Healthcare Quality Reporting Program

HOSPITAL-ACQUIRED INFECTIONS AND PREVENTION ADVISORY SUBCOMMITTEE

8:00-9:00am, 4/21/14 at Healthcentric Advisors

Goals/Objectives
▪ To discuss HAI work to date and make policy recommendations for pending and upcoming reports

Members		
✓ Nicole Alexander, MD	✓ Maureen Marsella, RN, BS	☐ Lee Ann Quinn, RN, BS, CIC
✓ Rosa Baier, MPH	☐ Linda McDonald, RN	✓ Janet Robinson, RN, Med, CIC
✓ Utpala Bandy, MD	✓ Leonard Mermel, DO, ScM	✓ Nancy Vallande, MSM, MT, CIC
✓ Emily Cooper, MPH	☐ Pat Mastors	☐ Cindy Vanner
✓ Marlene Fishman, MPH, CIC	✓ Robin Neale, MT (ASCP), SM,CIC	✓ Samara Viner-Brown, MS
✓ Yongwen Jiang, PhD	✓ Kathleen O'Connell, RN,BSN,CIC	
✓ Julie Jefferson, RN, MPH, CIC	✓ Sheila Turner, RN, MA	

Time	Topic/Notes

8:00am **Welcome & Administrative Updates**
Leonard Mermel, DO, ScM
Samara Viner-Brown, MS

- Len welcomed the group and reviewed today's agenda and the previous meeting's action items:

  - **Create the Hand Hygiene Report** (Emily/Blake) – Complete

    This report has been published and is available on the HEALTH website.

  - **Revise the Hospital Summary Report and Methods for the next update** (Emily) – Complete

    The comments have been incorporated into the report and the amended report will be published the next time the report is updated on HEALTH.

  - **Send information regarding NHSN's instructions for health system employees to the Subcommittee** (Emily/Rosa) – Complete

    This information was communicated following the previous meeting and is paraphrased below:

    Individuals paid on the corporate payroll should be included in the data submitted to NHSN, in the "other contract personnel" category. This is the only non-employee category that includes both clinical and non-clinical roles.

    (Email Rosa for the full email chain of questions and responses.)

Time	Topic/Notes
8:05pm	**Healthcare Worker Flu Vaccination Reporting** *Rosa Baier, MPH* *Emily Cooper, MPH*

- **Reporting requirements**

  Rosa provided an update on the Immunization Program's new request, that hospitals submit data to HEALTH using the link provided to them. This is a change from last year's policy, when HEALTH obtained the data from NHSN. Robin commented that she participated in *ad hoc* discussions about the data collection form and that the primary reason was the state's May deadline; last year, the NHSN deadline was in August.

- **Discussion**

  The group agreed with submitting data directly to both HEALTH and NHSN, to ensure that HEALTH receives the data as early as possible, but asked if the Immunization Program would consider pulling the data from NHSN again next year since the NHSN deadline is now May 15 (the same as the state's). They also commented that in 2016, hospitals will be required to submit additional HCW data to NHSN, so submitting to multiple locations will be more burdensome.

  The data submission request was sent to employee health. The group asked if Infection Preventionists could be added to the data submission request.

  Rosa will follow up with the Immunization Program regarding both questions:

  1. Will the Immunization Program consider pulling the data from NHSN again next year since the NHSN deadline is now May 15 (the same as the state's).
  2. Can the Infection Preventionists be added to the data submission request sent to Employee Health?

8:35am **Rhode Island *Clostridium difficile* Infection Trends and Laboratory ID Events Ranking**
Yongwen Jiang, PhD

- **Presentation**

  Yongwen presented an analysis of *C. difficile* data from Hospital Compare (LabID) and the Healthcare Cost and Utilization Project (HCUP; discharge diagnosis):

  - Table 1: Rhode Island ranked 51/51 for *C. difficile* LabID events, based on Hospital Compare data from Q1 2013.

