Summary of Specific Healthcare-Associated Infections (HAIs)

2013 Results

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ACRONYMS

ARRA	American Recovery and Reinvestment Act
CAH	Critical Access Hospital
CAUTIs	Catheter-associated urinary tract infections
CI	Confidence interval
CDC	Centers for Disease Control and Prevention
CLABSIs	Central line-associated bloodstream infections
CMS	Centers for Medicare and Medicaid Services
COLO	Colon Surgery
DUR	Device utilization ratio
HAIs	Healthcare-associated infections
HHS	US Department of Health and Human Services
HYST	Hysterectomy Surgery
ICUs	Intensive care units
IP	Infection Preventionist
IPPS	Inpatient Prospective Payment System
KDHE	Kansas Department of Health and Environment
KHAIRG	Kansas Healthcare-Associated Infections Reporting Group
KS	Kansas
LabID	Laboratory Identified
NHSN	National Healthcare Safety Network
MDRO	Multi-drug Resistant Organism
MRSA	Methicillin-resistant *Staphylococcus aureus*
SICU	Surgical intensive care unit
SIR	Standardized infection ratio
SSI	Surgical Site Infection
US	United States

Executive Summary

Overview

In 2013, many hospitals in Kansas submitted data about specific healthcare-associated infections (HAIs) to the Centers for Disease Control and Prevention's (CDC) National Healthcare Safety Network (NHSN), a secure, online surveillance system used by hospitals and other healthcare facilities. HAIs are infections acquired during the delivery of medical care that were not present or incubating upon exposure to the healthcare setting; they are largely preventable. Eighty hospitals voluntarily shared HAI data with the Kansas Department of Health and Environment (KDHE) through a data sharing group established within NHSN. Monthly data from January 1 to December 31, 2013 were analyzed for acute care hospitals that participated in the Inpatient Prospective Payments System (IPPS) through the Centers for Medicare and Medicaid Services (CMS) and also for critical access hospitals (CAH) contributing data on surgical site infections (SSIs) and multi-drug resistant organisms (MDROs). Data were analyzed from intensive care units about specific HAIs related to the use of medical devices: central line-associated bloodstream infections (CLABSIs) and catheter-associated urinary tract infections (CAUTIs). Additionally, data were analyzed about surgical site infections from abdominal hysterectomy (HYST) surgeries and colon (COLO) surgeries. This report also introduces the first-ever state-specific baseline estimates for laboratory identified, hospital-onset, MDROs. Specificially, *Clostridium difficile* infections and methicillin-resistant *Staphylococcus aureus* bloodstream infections (bacteremia).

Aggregate data analysis suggests that facilities participating in the Kansas HAI Reporting Group (KHAIRG) in 2013 had significantly fewer CLABSI, HYST, *C. difficile*, and MRSA bloodstream infections, based on their respective national baseline data (CLABSI and HYST from 2006-2008; *C. difficile* and MRSA from 2010-2011). CLABSI, HYST, and MRSA bloodstream infections also significantly outperformed national results from 2013.

Key Findings:

- Proportionally, Kansas had fewer CLABSIs in IPPS hospital ICUs than the nation in 2013.
- There were more CAUTIs in Kansas in 2013 than there were in 2012. Nationally, there has been an increase in CAUTIs.
- There were statistical fewer surgical site infections from abdominal hysterectomy (HYST) surgeries but statistically more infections from colon (COLO) surgeries between Kansas and the nation in 2013.
- Proportionally, Kansas is experiencing about the same level of infections from *C. difficile* as the US in 2013
- There were statistical fewer MRSA bloodstream infections between Kansas and the nation in 2013
- Kansas met the United States (US) Department of Health and Human Services (HHS) 2013 target goals of a 50% reduction in CLABSI, and 25% reduction in HYST from 2006-2008 levels and 25% reduction in MRSA bloodstream infections from 2010-2011 levels.
- The Kansas HAI Program has enabled a growing number of healthcare facilities across the continuum of care to collaborate in surveillance and prevention of these infections.

Summary of Specific Healthcare-Associated Infections (HAIs) in Kansas, 2013

Introduction

In 2009, the United States Department of Health and Human Services (HHS) released the *Action Plan to Prevent HAIs*, which established national goals and metrics for HAI prevention activities and outlined key actions for achieving reductions in the most common, costly, and deadly HAIs. In the same year, KDHE was awarded funding through the American Recovery and Reinvestment Act (ARRA) to support state-level infrastructure for coordination of HAI surveillance activities. The Kansas HAI Advisory Group (Appendix A) developed a comprehensive HAI state plan and identified HAI surveillance indicators based on the existence of evidence-based practice guidelines, morbidity / mortality associated with each HAI, and the ability to significantly improve patient outcomes. The HAI indicators chosen for surveillance, beginning in 2011, were CLABSIs and CAUTIs in adult ICUs. In 2012, these expanded to include COLO and HSYT SSIs, and in 2013 expanded to include the hospital-onset MDRO's *C. difficile* and MRSA bacteremia.

In 2010, The Kansas HAI Program was created within the Bureau of Epidemiology and Public Health Informatics (formerly Bureau of Surveillance and Epidemiology), Division of Public Health (formerly Division of Health), at KDHE. The program is comprised of a Program Director and a program Epidemiologist, with in-kind program support from the State Epidemiologist & Bureau Director of Epidemiology and Public Health Informatics; the Public Health Informatics Director, Deputy Bureau Director of Epidemiology and Public Health Informatics, and State Registrar; and the Secretary of KDHE & State Health Officer. Guided by the mission set forth by the Kansas HAI Advisory Group, the KDHE HAI Program coordinates statewide HAI prevention and surveillance efforts across the continuum of care. The program has fostered key relationships between the healthcare provider community and state agencies and routinely provides consultative services on issues pertaining to infection prevention and control. One of the key constituents served, are staff in healthcare facilities responsible for infection prevention and control activities, called infection preventionists (IPs).

In 2010, Centers for Medicare and Medicaid Services (CMS) took a major step in recognizing the importance of surveillance and prevention of HAI for reduction of healthcare costs. CMS implemented rules that, beginning in 2011, provided hospitals participating in the Hospital Inpatient Prospective Payment System (IPPS) with financial incentives to report HAI data. These incentives provided strong encouragement for hospitals to take actions toward accomplishing the goals set forth in the HHS *Action Plan to Prevent HAIs*. The HAI indicators chosen by CMS were the same indicators that were predicted by the expert panel members of the Kansas HAI Advisory Group.

Objective

This study was conducted to estimate the burden of illness of six specific HAIs: CLABSIs and CAUTIs in ICUs of hospitals participating in IPPS, SSIs from colon and abdominal hysterectomy surgeries in hospitals providing surgical services, and laboratory identified hospital-onset MDRO infections from *C. difficile* and MRSA bacteremia. Its purpose is to provide meaningful information for monitoring the progress made toward meeting national goals of eliminating HAIs.

Study Population

The study population for device associated surveillance included a representative sample of all patients admitted to ICUs in Kansas at hospitals participating in IPPS, all patients undergoing colon and abdominal hysterectomy surgeries for surgical infection surveillance, and all patients admitted to IPPS or CAH acute care hospitals for MDRO surveillance.

Study Design

The results of this study refer to HAI surveillance from January through December 2013 from hospitals that reported data to the CDC by August 1, 2014.

A cross-sectional design was utilized for this study. Representativeness of the available data was assessed by determining the number of hospitals by type, number of hospitals that belonged to the Kansas HAI Reporting Group (KHAIRG), number of hospitals that reported greater than one month of data, the percent of staffed beds KHAIRG member hospitals have out of the total staffed beds in Kansas, and the percent of ICU beds KHAIRG member hospitals have out of the total ICU beds in Kansas.

Completeness and volume of CLABSI and CAUTI data were assessed by determining the number of eligible IPPS hospitals reporting data and number of ICUs within those hospitals for which data was reported. Completeness of SSI data was also assessed by determining the number of eligible IPPS hospital reporting data for which data was reported, but also included data from contributing CAHs. Volume of SSI data was assessed by determining the number of procedures performed. Completeness and volume of MDRO data were assessed by determining the number of eligible IPPS hospitals reporting data for which data was reported.

The Device Utilization Ratio (DUR) was aggregated for all ICUs, and stratified by ICU type to estimate potential patient exposure risk for acquiring a CLABSI or CAUTI. The DUR is the ratio of patient-days in which patients had central-line or urinary catheter devices in place divided by the total number of patient-days.

To estimate the burden of illness of CLABSIs and CAUTIs in ICU units of IPPS hospitals within Kansas, SSIs from COLO and HYST procedures, and *C. difficile* and MRSA bacteremia infections, the numbers of observed and expected infections in Kansas were used to calculate the Standardized Infection Ratio (SIR). For CLABSI and CAUTI the SIR was aggregated for all ICU types that are found in Kansas and was stratified by ICU type. The SIR is the ratio of the observed number of infections to the number of expected infections. In this study, the number of expected CLABSI and SSI infections are calculated by applying the US baseline from 2006-2008 to the patient population in Kansas. The number of expected CAUTI infections is calculated by applying the US baseline from 2009. The number of expected MDRO infections is calculated by applying the US baseline from 2010-2011. To provide a more meaningful comparison, the results of the 2013 US SIR were also compared with the 2013 Kansas SIR using a statistical test to determine whether they are statistically different. To provide trend comparisons, when applicable, the results of the 2012 and 2013 Kansas SIR were also compared using the same statistical test.

Patient- and facility-specific data reported to CDC are kept confidential in accordance with section 304, 306, and 308(d) of the Public Health Service Act (42 USC 242b, 242k, and 242m(d)).

Methods

Data Source

The available CLABSI and CAUTI data for Kansas are from 53 IPPS hospital ICU units. SSI data are from 47 IPPS and 5 CAH hospitals, C. difficile data are from 61 hospitals, and MRSA bacteremia data are from 57 hospitals. These facilities voluntarily contribute data to the KHAIRG through NHSN.

Data Collection

De-identified patient information about CLABSIs, CAUTIs, SSIs, and MDROs are voluntarily submitted monthly by hospitals in Kansas. Data for intensive care units, surgical procedures, and laboratory identified MDRO events are entered into a secure website interface for the NHSN database. Hospital characteristics were measured from an annual self-reported survey used for accreditation with CMS and from an annual self-reported survey in NHSN.[1] All hospitals not sharing data with KDHE through NHSN provided ICU bed counts through a voluntary ad hoc self-reported survey. Data completeness and volume were measured from NHSN.

The number of patient days, the number of central line days, the number of indwelling urinary catheter days, demographic and clinical information about each surgical patient and each procedure, and the number of CLABSI, CAUTI, SSI, and MDRO events that meet NHSN case definitions were entered by infection preventionists (IPs) at each facility. Central line days and urinary catheter days were counted at the same time each day. While only one indwelling urinary catheter is typically used on a patient, there could be more than one central line in use for some patients. Each patient with one or more central lines at the time the count was performed was considered one central line day. Each patient with an indwelling urinary catheter in place at the time the count was performed was considered one urinary catheter day. A CLABSI event referred to a bloodstream infection that occurred in a patient with a central line in place and that met a number of additional criteria which assess its relation to other infection sources, per NHSN surveillance definitions.[2] A CAUTI event referred to a urinary tract infection which occurred in a patient with an indwelling urinary catheter in place, and also met a number of additional criteria which assess its relation to other infection sources, per NHSN surveillance definitions.[3] An SSI event referred to an infection that met the 30-day complex admission/readmission model for SSI, and also met a number of additional criteria which assess its relation to other infection sources, per NHSN surveillance definitions.[4] An MDRO event referred to an infection identified through laboratory testing to find the specific organisms *C. difficile*, in stool specimens, and MRSA, in blood specimens; that also met a number of additional criteria, per NHSN surveillance definitions.[5] Events reported in NHSN met specific surveillance definitions which were designed to be applied in a standardized method for all cases.[6] The surveillance definition could be different from the clinical determination used to treat a patient.

KDHE was able to view and analyze data in NHSN only for facilities that actively conferred rights to KHAIRG in NHSN. Facilities that submitted data allowed KDHE access to this information for the specific purposes of surveillance and aggregate public reporting of HAI indicators in Kansas.

Data underwent a routine review by Kansas HAI Program staff, and facilities that had data missing were notified. All CLABSI, CAUTI, and SSI events entered into NHSN were reviewed to determine appropriate application of NHSN surveillance definitions. Any fluctuations in denominator data were discussed with facilities, as they potentially could have been an indication of error (the numbers of patient days and central line days are typically relatively similar from month to month). Patient days, central line days, and urinary catheter days were also reviewed to ensure that the number of these devices' days did not exceed the number of patient days. Facilities were encouraged to consult KDHE and NHSN personnel to review suspect cases that were difficult to classify. Data quality checks were performed against the denominator data submitted. The goal was to ensure that the information reported was timely and accurate.

Data Analysis

Risk adjustment is used by NHSN to adjust for potential differences in patient populations and their underlying risk.[7] The way in which NHSN allows for individual hospitals to compare their CLABSI and CAUTI data with national outcomes is by establishing definitions for specific unit types. Hospitals use these definitions to classify their units in a standardized fashion, thereby limiting comparison to national patient populations with similar risk factors. For example, adult surgical intensive care unit (SICU) data was compared to data from other adult SICUs.

