0.14	5,930	0.36	1,496
2013	0.37	15,319	0.77	3,150
2014	0.81	33,356	1.27	5,171
2015	1.03	42,461	1.33	5,457
		97,066		**15,274**

Source: Analysis of federal fiscal year 2011-2015 inpatient discharge data from the Kansas Hospital Association and Missouri Hospital Association

Panel 1: Sepsis and Hospital-Acquired Sepsis Prevalence and Frequency in Inpatient Hospital Discharges by Age and Gender in Kansas and Missouri, FFYs 2011-2015



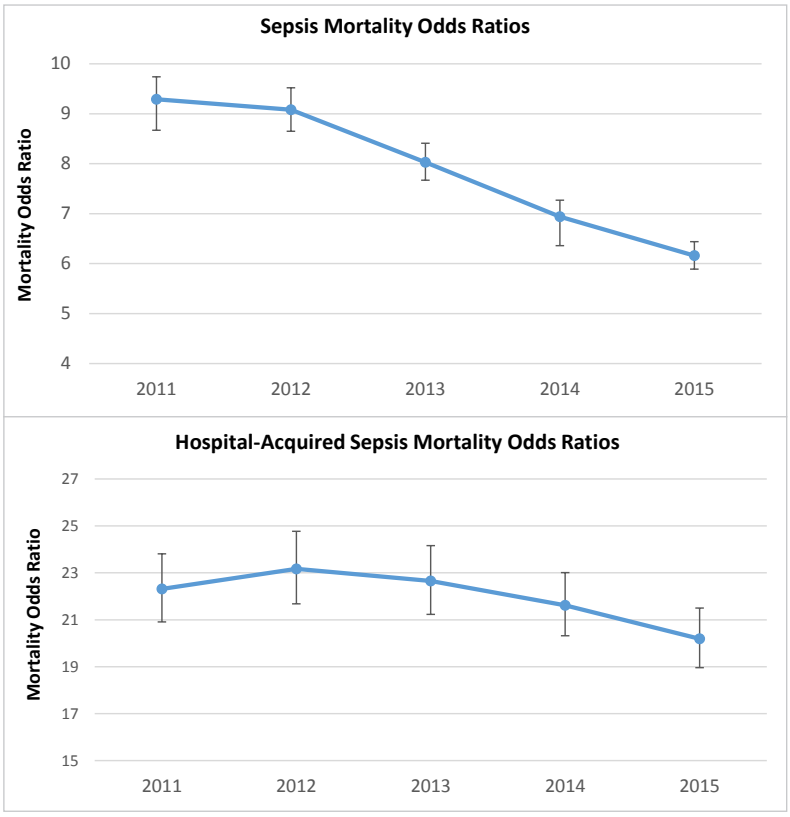
Source: Analysis of federal fiscal year 2011-2015 inpatient discharge data from the Kansas Hospital Association and Missouri Hospital Association

Conclusion

Increasing awareness of sepsis care, and early recognition and intervention, are contributing to better treatment and outcomes. MHA and the Kansas Healthcare Collaborative currently are leading statewide sepsis prevention projects through the American Hospital Association/ Health Research and Educational Trust Hospital Engagement Network (HEN 2.0). MHA has developed and led an immersion project designed to improve sepsis recognition, process standardization and prompt interventions through evidence-based practices. The immersion project offers a 12-month structured framework with quarterly tasks for participants to complete, leading to earlier recognition and intervention of sepsis. In addition, select Kansas hospitals have been involved in the Kansas Sepsis Project, which was launched in 2009 by the University of Kansas and the Midwest Critical Care Collaborative.