    The group discussed possible explanations for this ranking, including the fact that Q1 2013 was the first quarter for LabID reporting, the age of the Rhode Island population is greater than most states, and the fact that there is near-universal use of highly sensitive NAAT testing for *C. difficile* in Rhode Island. Although the measure is risk-adjusted for test type (and facility size and admission prevalence of LabID), it's possible the risk adjustment is not robust enough for the fact that most if not all Rhode Island facilities are using the most sensitive test.
  - Figure 1: HCUP data show that the increase in CDI in Rhode Island is outpacing the increase in the New England states with available data (Massachusetts and Vermont) and in the U.S. as a whole.

    Marlene asked about the data source; Yongwen explained that HCUP uses discharge diagnosis of CDI and is not risk adjusted. Additional limitations include the fact that only 36 states have data and some do not have data for every year;

Time	Topic/Notes
	nonetheless, this is our only source of longitudinal comparative data for CDI. • Figures 2 and 3: Hospital Compare (LabID) data show Rhode Island's ranking relative to other states, including the 95% CI of the SIR (Figure 2) and geographic distribution (Figure 3). Yongwen commented that 10 states were worse the US average. She noted that states with higher case volumes have smaller (more precise) 95% CIs. • Table 2: Hospital Compare (LabID) data show Rhode Island's performance relative to other New England states. Both Massachusetts and Rhode Island have worse than expected LabID rates; Vermont and Maine are about the same as expected; New Hampshire and Connecticut are better than expected. • Table 3: Hospital Compare (LabID) data show individual Rhode Island hospitals' performance using SIRs. Rosa noted that Yongwen, Rosa, Samara, Blake Morphis, and Len have also written a RIMS journal article that will be published later this year, most likely in the Fall. - **Discussion** Gina plans to share the infection ranking (Table 1) with her board and asked for the group's input explaining the results for C. difficile, CAUTI and SSI: Hysterectomy. In addition to the discussion with the slides, the group also discussed the questions sent with the agenda: • What might be different in Rhode Island vs. other states? • How can we interpret and act on the findings? • What are the limitations of the data? Several people noted that the ICU Collaborative was very successful and that the better than expected CLABSI rate is likely a positive effect of that work. Maureen and Julie commented on the importance of forming multi-disciplinary teams with strong leadership support. Perhaps these data could be used to advocate for additional resources and leadership support. Len noted that other states may have advocated antibiotic stewardship programs that have contributed to lowering *C. difficile* rates; some states/hospitals have protocols that have staff check on patients taking antibiotics every day to determine if the medication should be continued or discontinued. Robin said that leadership mandated that the hospital eliminate CLABSIs and provided whatever was required to make that a reality; this approach may work for C. difficile, because when leadership mandates change and provides resources, the change happens. Rosa commented that these data have caught Dr. Fine's attention; he asked Nicole to form a working group to assess communications and interventions to address CDI.
8:50am	**CDC HAI Reports** *Rosa Baier, MPH* *Emily Cooper, MPH* - **Review report (handout)** Rosa reviewed the CDC HAI reports, including the Rhode Island report, the state comparison and the national report. The discussion of these data was combined with

Time	Topic/Notes
	the discussion summarized on p. 3.
8:55am	**Open Forum & Action Items** *Rosa Baier, MPH*

- Rosa informed the group of an *ad hoc* meeting scheduled for 5/19 and asked the group to mark their calendars.

  When we shifted to meeting every two months, we agreed to hold additional meetings as needed. Today's discussion was time-sensitive because of the flu vaccination data submission deadline (5/15); we also need to discuss a hand hygiene discussion request from Dr. Fine, before the Steering Committee meets (also 5/19).

  The hand hygiene discussion request is summarized below in an excerpt from the 3/24 Steering Committee discussion:

  "Dr. Fine asked why the Hospital Hand Hygiene Report shows process measures, but does not report the results of the hand hygiene practices. Rosa explained that the report was the first step towards reporting MRSA outcomes, which are now reported. At the time the report was developed, the hospitals' infection control practices were too varied to collect uniform data (e.g., compliance with hand washing) for reporting. Now that the program reports MRSA, the HAI Subcommittee has periodically discussed the added value in continuing to report hand hygiene, but continues to recommend reporting these process measures.