Because data from all patients for all times at a given healthcare facility cannot be obtained (i.e., a hospital's true population data), it is conventional to use statistical procedures to estimate various measurements. Ninety-five percent confidence intervals (CI) are used to describe the variability around an estimate. The CIs that are used in this report provide the range within which the true value will fall 95% of the time. Confidence intervals are expressed as upper and lower limits, between which likely lies the true value. An additional statistical test reported is that of the p-value, which tells the statistical significance of a result. This report considers a p-value of $p < 0.05$ as statistically significant.

KHAIRG Facilities
The number of facilities reporting data to KHAIRG in NHSN was obtained from the analysis feature in NHSN. As a group, these hospitals were compared with all hospitals in Kansas for percentage of staffed beds and percentage of ICU beds. The number of staffed beds was obtained from the 2013 Kansas Hospital Survey.[1] The number of ICU beds for KHAIRG members was obtained from NHSN. For hospitals not participating in the KHAIRG, the number of ICU beds was obtained from a voluntary survey. In general, very few critical access hospitals (CAHs) have ICU beds and very rarely use central line devices or maintain inpatients with these devices in place for a relevant duration of time, and were therefore not included in the calculation of the percent of ICU beds, nor were they included in the total percent of ICU beds. Hospitals that belonged to KHAIRG but that did not report data had no ICU beds did not affect the calculation of percent staffed or ICU beds.

Data volume
Data for the Kansas HAI Reporting Group was obtained from the analysis feature in NHSN.

Device utilization
The use of an invasive device is an extrinsic risk factor for the acquisition of a healthcare-associated infection and is one measure of invasive practice. DUR is measured as a ratio of device days to patient days for each hospital unit type. A high DUR constitutes a greater risk for HAIs. DUR may also serve as a marker for severity of illness of patients, that is, patients' intrinsic susceptibility to infection.

Pooled mean was used to convey the proportion of days a device (a central line or indwelling urinary catheter) was used out of the total patient days. In this report, the term "pooled mean" has the same meaning as "mean" or "average." Multiplying this proportion by 100 would provide an average percentage of patient days that a device was used. The national pooled mean for 2006-2008, 2009, 2010, 2011, and 2012, was obtained from NHSN reports.[8-12] The national baseline period for CLABSI and SSI was 2006-2008. The national baseline period for CAUTI was 2009. The national baseline period for *C. difficile* and MRSA bacteremia was 2010-2011. For comparability, national pooled means were limited to adult ICU unit types found in Kansas: burn, medical, medical cardiac, medical/surgical, neurosurgical, surgical cardiothoracic, surgical, and trauma critical care. Excluded were: neurologic, prenatal, and respiratory critical care. Patient days occurred in nearly the same proportion by unit type in the national data as they occurred in Kansas. To prevent facility-specific results identification, reporting by unit type was limited to unit types where five or more facilities reported data to the KHAIRG. Comparisons of pooled mean rates were performed using a Poisson test.

Standardized Infection Ratio (SIR)
SIRs can be calculated at different levels: state, group of facilities, facility, or unit. Most importantly, SIRs can track trends over time in single units or large groups and will reflect changes in risk over time.

The SIR is a ratio that compares the number of observed events to the number expected.

$$\text{SIR} = \frac{\text{observed}}{\text{expected}} = \frac{\text{\# of infections}}{\text{\# of device days} \times \left(\frac{\text{baseline infection rate}}{1000}\right)}$$

A SIR less than 1 indicates that the number of observed HAI events is fewer than the number expected, while a SIR greater than 1 indicates that the number of observed events is greater than expected.

> **Limitations to the SIR*: The reference population is based on data submitted nationally to NHSN from a time in the past (baseline) for which the risk factors are likely to have changed over time. When comparing SIR calculations across a stratum, they cannot be validly ranked.

The SIR for SSIs is calculated using a procedure-specific risk model (logistic regression). From a multivariate analysis published by Edwards et al., titled *Improving Risk-Adjusted Measures of Surgical Site Infections for the National Healthcare Safety Network*, standardized results of significant risk factors are defined.[13] A full description of the how the SIR is calculated is available in the December 10, 2010 edition of the *NHSN e-News: SIRs Special Edition*. [14]

The SIR for MDRO LabID Events is calculated using an event-specific risk model (negative binomial regression). From a multivariate analysis published by Dudeck et al., titled *Risk Adjustment for Healthcare Facility-Onset C. difficile and MRSA Bacteremia Laboratory-identified Event Reporting in NHSN*, standardized risk factors are defined along with a full description of how the SIR is calculate.[15]

Financial
In order to estimate the burden of costs associated with CLABSIs and CAUTIs in acute care hospitals, COLO and HYST SSIs and *C. difficile* infections in all hospitals, a metric was developed using estimates from the US Consumer Price Index (CPI) for both urban consumers (which is believed to underestimate cost) and Inpatient Hospital Services (which is believed to overestimate costs), adjusted to 2007 dollars. From the national estimates of the cost per CLABSI, CAUTI, and SSI, the results were then multiplied by the number of infections reported to the KHAIRG.[16] The expected number of infections, based on the national baseline periods, were also multiplied by the national estimates of the cost. The differences in estimated costs from the baseline periods to the current period were calculated to estimate the potential savings.

Despite this being the best metric currently available to use, the results should be interpreted carefully as there is significant potential for variability, and the potential for a wide margin of error.

Results

Kansas HAI Reporting Group (KHAIRG) Facilities

In 2013, 80 facilities were enrolled in NHSN and belonged to the KHAIRG to voluntarily share HAI data. These included acute care hospitals (ACH), which for the purposes of this report are hospitals with more than 25 beds, and critical access hospitals (CAH), which are hospitals with 25 beds or fewer (designated as such by CMS and the state of Kansas).

Table 1 summarizes the number of hospitals in Kansas in 2013 by type (ACH and CAH), number of hospitals that belonged to the KHAIRG, number of hospitals that reported greater than one month of data, percent of staffed beds KHAIRG member hospitals had out of the total staffed beds in Kansas, and the percent of ICU beds KHAIRG member hospitals had out of the total ICU beds in Kansas.

By the end of data collection for 2013, 80 healthcare facilities, predominately ACHs, belonged to the KHAIRG (Table 1). Of these, 76 shared at least one month of data with KHAIRG. This group of ACH hospitals represented 96% of all staffed beds and 97% of all ICU beds in Kansas.

Table 1. Number and volume of facilities reporting to the Kansas HAI Reporting Group, 2013.

	KS Hospitals	KS hospitals belonging to KHAIRG	KS hospitals reporting >= 1 month of data to KHAIRG	% of staffed beds, KS hospitals reporting >= 1 month of data to KHAIRG vs. KS	% of ICU beds, KS hospitals reporting >= 1 month of data to KHAIRG vs. KS
ACHs	54	53	52	96%	97%
CAHs	83	24	21	27%	83%
IRFs	4	3	3	65%	N/A
All	**141**	**80**	**76**	**80%**	**97%**

Central-line Associated Blood Stream Infections

CLABSI Data

Figure 1: Count of Kansas hospitals and adult ICU units that reported CLABSI data, 2013.

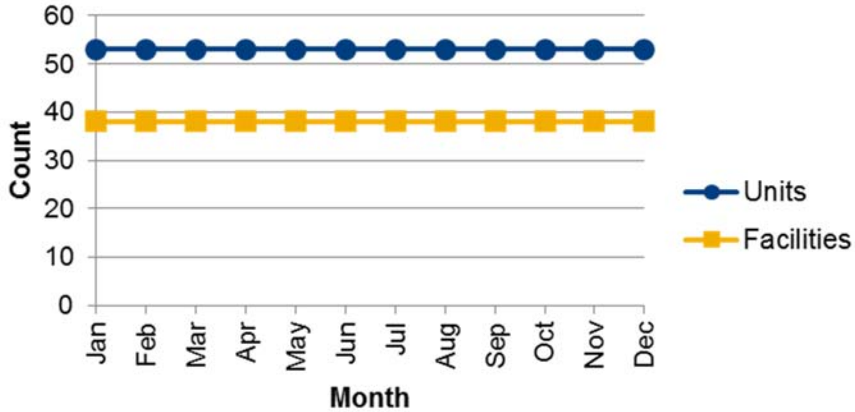
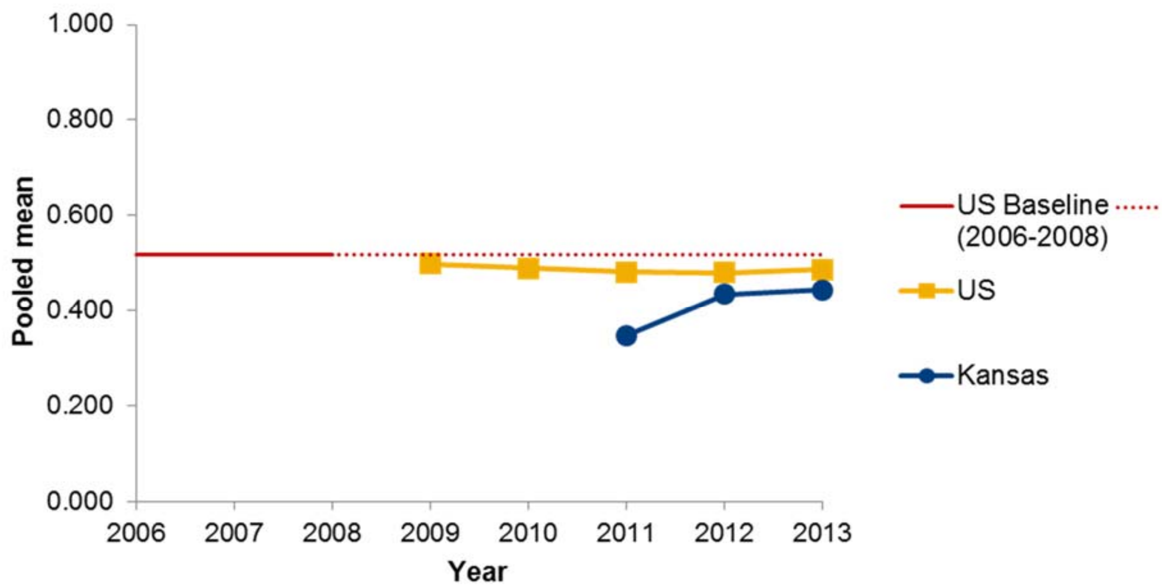


Figure 1 depicts the number of ACHs that reported CLABSI data, by month, during 2013. Because some hospitals have more than one adult ICU, of the same or of varying types, Figure 1 also depicts the number of individual component adult ICU units that reported CLABSI data. A total of 38 facilities submitted CLABSI data for 53 ICUs between January 1 and December 31, 2013. In total, 636 months of unit-specific data were reported. There was no variability in the number of facilities and units reporting data every month. Since CMS requires reporting of all ICUs from ACHs, variability in this measure would indicate that a facility or unit either closed or merged with another, was inactivated for a period of time (e.g. for construction), or failed to report data for the facility or unit. No facilities or units with CMS requirements to report CLABSI data were closed or merged, were inactive during any one month; nor failed to report data in 2013.

Device Utilization Ratio

The device utilization ratio (DUR) constitutes an extrinsic risk factor for HAI. When fewer devices are used the risks of HAIs are lower. In 2013, a central line device was used during 44% of ICU patient days in Kansas, compared to 49% of ICU patient days in the US (Figure 2 and Appendix B, Table 12). The difference between Kansas and the US in 2013 was statistically significant ($p < 0.0001$). There was a statistically significant increase in the central-line device utilization ratio observed in Kansas ICUs in 2013 compared to 2012 (44% vs. 44%; $p = 0.0023$). There were, however, fewer central-line device-days in 2013 (64,481 vs. 65,203, a 1% change), and fewer patient-days (145,139 vs. 149,778, a 3% change).

Figure 2. Pooled mean of patient days in adult ICUs with a central line device in use, US trend and Kansas, 2013.



Figures 3-4 show the pooled mean device utilization ratios for two of the most common types of adult ICUs found in Kansas. In 2013, a central line device was used during 51% of medical ICU patient days in Kansas, compared to 51% of medical ICU patient days in the US (Figure 3 and Appendix B, Table 13). Medical ICUs provided the most influence on the higher overall device utilization ratio in Kansas. A central line device was used during 43% of medical/surgical ICU patient days, in Kansas, compared to 45% of medical/surgical ICU patient days, in the US (Figure 4). The difference between Kansas and the US for each unit type, in 2013 was statistically significant ($p < 0.0001$). There was a statistically significant increase in the central-line device utilization ratio observed in Kansas medical ICUs in 2013 compared to 2012 (51% vs. 45%; $p < 0.0001$). There were, however, more central-line device-days in 2013 (11,886 vs. 10,528, an 11% change), but nearly the same patient-days in 2013 (23,303 vs. 23,286). There was a statistically significant increase in the central-line device utilization ratio observed in Kansas medical/surgical ICUs in 2013 compared to 2012 (43% vs. 42%; $p < 0.0001$). There were, however, more central-line device-days in 2013 (29,703 vs. 29,053, a 2% change), but nearly the same patient-days in 2013 (68,930 vs. 68,905).

Figures 3-4. Pooled mean of patient days in adult ICUs, by type, with central line device(s) in use, US trend and Kansas, 2013.