Although sepsis prevalence is on the rise nationwide, the duration of sepsis hospitalization and sepsis-related mortality in hospitals are declining in Kansas and Missouri. The Centers for Disease Control and Prevention suggests that this sustained surge in prevalence could be due to the advancing average age of the population, an increased prevalence of chronic illness, heightened awareness and tracking of sepsis by medical professionals, the proliferation of antibiotic-resistant microbes, and rising trends in patients receiving more invasive procedures, immunosuppressive pharmaceuticals, chemotherapy and organ transplantation.[xiii] Researchers have suggested that the Centers for Medicare & Medicaid Services' guidance regarding sepsis ICD-9 coding may be unintentionally generating surveillance bias. This may lead to additional cases of less severely ill sepsis patients being identified in recent years, which would tend to have a less burdensome impact on case-mix and a corresponding desirable impact on mortality rates.[ix] Alternatively, contributions to this positive change in mortality may be attributable to targeted interventions in Kansas and Missouri within the hospital setting. By prioritizing early recognition of sepsis and expanding awareness of efficacious sepsis care, hospitals may be bending the curve on sepsis patient excess hospitalization and patient mortality. Additional data is needed to estimate the influence that these interventions have on sepsis care and outcomes in Kansas and Missouri.

Panel 2: Sepsis and Hospital-Acquired Sepsis Mortality Odds Ratios in Kansas and Missouri, FFYs 2011-2015



Source: Analysis of federal fiscal year 2011-2015 inpatient discharge data from the Kansas Hospital Association and Missouri Hospital Association

Suggested Citation

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[i] Hall, M., Williams, S., DeFrances, C. & Golosinskiy, A. (2011). *Inpatient care for septicemia or sepsis: A challenge for patients and hospitals.* U.S. Department of Health & Human Services. National Center for Health Statistics Data Brief #62. Retrieved from http://www.cdc.gov/nchs/products/databriefs/db62.htm

[ii] Wood K. & Angus, D. (2004). Pharmacoeconomic implications of new therapies in sepsis. *PharmacoEconomics, 22*(14), 895-906.

[iii] Yende, S. & Angus, D. (2007, September). Long-term outcomes from sepsis. *Current Infectious Disease Reports, 9*(5), 382-386.

[iv] Yende, S., Iwashyna, T. & Angus, D. (2014). Interplay between sepsis and chronic health. *Trends in Molecular Medicine, 20*(4), 234-238.

[v] Dellinger, R., Levy, M., Rhodes, A., Annane, D., et al. (2013). International guidelines for management of severe sepsis and septic shock: 2012. *Critical Care Medicine, 41*(2), 580-637.

[vi] Walkey, A., Lagu, T. & Lindenauer, P. (2015). Trends in sepsis and infection sources in the United States: A population study. *Annals of the American Thoracic Society, 12*(2), 216-220.

[vii] Sutton, J. & Friedman, B. (2013, September). *Trends in septicemia hospitalizations and readmissions in selected HCUP states, 2005 and 2010.* HCUP Statistical Brief #161. Rockville, MD: Agency for Healthcare Research and Quality. Retrieved from http://www.hcup-us.ahrq.gov/reports/statbriefs/sb161.pdf

[viii] AHRQ Quality Indicators (AHRQ QI) ICD-9-CM and ICD-10-CM/PCS Specification Enhanced Version 5.0. Patient Safety Indicators #13 (PSI #13) Postoperative Sepsis Rate. (2015, October). Retrieved from http://www.qualityindicators.ahrq.gov/Downloads/Modules/PSI/V50-ICD10/TechSpecs/PSI%2013%20Postoperative%20Sepsis%20Rate.pdf

[ix] Gohil, S., Cao, C., Phelan, M., Tjoa, T., Rhee, C., Platt, R. & Huang, S. (2016). Impact of policies on the rise in sepsis incidence, 2000-2010. *Clinical Infectious Diseases, 62*(6), 695-703.

[x] Girard, T., Opal, S. & Ely, E. (2005). Insights into severe sepsis in older patients: From epidemiology to evidence-based management. *Aging and Infectious Diseases, 40*, 719-727.

[xi] Esper, A., Moss, M., Lewis, C., Nisbet, R. Mannino, D. & Martin,G. (2006). The role of infection and comorbitidy: Factors that influence disparities in sepsis. *Critical Care Medicine, 34*(10), 2576-2582.

[xii] Juel, K. & Christensen, K. (2008). Are men seeking medical advice too late? Contacts to general practitioners and hospital admissions in Denmark, 2005. *Journal of Public Health, 30*(1), 111-113.