  "Dr. Fine requested that the HAI Subcommittee explore the possibility of recommending a standard best practice that hospitals could then measure and report. Gina mentioned that the current process measures are based on the Joint Commission standards, which include several methods (e.g., observing hand washing, measuring the amount of hand sanitizer used). Program staff will discuss this request with the Subcommittee and then report back to the committee."

- **Action items:**
  - Share questions with the Immunization Program (Rosa)
  - Provide Gina with *C. difficile* talking points for the HARI Board (Rosa)

- **Next meeting:**
  - **5/19 (newly-scheduled)**

RHODE ISLAND DEPARTMENT OF HEALTH

Rhode Island *Clostridium difficile* Infection Trends and Laboratory ID Events Ranking

Yongwen Jiang, Rosa Baier, Blake Morphis,

Leonard Mermel, Samara Viner-Brown

Table 1. Hospital Healthcare-Associated Infections and LabID Events in Rhode Island

HAI	Time Period	SIR	95% CI	Rank*	Benchmark
c. difficile	**Q113**	**1.358**	**(1.162-1.578)**	**51/51**	**Worse than U.S.**
CAUTI	**Q212-Q113**	**1.416**	**(1.146-1.831)**	**42/50**	**Worse than U.S.**
CLABSI	**Q212-Q113**	**0.611**	**(0.430-0.842)**	**40/51**	**Better than U.S.**
MRSA Blood**	Q113	1.151	(0.575-2.060)	39/51	Same as U.S.
SSI: Colon	Q212-Q113	1.207	(0.849-1.663)	46/51	Same as U.S.
SSI: Hysterectomy	**Q212-Q113**	**1.817**	**(1.058-2.909)**	**51/51**	**Worse than U.S.**

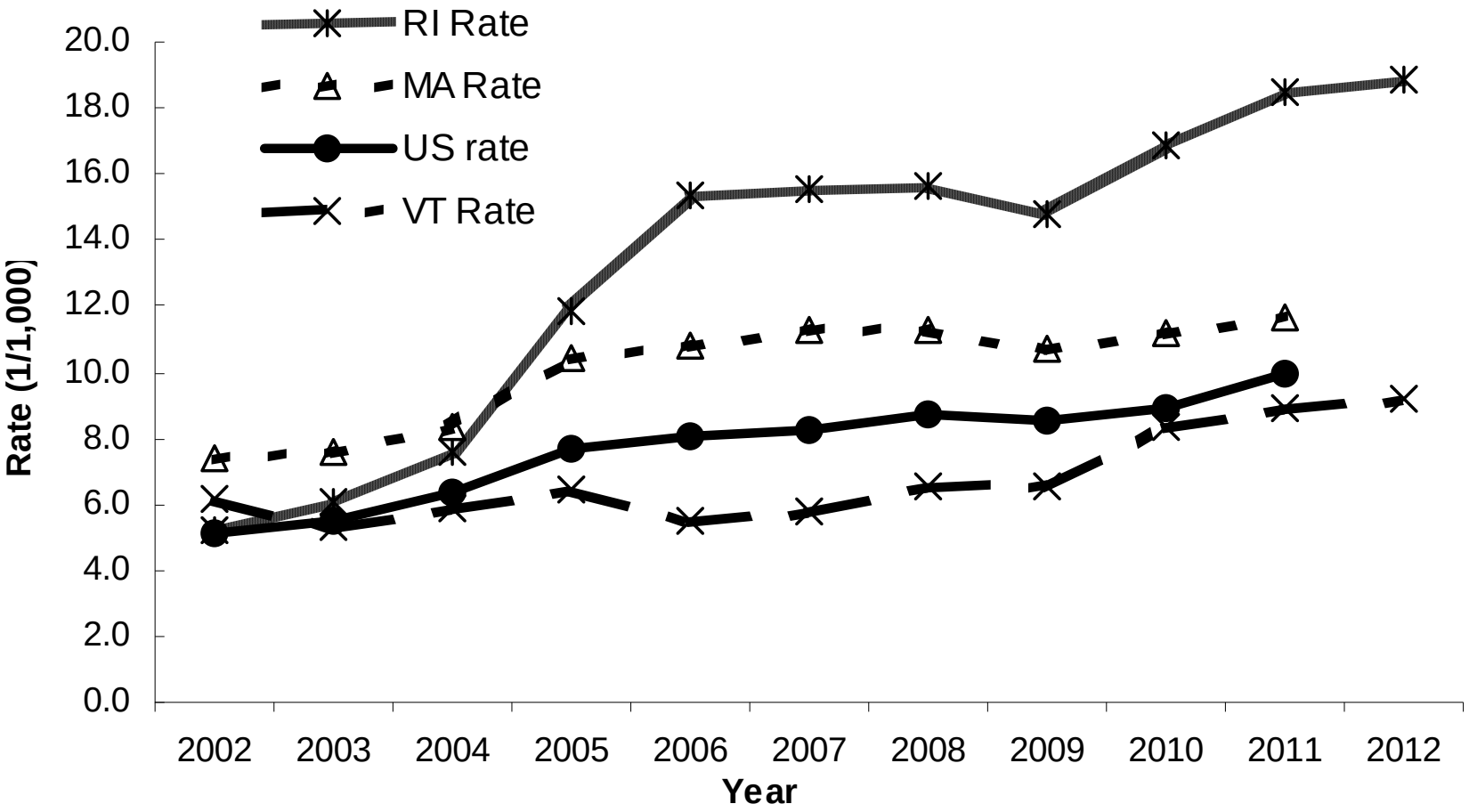
SIR: Standardized Incidence Ratio. CI: Confidence Interval.