Figure 3. Medical

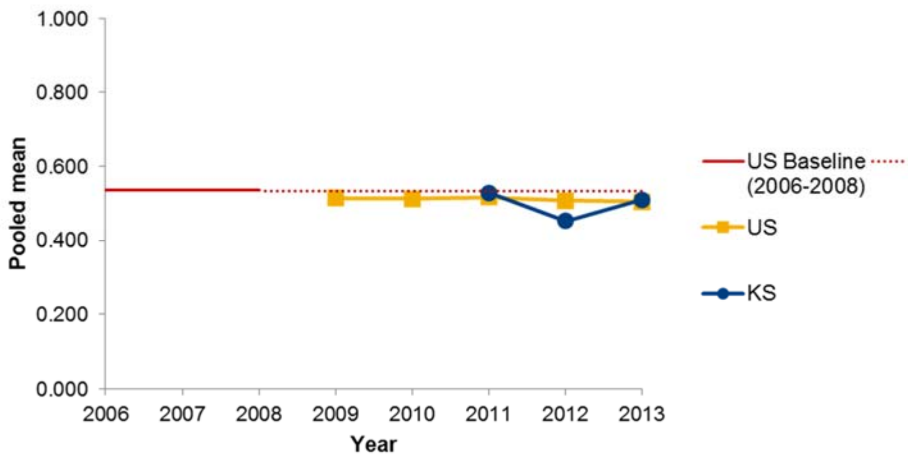
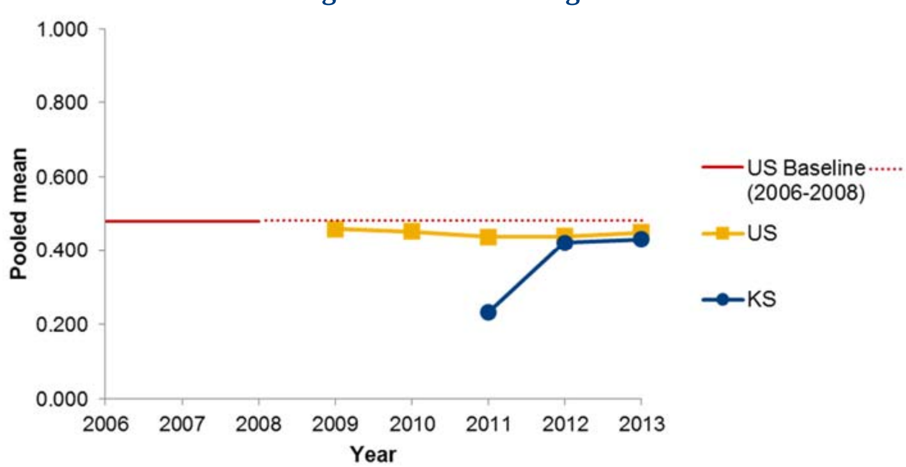


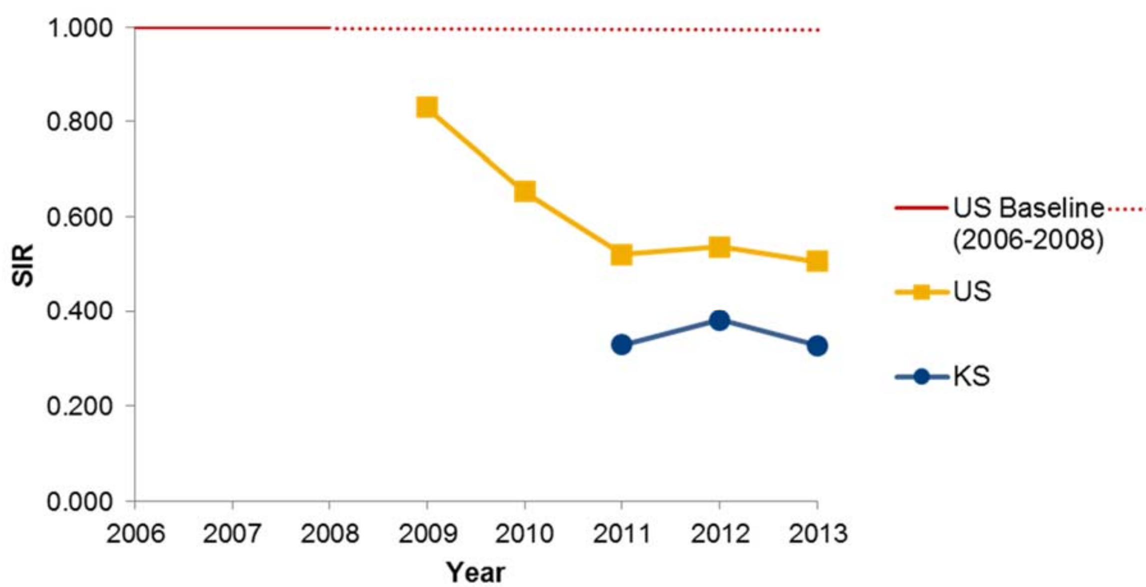
Figure 4. Medical/surgical



Standardized Infection Ratio (SIR)

The standardized infection ratio (SIR) is a ratio that compares the number of observed events to the number expected. In 2013, the CLABSI SIR in adult ICUs was 0.328 in Kansas, compared to 0.506 in the US (Figure 5 and Appendix B, Table 14). The difference between the CLABSI SIR in Kansas compared to the US baseline from 2006-2008 was statistically significant ($p < 0.0001$). This result represents an estimated 67% fewer CLABSIs than expected in Kansas, based on the US baseline from 2006-2008, compared to 49% fewer CLABSIs in the US in 2013. The difference between Kansas and the US in 2013 was statistically significant ($p < 0.0001$). The difference in the CLABSI SIR observed in Kansas ICUs in 2013 compared to 2012 (0.328 vs. 0.381) was not statistically significant ($p = 0.4679$).

Figure 5. CLABSI SIR in adult ICUs, US trend and Kansas, 2013. [17-22]



Figures 6-7 show the SIR for two of the most common types of adult ICUs found in Kansas. In 2013, the CLABSI SIR in medical ICUs was 0.456 in Kansas, compared to 0.511 in the US (Figure 6 and Appendix B, Table 15). This result represents an estimated 54% fewer CLABSIs than expected in Kansas, based on the US baseline for medical ICUs from 2006-2008, compared to 49% fewer CLABSIs in the US in 2013. Medical/surgical ICUs provided the most influence on the overall SIR in Kansas. The CLABSI SIR in medical/surgical ICUs was 0.318 in Kansas, compared to 0.551 in the US (Figure 7). This result represents an estimated 68% fewer CLABSIs than expected in Kansas, based on the US baseline for medical/surgical ICUs from 2006-2008, compared to 45% fewer CLABSIs in the US in 2013. The difference for medical ICUs between Kansas and the US in 2013 were not statistically significant (p = 0.7120). The difference for medical/surgical ICUs between Kansas and the US in 2013 was statistically significant (p = 0.0151). The differences in the CLABSI SIRs observed in Kansas medical ICUs in 2013 compared to 2012 (0.456 vs. 0.202), and medical/surgical ICUs in 2013 compared to 2012 (0.318 vs. 0.392), were not statistically significant (p = 0.1166 and p = 0.5366).

Figures 6-7. CLABSI SIR in adult ICUs, by type, US trend and Kansas, 2013. [17-22]

Figure 6. Medical

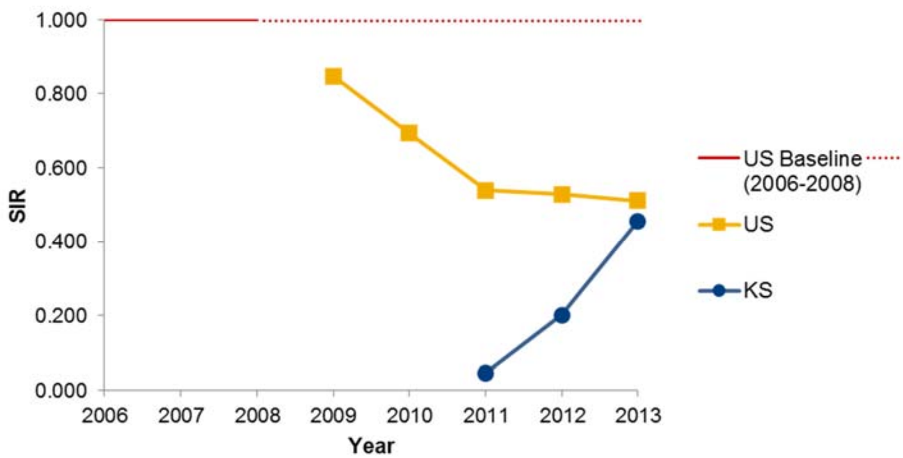
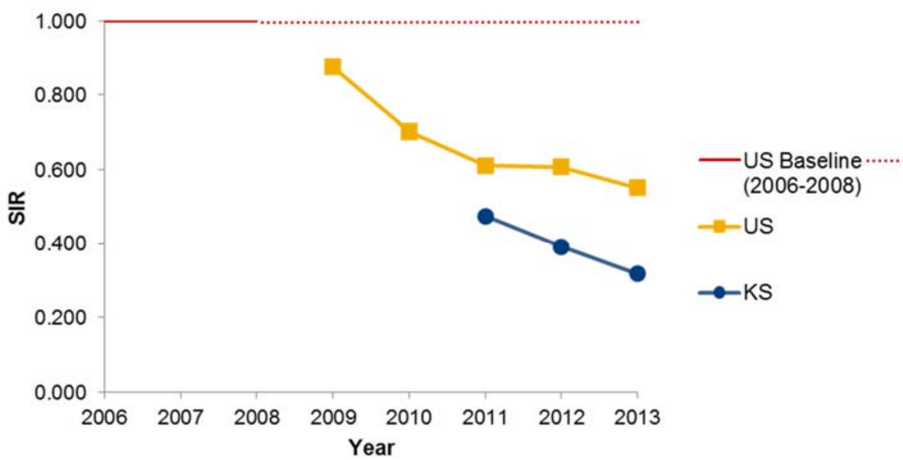


Figure 7. Medical/surgical (all bed size combined)



All CLABSIs reported to NHSN must be confirmed and identified by a laboratory test. Table 2 describes the number of laboratory confirmed bloodstream infections (LCBIs), based on two different criteria, as they occurred in critical care (ICU) areas in Kansas hospitals. Eighty-one percent of LCBIs in 2013 matched Criterion 1, which identifies infections caused by a recognized pathogen. The remaining 19% of LCBIs matched Criterion 2, which identifies infections caused by common commensal organisms. These are organisms that are commonly found on the human body, but do not cause infections where they normally reside. These organisms can, however, cause infections when introduced into an area of the body that is normally sterile, like the bloodstream. Understanding which infections are caused by organisms known to be normally found on the human body is important because it can be used to potentially indicate an infection caused by either improper skin disinfection before placement of the central line, or improper line care allowing for the migration of common commensal organisms into the blood.

Table 2. Distribution of criteria for central line-associated laboratory-confirmed BSI by location, 2012.

	LCBI				
	Criterion 1		Criterion 2		
Type of location	Count	n (%)	Count	n (%)	Total
Medical Critical Care	5	63%	3	37%	**8**
Medical Surgical Critical Care	30	91%	3	9%	**33**
Other Critical Care	0	0%	2	100%	**2**
Total	**35**	**81%**	**8**	**19%**	**43**

Organisms

As shown in Table 3, the most common organism identified through laboratory analysis was *Staphylococcus aureus*, accounting for 14% of CLABSIs, followed by *Enterococcus faecalis* (9%), *Candida albicans* (8%) and *Staphylococcus epidermidis* (8%). A patient can be co-infected with more than one bacterial organism. Although there were 43 CLABSIs in 2013, there were 52 pathogens. In the table below, "pan susceptible" means that when the organism was tested to see if it was susceptible to antibiotics of interest in determining possible treatment, the organism was susceptible to all of the antibiotics it was tested against. Multi-drug resistance (MDR) means that the organism was non-susceptible to more than one antibiotic which it was tested against.

Table 3. Laboratory identified organisms from CLABSIs, 2013.

CLABSI	Pan susceptible	MDR	MCR	Count
Enterococcus faecium - ENTFM	---	6	6	9
Staphylococcus epidermidis - SE	5	2	2	7
Escherichia coli - EC	---	3	3	5
Staphylococcus aureus - SA	1	2	2	5
Candida albicans - CA	3	---	---	4
Enterococcus faecalis - ENTFS	1	2	2	3
Candida glabrata - CG	2	---	---	2
Abiotrophia spp. - ABISP	1	---	---	1
Bacillus cereus - BC	1	---	---	1
Bacteroides spp. - BAS	---	---	---	1
Bacteroides uniformis - BACUN	---	---	---	1
Candida lipolytica - CANLIP	---	---	---	1
Candida spp. - CAS	---	---	---	1
Gemella haemolysans - GEMHA	1	0	0	1
Gram-positive cocci unspecified - GPC	---	---	---	1
Prevotella oris - PREOS	---	---	---	1
Proteus mirabilis - PM	0	0	0	1
Pseudomonas aeruginosa - PA	0	1	1	1
Staphylococcus coagulase negative - CNS	---	---	---	1
Staphylococcus hominis - STAHO	1	---	---	1
Staphylococcus hominis ss. *Hominis* - STAHOM	0	1	1	1
Stenotrophomonas maltophilia - STEMA	1	0	0	1
Streptococcus adjacens - GRADJ	---	---	---	1
Yeast NOS - YEAST	---	---	---	1
Total	**17 (32.7%)**	**17 (32.7%)**	**17 (32.7%)**	**52**

Financial:

As shown in Table 4, if Kansas had the same national average CLABSI rate as the nation in 2006-2008, 131 CLABSI events in Kansas would have been expected. (Again, CLABSIs were not measured during this time period in Kansas, so the true CLABSI rate during that time is not known.) Based on the 2007 CPI for all urban consumers, the expected cost per CLABSI would range from $6,461 to $25,156. Using this CPI for 131 CLABSIs, the estimated total cost for medical care would be between $846,391 and $3,386,219.