[xiii] Centers for Disease Control and Prevention. Sepsis Questions and Answers. Retrieved from http://www.cdc.gov/sepsis/basic/qa.html

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Appendix A: Sepsis Measures

Data: Fiscal years 2011 through 2015 inpatient discharges for Kansas and Missouri

Measures

Sepsis: Inpatient encounters with a secondary diagnosis of sepsis among all inpatient encounters for patients ages 18 and older

- Numerator: Inpatient discharges with 1+ AHRQ-designated (the codes are GEM-coded ICD-10 diagnosis codes for PSI-13) ICD-9 secondary diagnosis codes for sepsis among patients age 18+
- Denominator: Inpatient discharges for MO/KS hospitals ages 18+

Hospital-Acquired Sepsis: Inpatient encounters with a secondary diagnosis of sepsis among all inpatient encounters for patients ages 18 and older

- Numerator: Inpatient discharges with 1+ AHRQ-designated ICD-9 secondary diagnosis codes for sepsis where POA=N among patients age 18+ (the diagnosis codes are GEM-coded ICD-10 diagnosis codes for PSI-13)
- Denominator: Inpatient discharges for MO/KS hospitals age 18+
- Exclusions: Inpatient discharges with 1+ AHRQ-designated diagnosis codes for sepsis where POA=Y

Mortality: Deaths among all inpatient encounters for patients ages 18 and older

- Numerator: Inpatient discharges with a UB-04 disposition code of 20, 40, 41, 42 among patients age 18+
- Denominator: Inpatient discharges for MO/KS hospitals age 18+
- Exclusions: Discharge disposition missing, unavailable or 07 (AMA)

Geometric Mean Length of Stay (ALOS): Log-transformed length of hospital stay in days among patients ages 18 and older

- Numerator: Sum of log-transformed hospital days for inpatient encounters among patients age 18+, calculated for each inpatient encounter as natural log ((Discharge Date – Admit Date) + 1)
- Denominator: Inpatient discharges for MO/KS hospitals age 18+
- Inverse log transformations will be applied to reported values to aid interpretation on natural scale (days)

Data Analysis: Data were described using frequency tables for categorical variables and means and standard deviations for continuous variables. Cross-classification techniques and chi-square tests of independence were used to assess variation in prevalence estimates across levels of sociodemographic status, clinical status hospital type and discharge year factors. Linear graphs were used to display overall and stratum-specific prevalence estimates. Generalized linear model techniques with propensity score adjustments to account for differential patient risk distributions will be used to estimate the marginal effect of sepsis on LOS and inpatient mortality. Sepsis propensity scores were estimated using logistic regression to model sepsis status as a function of main and two-way interaction effects of patient major diagnostic category, age, gender, race/ethnicity, admit source and admit type. Model probabilities were classified into deciles that were then included as covariates in subsequent models LOS and mortality as a function of sepsis status. An unadjusted alpha of .05 was used for all tests of significance. All analyses were conducted separately with Kansas and Missouri data and reviewed for similarity prior to production of aggregate bistate results.

Secondary diagnosis codes used to define overall and hospital-acquired sepsis measures. The code list was derived by GEM-coding AHRQ-designated ICD-10 PSI-13 diagnosis codes.

ICD-9	Description
0031	SALMONELLA SEPTICEMIA
0223	ANTHRAX SEPTICEMIA
0270	LISTERIOSIS
0271	ERYSIPELOTHRIX INFECTION
0380	STREPTOCOCCAL SEPTICEMIA
3810	STAPHYLCOCC SEPTICEM NOS
3811	METH SUSC STAPH AUR SEPT
3812	MRSA SEPTICEMIA
3819	STAPHYLCOCC SEPTICEM NEC
0382	PNEUMOCOCCAL SEPTICEMIA
0383	ANAEROBIC SEPTICEMIA
3840	GRAM-NEG SEPTICEMIA NOS
3841	H. INFLUENAE SEPTICEMIA
3842	E COLI SEPTICEMIA
3843	PSEUDOMONAS SEPTICEMIA
3844	SERRATIA SEPTICEMIA
3849	GRAM-NEG SEPTICEMIA NEC
0388	SEPTICEMIA NEC
0389	SEPTICEMIA NOS
9889	GONOCOCCAL INF SITE NEC
1125	DISSEMINATED CANDIDIASIS
78552	SEPTIC SHOCK
99591	SEPSIS
99592	SEVERE SEPSIS
99800	POSTOPERATIVE SHOCK, NOS