*Bold confidence interval does not cross 1.

**LabID Events

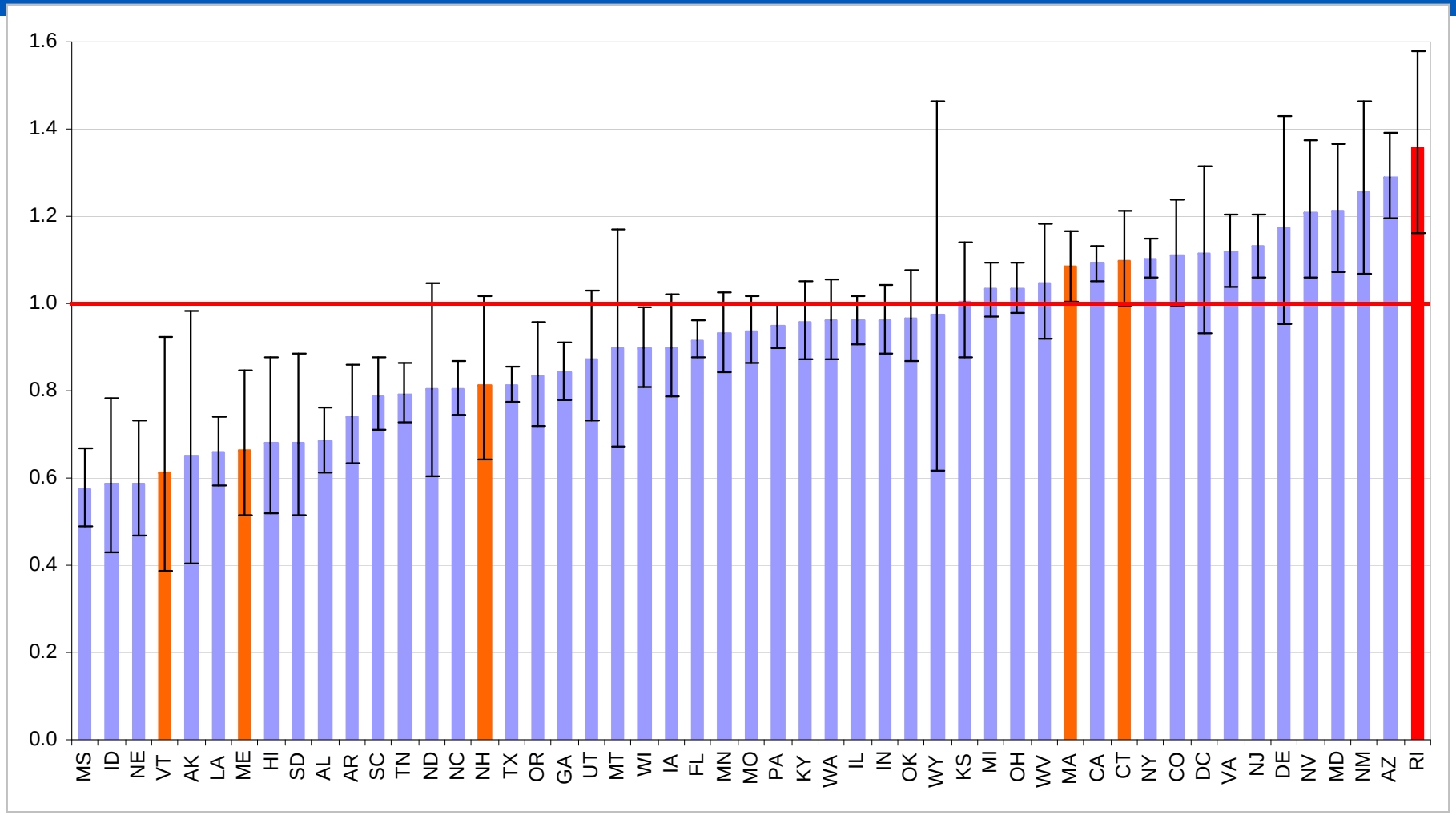
Note: Provided by HealthCentric Advisors.