Based on the 2007 CPI for all inpatient hospital services, the expected cost per CLABSI would range from $7,288 to $29,156. Using this CPI for 131 CLABSIs, the estimated total cost for medical care would be between $954,728 and $3,819,436.

Based on the 2007 CPI for all urban consumers, with 43 estimated CLABSIs in 2013, the estimated total cost for medical care would be between $277,823 and $1,111,507.

Based on the 2007 CPI for all inpatient hospital services, with 43 estimated CLABSIs in 2013, the estimated total cost for medical care would be between $313,384 and $1,253,708.

Using the 2007 CPI for all urban consumers, the cost savings projected when only 43 infections occurred rather than the projected 131, would represent a potential savings of $568,568 to $2,274,712. Using the 2007 CPI for all inpatient hospital services, the cost savings projected when only 43 infections occurred rather than the projected 131, would represent a potential savings of $641,344 to $2,565,728.

Table 4. Estimated cost of CLABSIs in Kansas, based on Consumer Price Index (2007).

	Consumer Price Index (2007)			
	2006-2008 baseline		2013	
	All urban consumers	Inpatient hospital services	All urban consumers	Inpatient hospital services
# of CLABSIs	131		43	
Cost per infection	$6,461 - $25,849	$7,288 - $29,156	$6,461 - $25,849	$7,288 - $29,156
Total cost	**$846,391 - $3,386,219**	**$954,728 – $3,819,436**	**$277,823 – $1,111,507**	**$313,384 - $1,253,708**

Catheter-Associated Urinary Tract Infection

CAUTI Data

Figure 8. Count of Kansas hospitals and adult ICU units that reported CAUTI data, 2013.

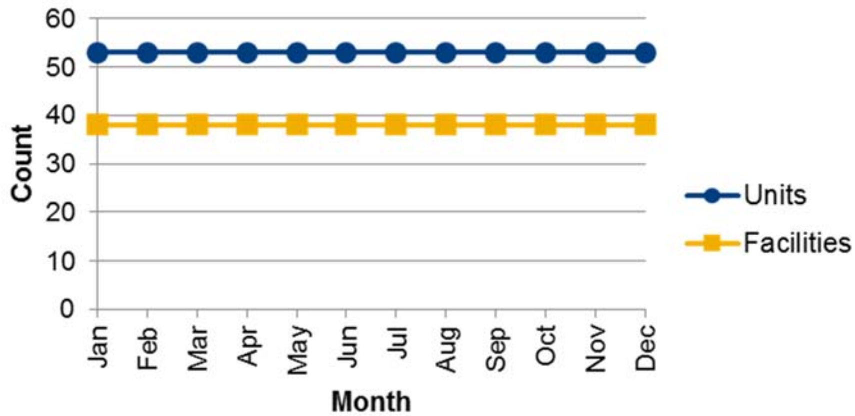
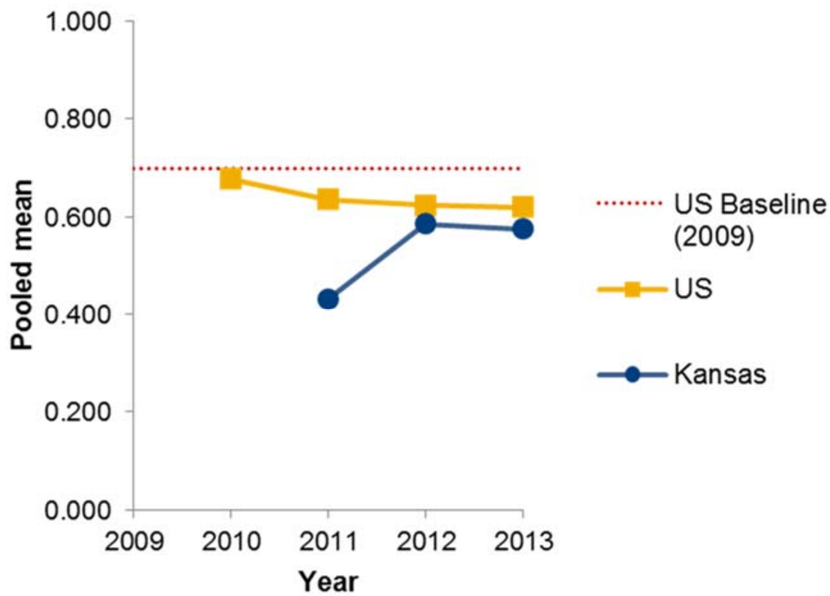


Figure 8 depicts the number of ACHs that reported CAUTI data, by month, during 2013. Because some hospitals have more than one adult ICU, of the same or of varying types, figure 8 also depicts the number of individual component adult ICU units that reported CAUTI data. A total of 38 facilities submitted CAUTI data for 53 ICUs between January 1 and December 31, 2013. In total, 636 months worth of unit-specific data were reported. There was no variability in the number of facilities and units reporting data every month. Since CMS requires reporting of all ICUs from ACHs, variability in this measure would indicate that a facility or unit either closed or merged with another, was inactivated for a period of time (e.g. for construction), or failed to report data for the facility or unit. No facilities or units with CMS requirements to report CAUTI data were closed or merged, were inactive during any one month; nor failed to report data in 2013.

Device Utilization Ratio

The device utilization ratio (DUR) constitutes an extrinsic risk factor for HAI. When fewer devices are used the risk of HAIs are lower. In 2013, an indwelling urinary catheter device was used during 58% of ICU patient days in Kansas, compared to 62% of ICU patient days in the US (Figure 9 and Appendix B, Table 16). The difference between Kansas and the US in 2013 was statistically significant ($p < 0.0001$). There was a statistically significant decrease in the indwelling urinary catheter device utilization ratio observed in Kansas ICUs in 2013 compared to 2012 (58% vs. 59%; $p = 0.0024$). There were fewer indwelling urinary catheter device-days in 2013 (83,639 vs. 89,010, a 6% change), and fewer patient-days in 2013 (145,402 vs. 151,924, a 4% change).

Figure 9. Pooled mean of patient days in adult ICUs with an indwelling urinary catheter device in use, US trend and Kansas, 2013.



Figures 10-11 show the pooled mean device utilization ratios for two of the most common types of adult ICUs found in Kansas. In 2013, an indwelling urinary catheter device was used during 58% of medical ICU patient days in Kansas, compared to 64% of medical ICU patient days in the US (Figure 10 and Appendix B, Table 17). Medical/surgical ICUs provided the most influence on the lower overall device utilization ratio in Kansas. An indwelling urinary catheter device was used during 57% of medical/surgical ICU patient days, compared to 60% of medical/surgical ICU patient days in the US (Figure 11). The differences in the results for medical and medical/surgical ICUs between Kansas and the US in 2013, were both statistically significant ($p < 0.0001$). There was a statistically significant increase in the indwelling urinary catheter device utilization ratio observed in Kansas medical ICUs in 2013 compared to 2012 (58% vs. 54%; $p < 0.0001$). There were, however, more indwelling urinary catheter device-days in 2013 (13,406 vs. 12,483, a 7% change), but nearly the same number of patient-days in 2013 (23,303 vs. 23,286). There was a statistically significant decrease in the indwelling urinary catheter device utilization ratio observed in Kansas medical/surgical ICUs in 2013 compared to 2012 (57% vs. 60%; $p < 0.0001$). There were fewer indwelling urinary catheter device-days in 2013 (39, 334 vs. 41,180, a 5% change), but nearly the same number of patient-days in 2013 (69,149 vs. 68,905).

Figures 10-11. Pooled mean of patient days in adult ICUs, by type, with indwelling urinary catheter device in use, US trend and Kansas, 2013.

Figure 10. Medical

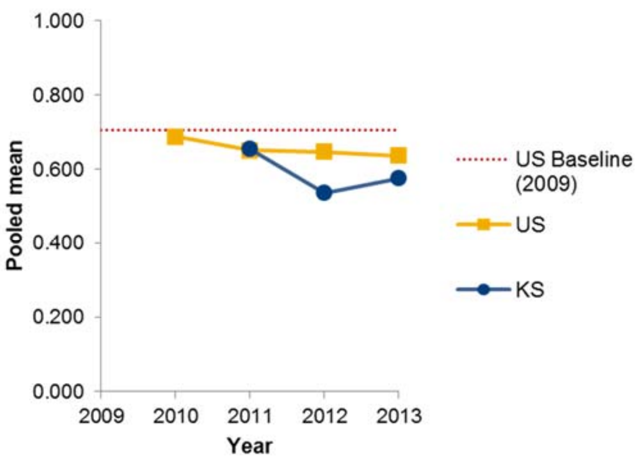
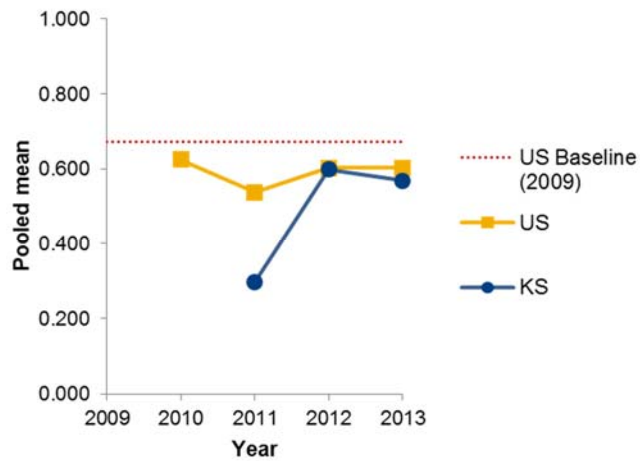


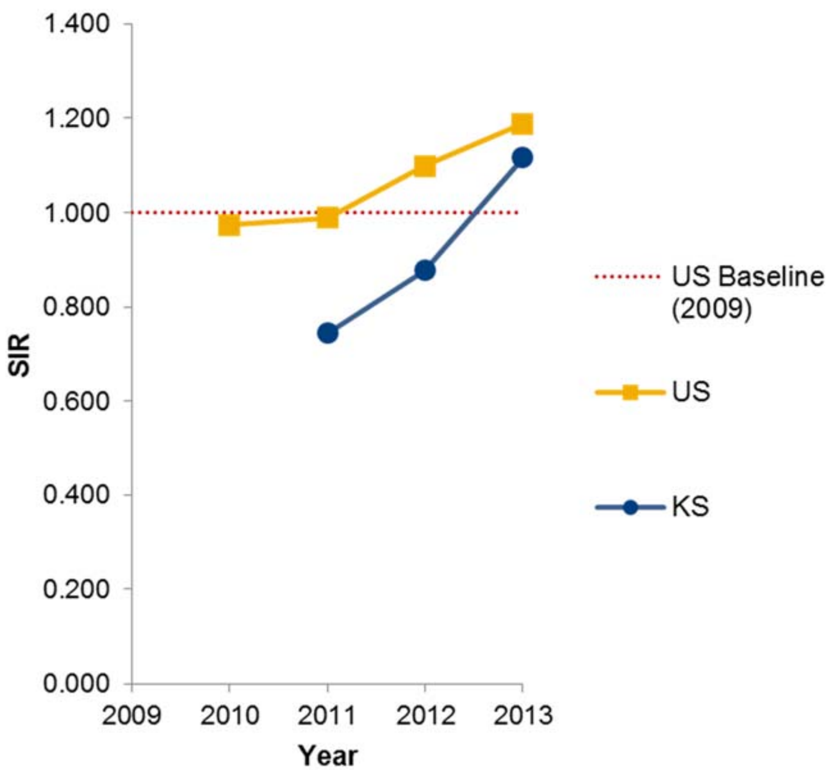
Figure 11. Medical/surgical



Standardized Infection Ratio (SIR)

The standardized infection ratio (SIR) is a ratio that compares the number of observed events to the number expected. In 2013, the CAUTI SIR in adult ICUs was 1.116 in Kansas, compared to 1.188 in the US (Figure 12 and Appendix B, Table 18). The difference between the CAUTI SIR in Kansas compared to the US baseline from 2006-2008 was not statistically significant ($p = 0.1473$). The difference between the estimated 12% more CAUTIs than expected in Kansas and the 19% more CAUTIs than expected in the US in 2013, was also not statistically significant ($p = 0.3921$). The difference in the CAUTI SIR observed in Kansas ICUs in 2013 compared to 2012 (1.116 vs. 0. 877) was statistically significant ($p = 0.0239$).

Figure 12. CAUTI SIR in adult ICUs, US trend and Kansas, 2013. [19-22]



Figures 13-14 show the SIR for two of the most common types of adult ICUs found in Kansas. In 2013, the CAUTI SIR in medical ICUs was 0.919 in Kansas, compared to 1.267 in the US (Figure 13 and Appendix B, Table 19). This result represents an estimated 8% fewer CAUTIs than expected in Kansas, based on the US baseline for medical ICUs from 2006-2008, compared to 27% more CAUTIs in the US in 2013. Medical/surgical ICUs provided the most influence on overall SIR in Kansas. The CAUTI SIR in medical/surgical ICUs was 1.041 in Kansas, compared to 1.195 in the US (Figure 14). This result represents an estimated 4% more CAUTIs than expected in Kansas, based on the US baseline for medical/surgical ICUs from 2006-2008, compared to 20% more CAUTIs in the US in 2013. The differences for medical ICU and medical/surgical ICU unit types between Kansas and the US in 2013 were not statistically significant (p = 0.0845 and p = 0.2354). The difference in the CAUTI SIR observed in Kansas medical ICUs in 2013 compared to 2012 (0.919 vs. 0.662) was not statistically significant (p = 0.2850). The difference in the CAUTI SIR observed in medical/surgical ICUs in 2013 compared to 2012 (1.041 vs. 0.709), was statistically significant (p = 0.0461).

Figures 13-14. CAUTI SIR in adult ICUs, by type, US trend and Kansas, 2013. [19-22]

Figure 13. Medical

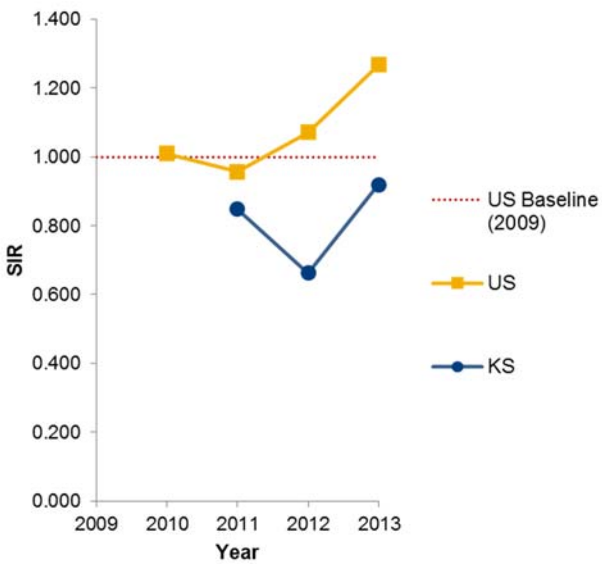
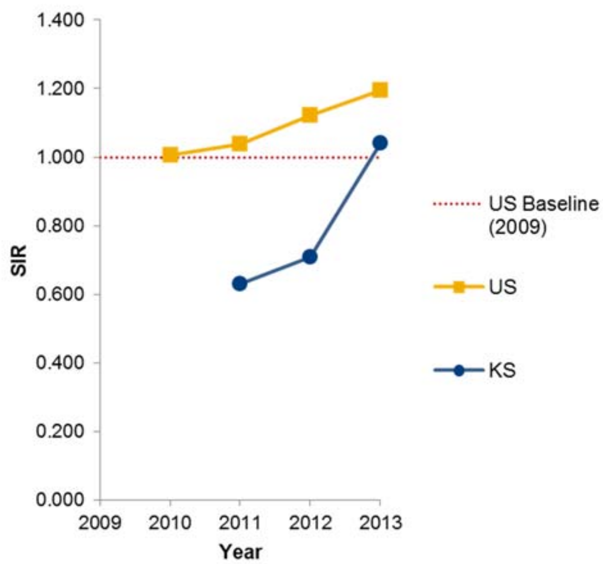


Figure 14. Medical/surgical



Organisms

As shown in Table 5, the most common organism identified through laboratory analysis was *Escherichia coli*, accounting for 21% of CAUTIs, followed by *Pseudomonas aeruginosa* (8%), *Candida albicans* (8%), and Yeast (8%). A patient can be co-infected with more than one bacterial organism. Although there were 188 CAUTIs in 2013, there were 216 pathogens. In the table below, "pan susceptible" means that when the organism was tested to see if it was susceptible to antibiotics of interest in determining possible treatment, the organism was susceptible to all of the antibiotics it was tested against. Multi-drug resistance (MDR), means that the organism was non-susceptible to more than one antibiotic which it was tested against.

Table 5. Laboratory identified organisms from CAUTIs, 2013.

CAUTI	Pan susceptible	MDR	MCR	Count
Escherichia coli - EC	19	13	13	39
Candida albicans - CA	1	---	---	30
Enterococcus faecalis - ENTFS	8	5	5	21
Yeast NOS - YEAST	---	---	---	17
Candida spp. - CAS	---	---	---	15
Pseudomonas aeruginosa - PA	7	6	6	14
Enterococcus spp. - ENTSP	7	1	1	11
Klebsiella pneumoniae - KP	0	3	3	8
Proteus mirabilis - PM	5	---	---	6
Enterobacter cloacae - ENC	0	4	4	5
Enterococcus faecium - ENTFM	0	5	5	5
Enterobacter cloacae complex - ENCCX	2	0	0	4
Staphylococcus aureus - SA	---	2	2	4
Staphylococcus coagulase negative - CNS	---	2	2	4
Candida glabrata - CG	---	---	---	3
Escherichia coli - enteropathogenic A - ECEP	1	2	2	3
Klebsiella oxytoca - KO	0	2	2	3
Staphylococcus epidermidis - SE	2	---	---	3
Candida tropicalis - CT	---	---	---	2
Citrobacter freundii - CF	0	2	2	2
Citrobacter koseri - CITKO	2	---	---	2
Gram-negative rod unspecified - GNR	---	---	---	2
Morganella morganii - MORMO	0	1	1	2
Citrobacter braakii - CITBRA	---	---	---	1
Corynebacterium Genus - CORGN	---	---	---	1
Enterobacter aerogenes – EA	0	1	1	1
Hafnia alvei - HA	0	1	1	1
Hemophilus vaginalis - GV	---	---	---	1
Klebsiella pneumoniae ss. Pneumoniae - KLEPNE	1	0	0	1
Lactobacillus spp. - LS	---	---	---	1
Serratia marcescens - SM	1	0	0	1

Staphylococcus spp. - SS	---	---	---	1
Stenotrophomonas maltophilia - STEMA	1	0	0	1
Streptococcus agalactiae - GBS	---	---	---	1
Total	**57 (26.4%)**	**50 (23.1%)**	**50 (23.1)**	**216**

Financial

As shown in Table 6, if Kansas had the same average CAUTI rate as the nation in 2009, 169 CAUTI events in Kansas would have been expected. (Again, CAUTIs were not measured during this time period in Kansas, so the true CAUTI rate during that time is not known.) Based on the 2007 CPI for all urban consumers, the expected cost per CAUTI would range from $749 to $832. Using this CPI for 169 CAUTIs, the estimated total cost for medical care would be between $126,581 and $140,608.

Based on the 2007 CPI for all inpatient hospital services, the expected cost per CAUTI would range from $862 to $1,007. Using this CPI for 169 CAUTIs, the estimated total cost for medical care would be between $145,678 and $170,183.

Based on the 2007 CPI for all urban consumers, with 188 estimated CAUTIs in 2013, the estimated total cost for medical care would be between $140,812 and $156,416.

Based on the 2007 CPI for all inpatient hospital services, with 188 estimated CAUTIs in 2013, the estimated total cost for medical care would be between $162,056 and $189,316.

Using the 2007 CPI for all urban consumers, the cost savings projected when only 188 infections occurred rather than the projected 169, would represent a potential savings of $14,231 to $15,808. Using the 2007 CPI for all inpatient hospital services, the cost savings projected when only 188 infections occurred rather than the projected 169, would represent a potential savings of $16,378 to $19,133.

Table 6. Estimated cost CAUTIs in Kansas, based on Consumer Price Index (2007).

	Consumer Price Index (2007)			
	2009 baseline		**2013**	
	All urban consumers	Inpatient hospital services	All urban consumers	Inpatient hospital services
# of CAUTIs	169		188	
Cost per infection	$749 - $832	$862-$1,007	$749 - $832	$862-$1,007
Total cost	**$126,581 – $140,608**	**$145,678 - $170,183**	**$140,812 - $156,416**	**$162,056 – $189,316**

Surgical Site Infections

COLO Data

Figure 15. Count of Kansas hospitals that reported COLO data, 2013.

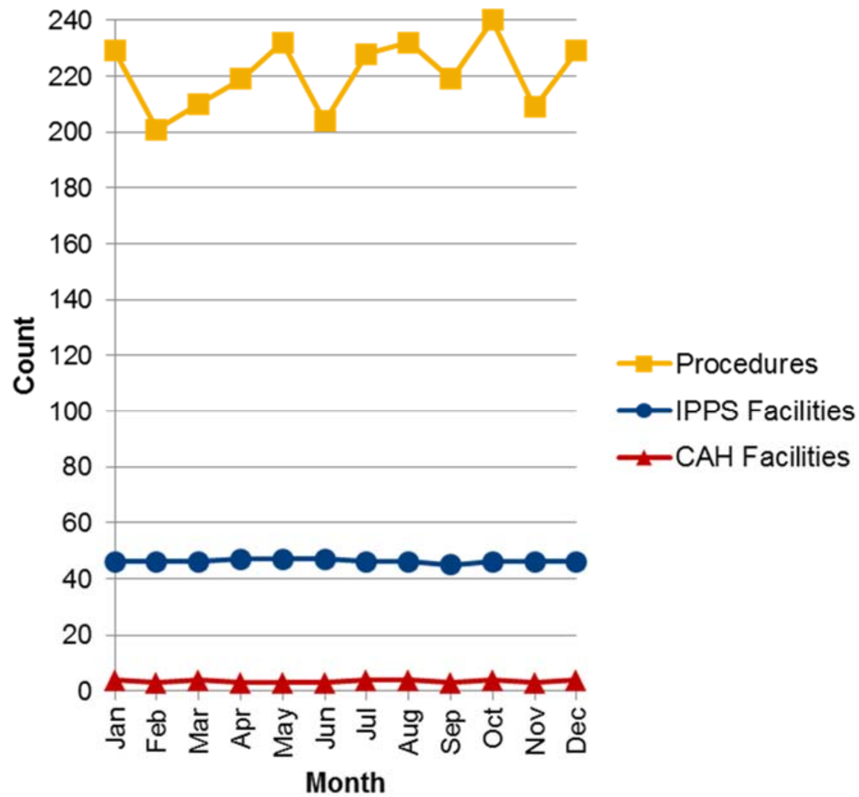
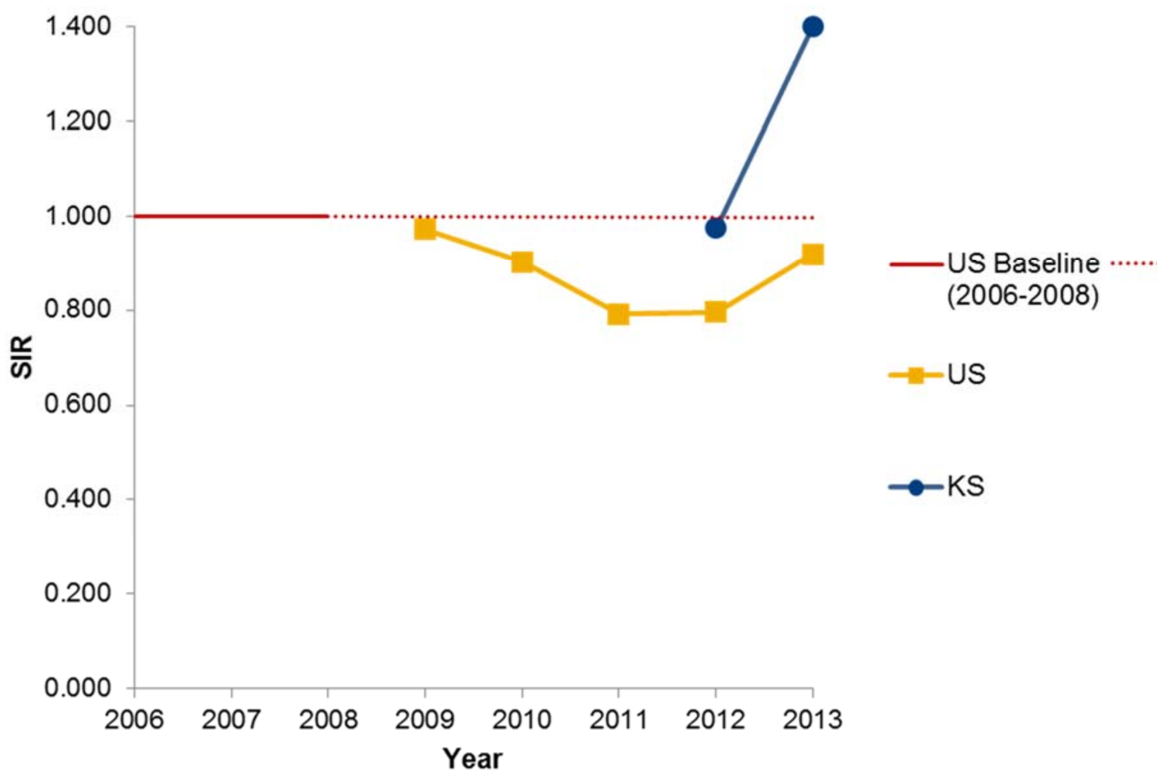


Figure 15 depicts the number of ACHs that reported SSI data on COLO procedures, by month, during 2013. A total of 51 facilities submitted SSI data on COLO procedures between January 1, 2013 and December 31, 2013. In total, 596 months worth of procedure-specific data were reported on 2652 COLO procedures. The number of procedures performed each month will naturally vary. The number of facilities reporting remained relatively stable; however, less variability was expected (a flatter line for facilities). Since CMS requires reporting of all COLO procedures from ACHs, or reporting that no procedures were performed during a month, variability in this measure should only indicate that a facility closed or merged with another, had a CMS waiver for reporting in place but reported some data, or failed to report procedure data.