Figure 1. *Clostridium difficle* Infection Rate, New England Area and U.S. 2002-2012



Note: Data from Healthcare Cost and Utilization Project (HCUP) (http://www.hcup-us.ahrq.gov/)

Figure 2. States Ranked by SIR of *C. difficile* LabID Event, First Quarter of 2013



Note: Data from Hospital Compare Website (https://data.medicare.gov/)

Figure 3. States Ranked by SIR of *C. difficile* LabID Event, First Quarter of 2013

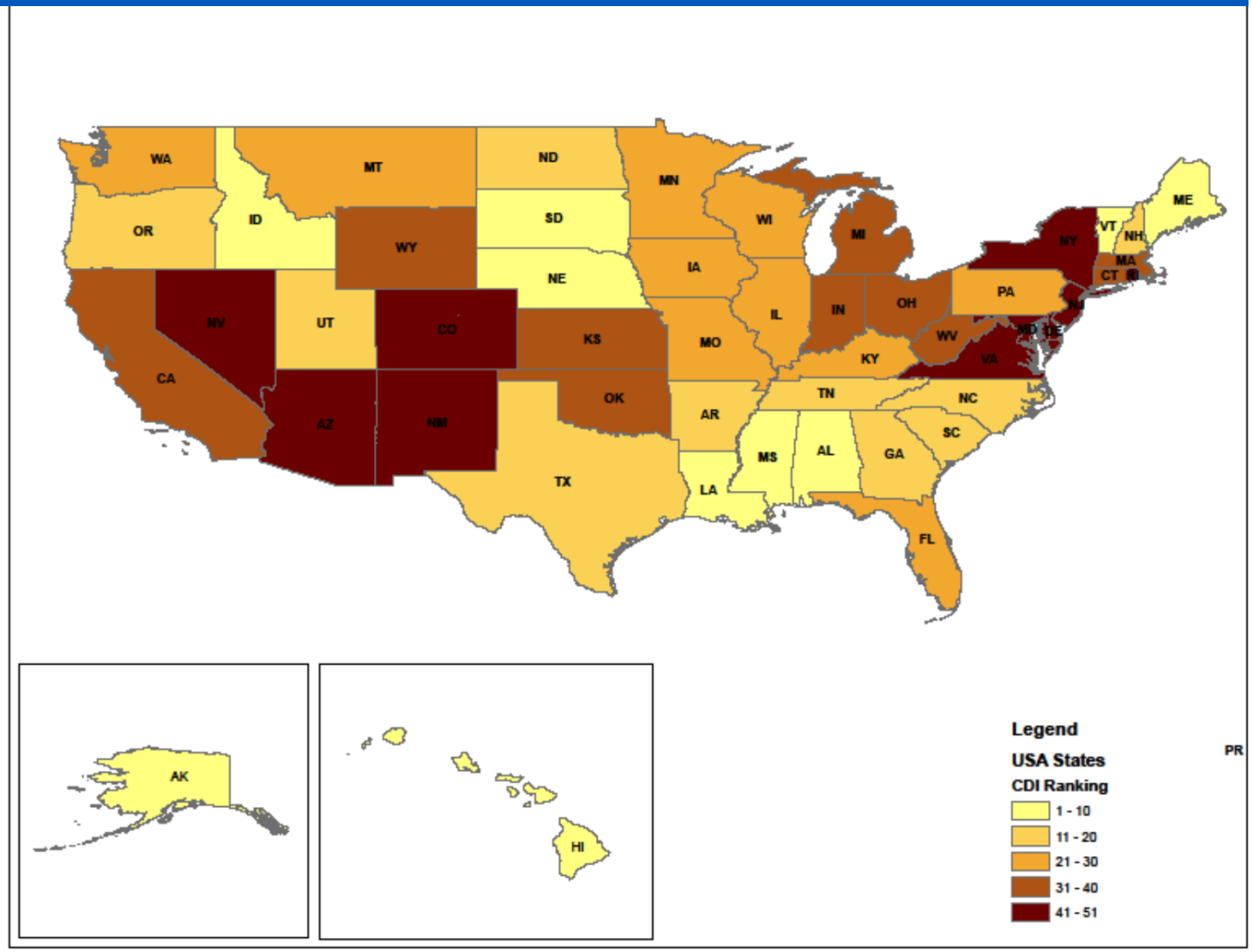


Table 2. Hospital *Clostridium difficile* LabID Events in New England States, First Quarter of 2013

State	Observed Cases	Predicted Cases	SIR	95% CI	Rank
Vermont	23	37.4	0.614	0.389-0.922	4
Maine	65	97.8	0.665	0.513-0.847	7
New Hampshire	77	94.6	0.814	0.642-1.017	16
Massachusetts	693	640.0	1.083	1.004-1.167	38
Connecticut	397	356.9	1.100	0.994-1.213	40
Rhode Island	170	125.2	1.358	1.162-1.578	51

SIR, standardized incidence ratio; CI, confidence interval.

Note: Data from Hospital Compare Website (https://data.medicare.gov/)

Table 3. Hospital *Clostridium difficile* LabID Events in RI, First Quarter of 2013

Hospital	Observed Cases	Predicted Cases	SIR
Kent County Memorial Hospital	28	17.0	1.650
Landmark Medical Center, Inc	8	6.2	1.281
Memorial Hospital of Rhode Island	13	7.8	1.675
Miriam Hospital	30	18.8	1.599
Newport Hospital	7	5.4	1.304
Rhode Island Hospital	62	44.0	1.410
Roger Williams Medical Center	6	5.7	1.057
South County Hospital Inc	2	3.3	0.613
St Joseph Health Services of RI	12	8.1	1.485
Westerly Hospital	2	2.4	0.824
Women and Infants Hospital of RI	0	6.6	0.000
Grand Total	170	125.2	1.358

SIR: Standardized Incidence Ratio.

Note: Data from Hospital Compare Website (www.hospitalcompare.hhs.gov)

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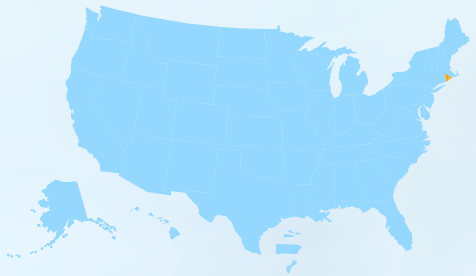
HEALTHCARE ASSOCIATED INFECTIONS PROGRESS

RHODE ISLAND

Healthcare-associated infections (HAIs) are infections patients can get while receiving medical treatment in a healthcare facility. The **standardized infection ratio (SIR)** is a statistic used to track HAI prevention progress over time; lower SIRs indicate better progress. The infection data are collected through CDC's National Healthcare Safety Network (NHSN). Some states require hospitals to publicly report at least one HAI to NHSN, and HAI data for nearly all U.S. hospitals are published on the Hospital Compare website.



CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS

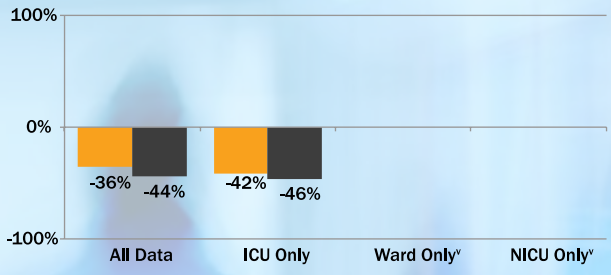
CLABSIs ↓ 36% LOWER COMPARED TO NAT'L BASELINE

A **central line** is a tube that a doctor usually places in a large vein of a patient's neck or chest to give important medical treatment. When not put in correctly or kept clean, central lines can become a freeway for germs to enter the body and cause deadly infections in the blood.

Rhode Island hospitals did not report a significant change in CLABSIs between 2011 and 2012

Not enough data to report how many Rhode Island hospitals have an SIR significantly worse than the national SIR of 0.56.

Changes in CLABSI vs. 2008 National Baseline



LEGEND

- State
- National
- ✓ State examines data and reviews medical charts for this infection to confirm accuracy and completeness
- Q State investigates data for this infection to assess completeness and quality
- * Statistically significant difference
- ∨ Fewer than 5 facilities reported data

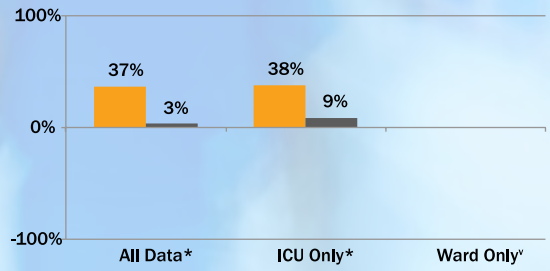
CAUTIs ↑ 37% HIGHER COMPARED TO NAT'L BASELINE

CATHETER-ASSOCIATED URINARY TRACT INFECTIONS

When a urinary catheter is not inserted correctly, not kept clean, or left in a patient for too long, germs can travel through the catheter and cause a **catheter-associated urinary tract infection** in the urinary system, which includes the bladder and kidneys.

30% **30% of Rhode Island hospitals have a SIR worse than the national SIR of 1.03.**

Changes in CAUTI vs. 2009 National Baseline



SSIs: COLON SURGERY ↑ 38% HIGHER COMPARED TO NAT'L BASELINE

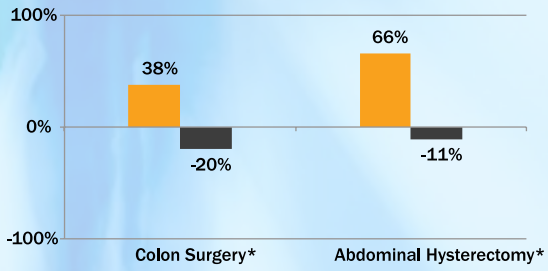
SSIs: ABDOMINAL HYSTERECTOMY ↑ 66% HIGHER COMPARED TO NAT'L BASELINE

SURGICAL SITE INFECTIONS: COLON SURGERY AND ABDOMINAL HYSTERECTOMY SURGERY

When germs get into an area where surgery is or was performed, patients can get a **surgical site infection**. Sometimes these infections involve the skin only. Other SSIs can involve tissues under the skin, organs, or implanted material.

30% **30% of Rhode Island hospitals have a colon surgery SIR worse than the national SIR 0.80.**

Changes in SSI vs. 2008 National Baseline



Not enough data to report how many Rhode Island hospitals have an abdominal hysterectomy SIR significantly worse than the national SIR of 0.89.

THIS REPORT IS BASED ON 2012 DATA, PUBLISHED MARCH 2014

RHODE ISLAND

HEALTHCARE ASSOCIATED INFECTIONS PROGRESS

HEALTHCARE-ASSOCIATED INFECTION (HAI) DATA gives healthcare facilities and public health agencies knowledge to design, implement, and evaluate HAI prevention efforts.