Standardized Infection Ratio (SIR)

The standardized infection ratio (SIR) is a ratio that compares the number of observed events to the number expected. In 2013, the COLO SIR was 1.399 in Kansas, compared to 0.919 in the US (Figure 16 and Appendix B, Table 20). The difference between the COLO SIR in Kansas compared to the US baseline from 2006-2008 was statistically significant ($p = 0.0010$). The difference between the estimated 40% more COLOs than expected in Kansas and the 8% fewer COLOs than expected in the US in 2013, was statistically significant ($p < 0.0001$). The difference in the COLO SIR observed in Kansas in 2013 compared to 2012 (1.399 vs. 0. 979) was also statistically significant ($p = 0.0150$).

Figure 16. COLO SSI SIR, US trend and Kansas, 2013. [17-22]



Organisms

As shown in Table 7, the most common organism identified through laboratory analysis was *Escherichia coli*, accounting for 16% of COLO SSIs, followed by *Enterococcus faecalis* (8%), *Enterococcus faecium* (7%), and *Enterococcus* spp. (7%). A patient can be co-infected with more than one bacterial organism. Although there were 110 COLO SSIs in 2013, there were 177 pathogens. In the table below, “pan susceptible” means that when the organism was tested to see if it was susceptible to antibiotics of interest in determining possible treatment, the organism was susceptible to all of the antibiotics it was tested against. Multi-drug resistance (MDR), means that the organism was non-susceptible to more than one antibiotic which it was tested against.

Table 7. Laboratory identified organisms from COLO SSIs, 2013.

COLO SSI	Pan susceptible	MDR	MCR	Count
Escherichia coli - EC	16	18	18	40
Pseudomonas aeruginosa - PA	10	1	1	13
Staphylococcus aureus - SA	3	7	7	12
Bacteroides fragilis - BF	---	1	1	10
Enterococcus faecalis - ENTFS	9	1	1	10
Enterococcus spp. - ENTSP	6	---	---	8
Enterococcus faecium - ENTFM	1	2	2	6
Staphylococcus coagulase negative - CNS	---	1	1	6
Streptococcus viridans group - SVU	1	---	---	6
Bacteroides thetaiotaomicron - BACTH	---	1	1	5
Candida albicans - CA	---	---	---	5
Enterobacter cloacae - ENC	---	3	3	5
Candida spp. - CAS	---	---	---	4
Klebsiella pneumoniae - KP	1	1	1	4
Lactobacillus spp. - LS	---	---	---	3
Proteus vulgaris - PV	1	2	2	3
Streptococcus avium - ENTA	1	---	---	3
Citrobacter freundii - CF	1	1	1	2
Gram-negative rod unspecified - GNR	---	---	---	2
Levinea amalonatica - CITAM	0	1	1	2
Prevotella melaninogenica - PREM	---	---	---	2
Proteus mirabilis - PM	---	---	---	2
Streptococcus alpha-hemolytic - AS	---	---	---	2
Streptococcus spp. - STR	---	---	---	2
Yeast NOS - YEAST	---	---	---	2
Actinomyces meyeri - ACTME	---	---	---	1
Anaerobe NOS - ANS	---	---	---	1
Candida famata - CANFAM	---	---	---	1
Candida krusei - CK	---	---	---	1
Citrobacter koseri - CITKO	---	---	---	1
Clostridium spp. - CLS	---	---	---	1

Clostridium tertium - CLOTE	---	---	---	1
Corynebacterium Genus - CORGN	---	---	---	1
Corynebacterium spp. - COS	---	---	---	1
Diphtheroids - DIPTH	---	---	---	1
Enterobacter aerogenes - EA	1	0	0	1
Eubacterium spp. - EUBSP	---	---	---	1
Gram-positive rod unspecified - GPR	---	---	---	1
Klebsiella oxytoca - KO	0	1	1	1
Peptostreptococcus spp. - PSS	---	---	---	1
Prevotella spp. - PRESP	---	---	---	1
Streptococcus anginosus - STRVN	---	---	---	1
Welchia perfringens - CLP	---	---	---	1
Total	**51 (28.8%)**	**41 (23.2%)**	**41 (23.2%)**	**177**

Financial

As shown in Table 8, if Kansas had the same average COLO SSI rate as the nation in 2006-2008, 79 COLO SSI events in Kansas would have been expected. (Again, COLO SSIs were not measured during this time period in Kansas, so the true COLO SSI rate during that time is not known.) Based on the 2007 CPI for all urban consumers, the expected cost per SSI would range from $11,087 to $29,443. Using this CPI for 79 COLO SSIs, the estimated total cost for medical care would be between $875,873 and $2,325,997.

Based on the 2007 CPI for all inpatient hospital services, the expected cost per SSI would range from $11,874 to $34,670. Using this CPI for 79 COLOs, the estimated total cost for medical care would be between $938,046 and $2,738,930.

Based on the 2007 CPI for all urban consumers, with 110 estimated COLO SSIs in 2013, the estimated total cost for medical care would be between $1,219,570 and $3,238,730.

Based on the 2007 CPI for all inpatient hospital services, with 110 estimated COLO SSIs in 2013, the estimated total cost for medical care would be between $1,306,140 and $3,813,700.

Using the 2007 CPI for all urban consumers, the cost projected when 110 infections occurred rather than the projected 79, would represent a potential additional cost of $343,697 to $912,733. Using the 2007 CPI for all inpatient hospital services, the cost projected when 110 infections occurred rather than the projected 79, would represent potential additional costs of $368,094 to $1,074,770.

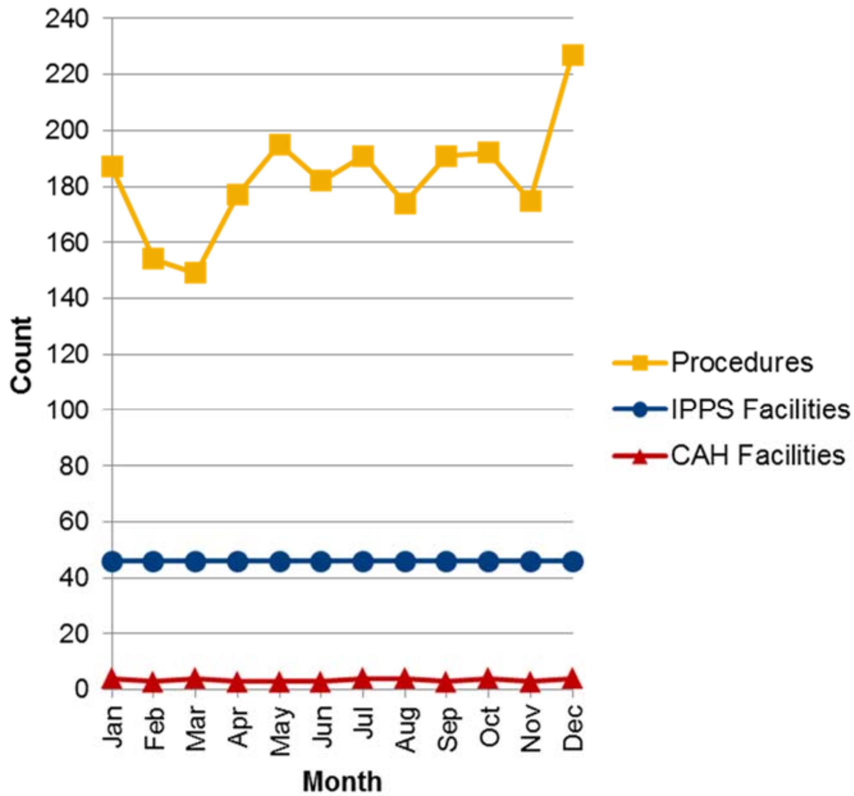
Table 8. Estimated cost COLO SSIs in Kansas, based on Consumer Price Index (2007).

	Consumer Price Index (2007)			
	2006-2008 baseline		2013	
	All urban consumers	Inpatient hospital services	All urban consumers	Inpatient hospital services
# of COLO SSIs	79		110	
Cost per infection	$11,087 - $29,443	$11,874-$34,670	$11,087 - $29,443	$11,874-$34,670
Total cost	**$875,873– $2,325,997**	**$938,046 - $2,738,930**	**$1,219,570 - $3,238,730**	**$1,306,140 – $3,813,700**

HYST Data

Figure 17 depicts the number of ACHs that reported SSI data on HYST procedures, by month, during 2013. A total of 51 facilities submitted data on HYST procedures between January 1, 2013 and December 31, 2013. In total, 594 months worth of procedure-specific data were reported on 2194 HYST procedures. The number of procedures performed each month will naturally vary. The number of facilities reporting remained relatively stable; however, less variability was expected (a flatter line for facilities). Since CMS requires reporting of all HYST Procedures from ACHs, or reporting that no procedures were performed during a month, variability in this measure should only indicate that a facility closed or merged with another, had a CMS waiver for reporting in place but reported some data, or failed to report procedure data.

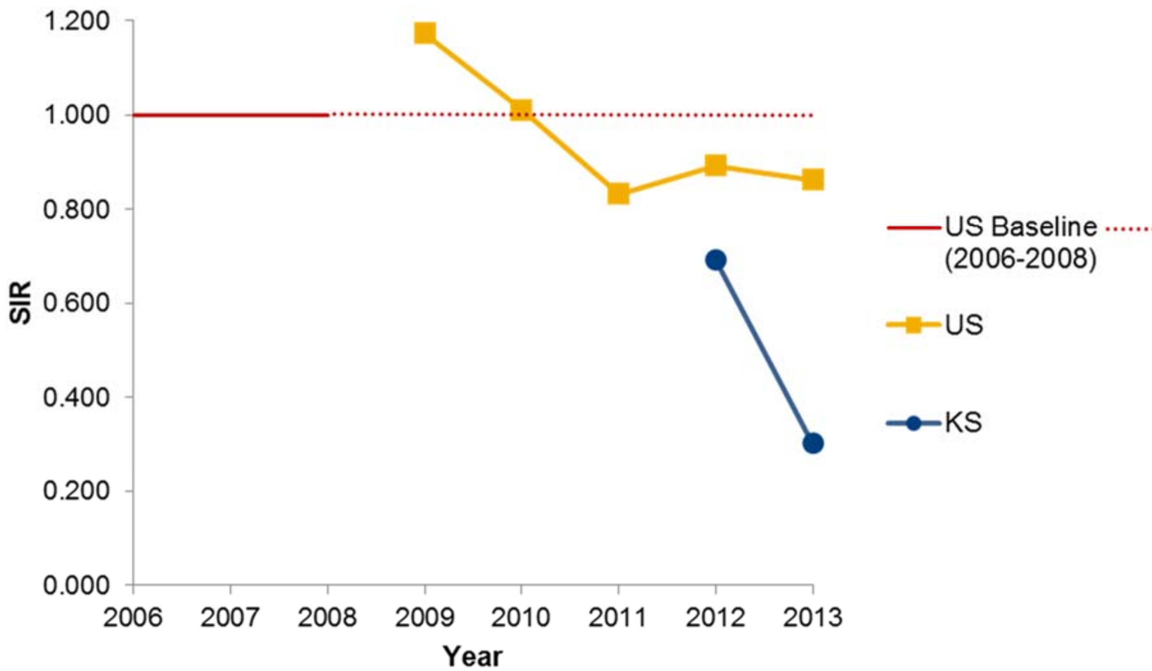
Figure 17. Count of Kansas hospitals that reported HYST data, 2013.



Standardized Infection Ratio (SIR)

The standardized infection ratio (SIR) is a ratio that compares the number of observed events to the number expected. In 2013, the HYST SSI SIR was 0.302 in Kansas, compared to 0.862 in the US (Figure 18 and Appendix B, Table 21). The difference between the HYST SIR in Kansas compared to the US baseline from 2006-2008 was statistically significant (p = 0.0012). The difference between the estimated 70% fewer HYSTs than expected in Kansas and the 14% fewer HYSTs than expected in the US in 2013, was also statistically significant (p = 0.0062). The difference in the HYST SIR observed in Kansas in 2013 compared to 2012 (0.302 vs. 0. 705) was not statistically significant (p = 0.1140).

Figure 18. HYST SSI SIR, US trend and Kansas, 2013. [17-22]



Organisms

As shown in Table 9, the most common organism identified through laboratory analysis was *Enterococcus* spp., accounting for 21% of HYST SSIs, followed by *Bacteroides fragilis* (14%). A patient can be co-infected with more than one bacterial organism. Although there were 5 HYST SSIs in 2013, there were 8 pathogens. In the table below, "pan susceptible" means that when the organism was tested to see if it was susceptible to antibiotics of interest in determining possible treatment, the organism was susceptible to all of the antibiotics it was tested against. Multi-drug resistance (MDR), means that the organism was non-susceptible to more than one antibiotic which it was tested against.

Table 9. Laboratory identified organisms from HYST SSIs, 2013.

HYST SSI	Pan susceptible	MDR	MCR	Count
Prevotella spp. - PRESP	---	---	---	**2**
Staphylococcus epidermidis - SE	1	---	---	**2**
Enterococcus spp. - ENTSP	1	0	0	**1**
Propionibacterium spp. - PRSU	---	---	---	**1**
Staphylococcus coagulase negative - CNS	---	---	---	**1**
Streptococcus constellatus - STRVC	1	0	0	**1**
Total	**3 (37.5%)**	**0 (0.0%)**	**0 (0.0%)**	**8**

Financial

As shown in Table 10, if Kansas had the same average HYST SSI rate as the nation in 2006-2008, 17 HYST SSI events in Kansas would have been expected. (Again, HYST SSIs were not measured during this time period in Kansas, so the true HYST SSI rate during that time is not known.) Based on the 2007 CPI for all urban consumers, the expected cost per SSI would range from $11,087 to $29,443. Using this CPI for 17 COLO SSIs, the estimated total cost for medical care would be between $188,479 and $500,531.

Based on the 2007 CPI for all inpatient hospital services, the expected cost per SSI would range from $11,874 to $34,670. Using this CPI for 17 HYST s, the estimated total cost for medical care would be between $201,858 and $589,390.

Based on the 2007 CPI for all urban consumers, with 5 estimated HYST SSIs in 2013, the estimated total cost for medical care would be between $55,435 and $147,215.

Based on the 2007 CPI for all inpatient hospital services, with 5 estimated HYST SSIs in 2013, the estimated total cost for medical care would be between $59,370 and $173,350.

Using the 2007 CPI for all urban consumers, the cost savings projected when only 5 infections occurred rather than the projected 17, would represent a potential savings of $133,044 to $353,316. Using the 2007 CPI for all inpatient hospital services, the cost savings projected when only 5 infections occurred rather than the projected 17, would represent a potential savings of $142,488 to $416,040.

Table 10. Estimated cost HYST SSIs in Kansas, based on Consumer Price Index (2007).

	Consumer Price Index (2007)			
	2006-2008 baseline		2013	
	All urban consumers	Inpatient hospital services	All urban consumers	Inpatient hospital services
# of HYST SSIs	17		5	
Cost per infection	$11,087 - $29,443	$11,874-$34,670	$11,087 - $29,443	$11,874-$34,670
Total cost	**$188,479 – $500,531**	**$201,858 - $589,390**	**$55,435 - $147,215**	**$59,370 – $173,350**

Laboratory Identified Multi-drug Resistant Organisms

Clostridium difficile Data

Figure 19. Count of Kansas hospitals that reported *C. difficile* infection data, 2013.

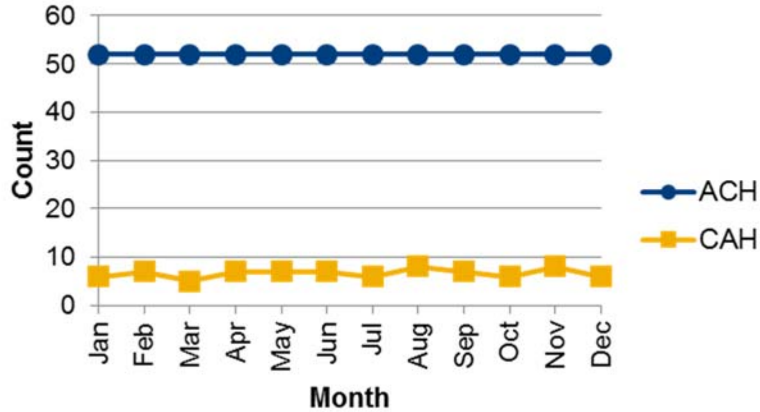
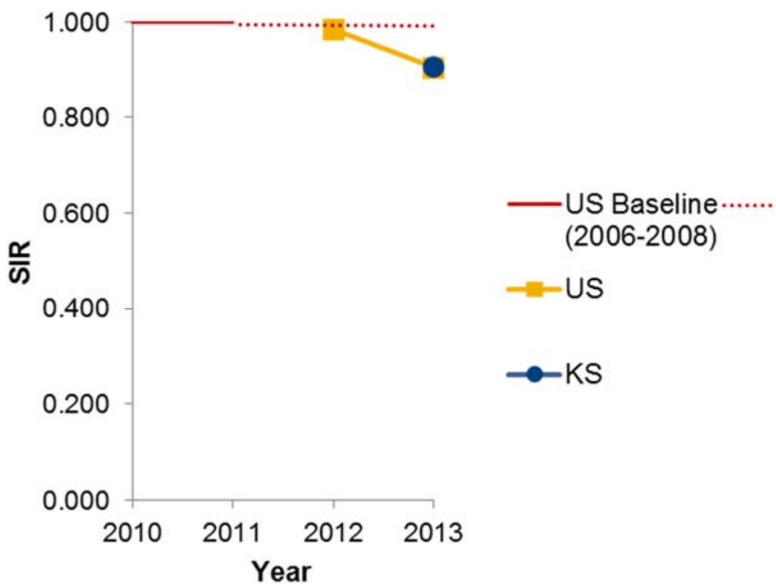


Figure 19 depicts the number of ACHs and CAHs that reported MDRO data on *C. difficile*, by month, during 2013. A total of 61 facilities submitted 700 months worth of data between January 1, 2013 and December 31, 2013. There was no variability in the number of ACH facilities reporting data every month. Since CMS requires reporting from ACHs, variability in this measure would indicate that a facility either closed or merged with another, or failed to report data for the facility. No facilities or with CMS requirements failed to report *C. difficile* infections data; nor were any closed or merged in 2013.

Standardized Infection Ratio (SIR)

The standardized infection ratio (SIR) is a ratio that compares the number of observed events to the number expected. In 2013, the *C. difficile* SIR was 0.906 in Kansas, compared to 0.904 in the US (Figure 20 and Appendix B, Table 22). The difference between the *C. difficile* SIR in Kansas compared to the US baseline from 2010-2011 was statistically significant (p = 0.0053). The difference between the *C. difficile* SIR in Kansas compared to the US in 2013 was not statistically significant (p = 0.9326).

Figure 20. *C. difficile* SIR, US trend and Kansas, 2013. [19-22]



Financial

As shown in Table 11, if Kansas had the same average *C. difficile* infection rate as the nation in 2010-2011, 871 *C. difficile* infection events in Kansas would have been expected. (Again, *C. difficile* infections were not measured broadly during this time period in Kansas, so the true *C. difficile* infection rate during that time is not known.) Based on the 2007 CPI for all urban consumers, the expected cost per infection would range from $5,682 to $8,090. Using this CPI for 871 *C. difficile* infections, the estimated total cost for medical care would be between $4,949,022 and $7,046,390.

Based on the 2007 CPI for all inpatient hospital services, the expected cost per infection would range from $6,408 to $9,124. Using this CPI for 871 *C. difficile* infections, the estimated total cost for medical care would be between $5,581,368 and $7,947,004.

Based on the 2007 CPI for all urban consumers, with 789 estimated *C. difficile* infections in 2013, the estimated total cost for medical care would be between $4,483,098 and $6,383,010.

Based on the 2007 CPI for all inpatient hospital services, with 789 estimated *C. difficile* infections in 2013, the estimated total cost for medical care would be between $5,055,912 and $7,198,836.

Using the 2007 CPI for all urban consumers, the cost savings projected when only 789 infections occurred rather than the projected 871, would represent a potential savings of $465,924 to $663,380. Using the 2007 CPI for all inpatient hospital services, the cost savings projected when only 789 infections occurred rather than the projected 871, would represent a potential savings of $525,456 to $748,168.

Table 11. Estimated cost *C. difficile* infections **in Kansas, based on Consumer Price Index (2007).**

	Consumer Price Index (2007)			
	2010-2011 baseline		2013	
	All urban consumers	Inpatient hospital services	All urban consumers	Inpatient hospital services
# of C. difficile infections	871		789	
Cost per infection	$5,682 - $8,090	$6,408 - $9,124	$5,682 - $8,090	$6,408 - $9,124
Total cost	**$4,949,022 – $7,046,390**	**$5,581,368 - $7,947,004**	**$4,483,098 - $6,383,010**	**$5,055,912 – $7,198,836**

Methicillin-resistant Staphylococcus aureus Bloodstream Infections Data

Figure 21. Count of Kansas hospitals that reported MRSA Bloodstream Infection data, 2013.

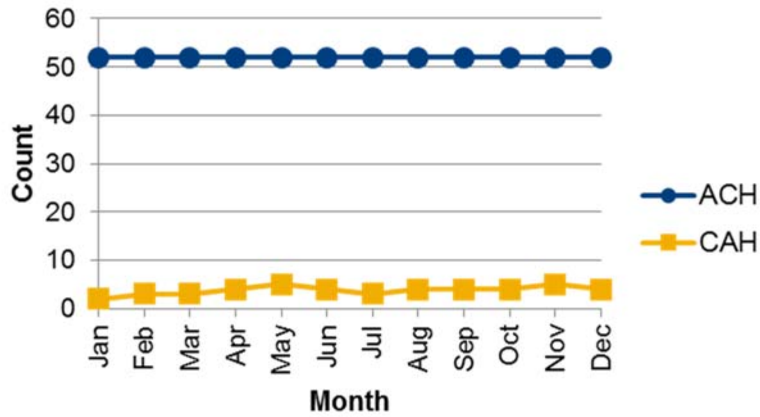
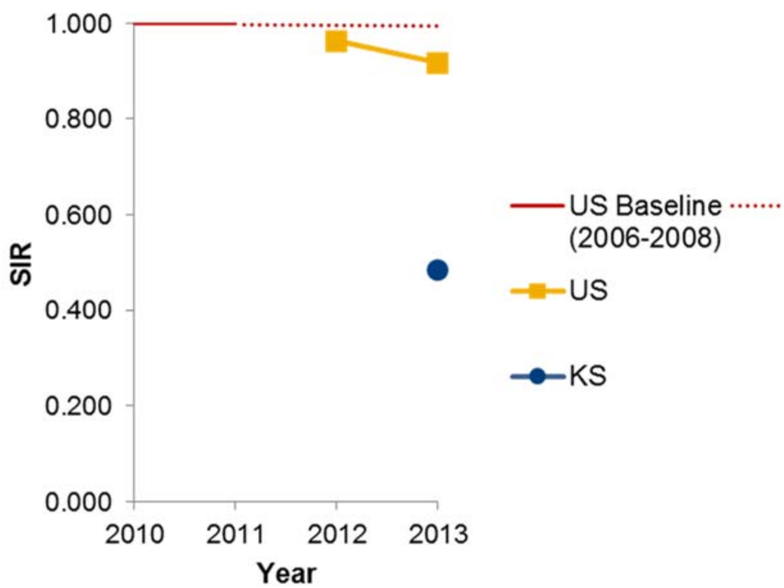


Figure 21 depicts the number of ACHs and CAHs that reported MDRO data on *C. difficile*, by month, during 2013. A total of 57 facilities submitted 668 months worth of data between January 1, 2013 and December 31, 2013. There was no variability in the number of ACH facilities reporting data every month. Since CMS requires reporting from ACHs, variability in this measure would indicate that a facility either closed or merged with another, or failed to report data for the facility. No facilities or with CMS requirements failed to report MRSA Bloodstream infections data; nor were any closed or merged in 2013.

Standardized Infection Ratio (SIR)

The standardized infection ratio (SIR) is a ratio that compares the number of observed events to the number expected. In 2013, the MRSA bloodstream infections SIR was 0.484 in Kansas, compared to 0.917 in the US (Figure 22 and Appendix B, Table 23). The difference between the MRSA bloodstream infections SIR in Kansas compared to the US baseline from 2010-2011 was statistically significant ($p < 0.0001$). The difference between the MRSA bloodstream infections SIR in Kansas compared to the US in 2013 was statistically significant ($p < 0.0001$).

Figure 22. MRSA Bloodstream Infections SIR, US trend and Kansas, 2013. [19-22]



Discussion

The findings of this report reflect the third year of HAI surveillance, 2013, in Kansas. In the development of this study, attention was given to present methods used consistently by NHSN, and by states, for the public reporting of HAI data. While this report is not inclusive of all hospitals in Kansas that were eligible to contribute data to the Kansas HAI Reporting Group, it represented 97% of all ICU beds. It is reasonable to assume that the data are adequately representative of the population of interest.

Maintaining strong relationships with participating facilities and continuing to recruit Kansas hospitals will allow for more accurate observations of the burden of HAIs in Kansas. Data reporting each month by participating hospitals has been sufficiently consistent for the purposes of this study. There is a continued need for facilities to report data in an accurate and timely manner to qualify for reimbursement payments through the CMS IPPS program, to meet HHS Action Plan goals and to aid in improvement efforts. It has been suggested that increased reporting can have an impact on reducing HAIs. [23, 24]

The use of central lines and urinary catheter devices in Kansas appears to have increased in 2013, but continued to be lower than overall use across the nation; however, the gap had decreased. When comparing trends in this measure over time, increases or decreases in either device-days or in patient-days influence the outcome.

In 2013, there was an increase in the central-line device utilization ratio (DUR). There were slightly fewer device-days compared to the prior year, but the increase was largely driven by a slightly larger decrease in patient-days. A higher proportion of device-days occurred among fewer patient-days. The overall increase in the central-line DUR was largely driven by the increased device utilization in medical ICUs. In this type of unit, there were more device-days compared to the prior year, among comparably similar patient-days. A higher proportion of device-days occurred among nearly the same number of patient-days in medical ICUs. Medical/surgical ICUs also experienced more device-days compared to the prior year, among comparably similar patient-days. A higher proportion of device-days occurred among nearly the same number of patient-days in medical/surgical ICUs. Overall, other ICU unit types accounted for the decrease in patient-days.

In 2013, there was a decrease in the indwelling urinary catheter DUR. The decrease was largely driven by the fact that there were fewer device-days compared to the prior year. A lower proportion of device-day occurred among fewer patient-days. The overall decrease in the urinary catheter DUR was largely driven by the decreased device utilization in medical/surgical ICUs. In this type of unit, there were fewer device-days compared to the prior year, among comparably similar patient-days. A lower proportion of device-day occurred among nearly the same number of patient-days in in medical/surgical ICUs. Medical ICUs, conversely, experienced an increase in the urinary catheter DUR. There were more device-days compared to the prior year, among comparably similar patient-days.. A higher proportion of device-day occurred among nearly the same number of patient-days.

The trend in the central-line device utilization ratio would indicate that targeting reductions of device use in medical units would be the most efficient use of resources. The trend in the urinary catheter device utilization ratio would indicate that targeting reductions of device use in medical/surgical units would be the most efficient use of resources. Use of these devices greatly contributes to the risk of acquiring a bloodstream infection or urinary tract infection, so using these devices only when medically necessary is an important factor in reducing the risk of infections.

Kansas met the US HHS 2013 target goal of a 50% reduction in CLABSIs. In 2012, an initiative in Kansas to reduce CLABSIs, which began in 2010, was led to completion by a valued partner in HAI prevention. The Kansas Healthcare Collaborative (KHC), a member of the Kansas HAI Advisory Group, led the Comprehensive Unit-based Safety Program (CUSP) Stop Blood Stream Infections (On the CUSP: Stop BSI) initiative, in which many Kansas HAI Reporting Group hospitals participated. Maintaining lessons learned and potential gains made from this initiative could be very important in keeping CLABSI reductions on track with the HHS 2020 target goal. In 2011, KHC began the On the CUSP: Stop CAUTI initiative, building on the successes of their previous initiative. In 2011 in Kansas, the estimated reduction of CAUTIs from the 2009 baseline exceeded the HHS 2013 target goal; however, in 2012 and 2013 it appeared that there may have been an increase in the CAUTI SIR, both nationally and in Kansas. The US HHS 2013 target goal of a 25% reduction in CAUTIs was not met. In order for Kansas to reverse the trend, participation in initiatives, like On the CUSP: Stop CAUTI, as well as facility led efforts, will be extremely important.

In 2013 there were statistically significantly more SSIs from colon surgeries in Kansas compared to the national baseline from 2006-2008, as well as compared to the US in 2013, and compared to Kansas in the prior year. Nationally, the colon SSI SIR was statistically significantly below the national baseline but experienced a statistically significant increase of 14% in 2013. Neither Kansas nor the nation met the US HHS 2013 target goal of a 25% reduction in COLO SSIs. There are however proven national SSI collaboratives and bundles of interventional strategies available for facilities to utilize.

SSIs from abdominal hysterectomy surgeries did however show a statistically significant reduction from the national baseline and were significantly lower than the nation in 2013. Nationally there were also significant reductions from the nation baseline. While the nation did not meet the US HHS 2013 target goal of a 25% reduction from the baseline period, Kansas did meet the goal with a 70% reduction.

In this first year of surveillance for the multi-drug resistant organisms, *C. difficile* and MRSA bloodstream infections both had statistically significant lower SIRs than the national baselines from 2010-2011. Nationally, these measures showed statistically significant reductions from the baseline and reductions from the prior year however, neither measure met the US HHS 2013 target goals of 30% reductions from the baseline for *C. difficile* or 25% reductions from the baseline for MRSA bloodstream infections. Kansas however did meet the US HHS 2013 target goal for reductions in *C. difficile*.

Public health is well equipped to work with healthcare facilities from across the continuum of care to address HAI reduction efforts. Public health surveillance involves ongoing, systematic collection, analysis and interpretation of health data for planning, implementation and evaluation of public health practice, and is closely integrated with the timely dissemination of these data to those responsible for prevention and control. In essence, HAI surveillance aims to accurately quantify the burden of the infection, establish a baseline, and develop tools and methods to decrease the burden of the disease.

Surveillance data is most effective when it is used to drive prevention efforts and focus application of best practice measures. A number of national efforts, some governmental and some private, are creating structures for implementing broad-based and infection-specific HAI prevention initiatives. As national focus on HAIs increases, surveillance becomes key to further define the magnitude of the problem, understand trends, and monitor progress in reducing and eliminating these infections. Significant progress is being made in the US toward nationwide HAI surveillance through the cooperation of federal regulatory agencies, state health departments, healthcare stakeholders, and an informed and active public.

Healthcare facilities that provided CLABSI data to CMS as part of Inpatient Quality Reporting (IQR) for hospitals participating in the IPPS incentive program have their data publicly reported, perpetually, through the Hospital Compare website. These data are not expected to be consistent with the SIR values represented in this report because the website uses a facility-specific SIR, not a unit-specific SIR. Continuing growth in the collaboration and coordination between CMS and stakeholders in HAI surveillance and prevention will be important in order to promote the most efficient surveillance methods and meaningful reporting efforts.

Recent successes in HAI elimination have been encouraging. The CDC recently published an estimate that in 2009, U.S. ICUs had reduced CLABSIs by 58% (from 43,000 to 18,000 per year) since 2001. This reduction could represent up to 6,000 lives saved and $414 million in potential excess health-care costs saved in 2009. Cumulatively, an approximate savings of $1.8 billion in excess health-care costs occurred since 2001. [25] While reductions have been demonstrated for some HAIs and in some healthcare settings, much more remains to be done. Ongoing vigilance and adherence to infection prevention guidelines is needed to ensure that all care is safe care. This includes traditional hospital settings as well as outpatient surgery centers, long-term care facilities, rehabilitation centers, and community clinics.

Data from NHSN, the same data used for these reports, can also help identify institutional problems and are used to monitor infection rates over time to help evaluate the implementation of new and innovative infection prevention practices.

Limitations

Data submitted to NHSN during 2013 have not been validated. Therefore, there is limited assurance of consistent case finding and accurate application of surveillance definitions. Additionally, one IPPS hospital did not participate in sharing data with KHAIRG, which had one or more ICU settings. Some CAH hospitals that perform COLO and HYST surgeries are not currently sharing data with KHAIRG or are not reporting to NHSN. Misapplication of the case definitions could have contributed to misclassification of cases, resulting in either over- or under-representation of the numerator. Incorrect patient-day counts could have contributed to misclassification of the population under surveillance, resulting in either over- or under-representation of the denominator.

Strengths

The strong support and high voluntary participation rate of IPPS hospitals in Kansas provides good estimation of the burden of CLABSIs, CAUTIs and SSIs. The hospitals submitting data for this report, representing 94% of staffed beds and 97% of ICU beds, are deemed to be highly representative of the population of ACHs in Kansas. Particularly, these provide a good estimation of the burden of CLABSIs and SSIs in Kansas, and more specific to location, CAUTIs in ICU settings. A large number of central lines are placed and managed in ICU settings in Kansas, and ICU settings are almost exclusively limited to IPPS hospitals. The majority of COLO and HYST surgeries are performed in the ACH hospitals and the CAH hospitals representative in this report. Urinary catheters are utilized across the continuum of care, so understanding the burden of CAUTIs in additional settings in the future will be important.

The Kansas HAI Program includes numerous individuals and organizations that are committed to the reduction and, wherever possible, the elimination of HAIs. While these findings are encouraging, the Kansas HAI Advisory Committee and partner healthcare facilities will continue to follow progress in the state as they implement best practices for monitoring and preventing HAI in order to improve the health status for the population of Kansas. Collaboration among healthcare facilities and with partner entities, such as the Kansas HAI Advisory Committee and its component organizations, is exceptionally strong. This has served the Kansas HAI Program well, as evidenced by early outcomes. Research to understand the broad issues at the state and national levels will evolve, and stakeholders will continue to provide input that will influence state and national goals and objectives related to HAI prevention. The Kansas HAI Advisory Committee plans to continue to provide a report such as this one to the public on an annual basis.

Appendix A: Kansas Healthcare-associated Infections Advisory Committee

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Deborah Stern, RN, Esq.

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Jerry Slaughter

Heartland Kidney Network

Kansas City, Mo

Sharlyn Bogner, MSN, RN, CNN, CCTC

Stormont-Vail Health Care

Terri Janda,

Appendix B: Additional tables

CLABSI

Table 12. Central-line device utilization ratio in Kansas adult ICUs versus US, 2013.

Location	No. of units	Central-line days	Patient days	2013 KS Pooled mean	2006-2008 US Pooled mean	2013 US Pooled mean
KS ICUs	56	65203	149778	**0.444**	0.500	**0.486**

Table 13. Unit-specific (adult) central-line device utilization ratio in Kansas versus US, 2013.

Type of location	No. of units	Catheter days	Patient days	2013 KS Pooled mean	2006-2008 US Pooled mean	2013 US Pooled mean
Medical Critical Care	8	11886	23303	**0.510**	0.536	0.505
Medical/Surgical Critical Care	34	29703	68930	**0.431**	0.481	0.450

Table 14. CLABSI SIRs in Kansas adult ICUs versus US, 2013.

No. of units	Observed CLABSIs	Expected CLABSIs	2013 aggregate KS SIR	p-value	95% Confidence interval	2006-2008 US SIR	2013 US SIR
53	43	131.182	**0.328**	< 0.0001	0.240, 0.437	1.000	**0.506**

Table 15. Unit-specific (adult) CLABSI SIRs in Kansas versus US, 2013.

Type of location	No. of units	Observed CLABSIs	Expected CLABSIs	2013 KS aggregate unit SIR	p-value	95% Confidence interval	2006-2008 US SIR	2013 US SIR
Medical Critical Care	8	13	28.4963	**0.456**	0.0014	0.254, 0.761	1.000	**0.511**
Medical/Surgical Critical Care (combined)	33	17	53.385	**0.318**	<0.0001	0.192, 0.500	1.000	**0.551**

CAUTI

Table 16. Urinary catheter device utilization ratio in Kansas adult ICUs versus US, 2013.

Location	No. of units	Catheter days	Patient days	2013 KS Pooled mean	2009 US Pooled mean	2013 US Pooled mean
KS ICUs	56	83639	145402	**0.575**	0.700	**0.620**

Table 17. Unit-specific (adult) catheter device utilization ratio in Kansas versus US, 2013.

Type of location	No. of units	Catheter days	Patient days	2013 KS Pooled mean	2009 US Pooled mean	2013 US Pooled mean
Medical Critical Care	8	13406	23303	**0.575**	0.706	**0.636**
Medical/Surgical Critical Care	34	39334	69149	**0.569**	0.704	**0.602**

Table 18. CAUTI SIRs in Kansas adult ICUs versus US, 2013.

No. of units	Observed CAUTIs	Expected CAUTIs	2013 aggregate KS SIR	p-value	95% Confidence interval	2009 US SIR	2013 US SIR
53	188	168.513	**1.116**	0.1473	0.964, 1.284	1.000	1.188

Table 19. Unit-specific (adult) CAUTI SIRs in Kansas versus US, 2013.

Type of location	No. of units	Observed CAUTIs	Expected CAUTIs	2013 KS aggregate unit SIR	p-value	95% Confidence interval	2009 US SIR	2013 US SIR
Medical Critical Care	8	27	29.393	**0.919**	0.2850	0.960, 2.053	1.000	**1.267**
Medical/Surgical Critical Care (combined)	33	74	71.063	**1.041**	0.0461	0.919, 1.452	1.000	**1.195**

SSI

Table 20. COLO SSI SIRs in Kansas versus US, 2013.

No. of facilities	No. of procedures	Observed COLO SSIs	Expected COLO SSIs	2013 aggregate KS SIR	p-value	95% Confidence interval	2006-2008 US SIR	2013 US SIR
51	2652	110	78.622	**1.399**	0.0010	1.155, 1.680	1.000	0.919

Table 21. HYST SSI SIRs in Kansas versus US, 2012.

No. of facilities	No. of procedures	Observed HYST SSIs	Expected HYST SSIs	2013 aggregate KS SIR	p-value	95% Confidence interval	2006-2008 US SIR	2013 US SIR
51	2194	5	16.562	**0.302**	0.0012	0.111, 0.669	1.000	0.862

MDRO

Table 22. *C. difficile* infections SIRs in Kansas versus US, 2013.

No. of facilities	Observed *C. difficile* Infections	Expected *C. difficile* Infections	2013 aggregate KS SIR	p-value	95% Confidence interval	2010-2011 US SIR	2013 US SIR
61	789	870.716	**0.906**	0.0053	0.845, 0.971	1.000	0.904

Table 23. MRSA bloodstream infections SIRs in Kansas versus US, 2013.

No. of facilities	Observed MRSA Bloodstream Infections	Expected MRSA Bloodstream Infections	2013 aggregate KS SIR	p-value	95% Confidence interval	2010-2011 US SIR	2013 US SIR
57	43	88.935	**0.484**	< 0.0001	0.354, 0.645	1.000	0.917

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