Learn how your hospital is preventing infections: **www.medicare.gov/hospitalcompare**
For more information:

- 2012 HAI Progress Report: **www.cdc.gov/hai/progress-report/**
- Preventing HAIs: **www.cdc.gov/hai**
- NHSN: **www.cdc.gov/nhsn**
- HAIs in Rhode Island: **www.health.ri.gov/programs/healthcarequalityreporting/index.php**

WHAT IS THE STANDARDIZED INFECTION RATIO?

The **standardized infection ratio (SIR)** is a statistic used to track healthcare-associated infection prevention progress over time. The SIR for a facility or state is adjusted to account for factors that might cause infection rates to be higher or lower, such as hospital size, teaching status, the type of patients a hospital serves, and surgery and patient characteristics.

✓ Q In some cases, states that work to validate, or double check, HAI data may have higher SIRs since they are actively looking for infections.

WHAT DOES THE STANDARDIZED INFECTION RATIO MEAN?

IF THE STATE SIR IS:

MORE THAN 1 — There were more infections reported in the state in 2012 compared to the national baseline data, **indicating there has been an increase in infections.**

1 — There were about the same number of infections reported in the state in 2012 compared to the national baseline data, **indicating no progress has been made.**

LESS THAN 1 — There were fewer infections reported in the state in 2012 compared to the national baseline data, **indicating progress has been made in preventing infections.**

WHAT IS RHODE ISLAND DOING TO PREVENT HEALTHCARE-ASSOCIATED INFECTIONS?

Rhode Island has a state mandate to publicly report at least one HAI to NHSN.

Rhode Island has several prevention efforts (known as prevention collaboratives) to reduce specific HAIs, including:

- Central line-associated bloodstream infections
- Cather-associated urinary tract infections
- Surgical site infections
- MRSA infections
- Multidrug-resistant organism infections
- Ventilator-associated pneumonia infections

Rhode Island implemented prevention efforts to improve antibiotic stewardship.

NUMBER OF RHODE ISLAND HOSPITALS THAT REPORTED DATA TO CDC'S NHSN IN 2012 Total Hospitals: 14+		STATE SIR	NAT'L SIR
CLABSI 11 hospitals	Rhode Island's 2012 state **CLABSI** SIR is similar to the 2012 national SIR.	0.64	0.56
CAUTI 10 hospitals	Rhode Island's 2012 state **CAUTI** SIR is significantly worse than the 2012 national SIR.	1.37	1.03
SSI, Colon Surgery 11 hospitals	Rhode Island's 2012 state **Colon Surgery SSI** SIR is significantly worse than the 2012 national SIR.	1.38	0.80
SSI, Abdominal Hysterectomy 11 hospitals	Rhode Island's 2012 state **Abdominal Hysterectomy SSI** SIR is significantly worse than the 2012 national SIR.	1.66	0.89

+ Not all hospitals are required to report these infections; some hospitals do not use central lines or urinary catheters, or do not perform colon or abdominal hysterectomy surgeries.

THIS REPORT IS BASED ON 2012 DATA, PUBLISHED MARCH 2014

STATE HAI PROGRESS

HEALTHCARE ASSOCIATED INFECTIONS PROGRESS

STATE	CLABSI				CAUTI			SSI - Colon Surgery			SSI - Abdominal Hysterectomy		
	# Facilities Reporting	2012 STATE SIR vs. 2011 State SIR	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2008 Nat'l Baseline	# Facilities Reporting	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2009 Nat'l Baseline	# Facilities Reporting	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2008 Nat'l Baseline	# Facilities Reporting	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2008 Nat'l Baseline
Alabama	76		↑	↓	90	↓	↓	74	↓	↓	64	↓	↓
Alaska	11		↑		12			9	↑		9		
Arkansas	49			↓	51			40			39		
Arizona	58		↑	↓	58	↑	↑	54	↑		51	↑	
California	352	↓	↓	↓	338	↓	↓	317	↓	↓	305		↓
Colorado	51	↓	↓	↓	50	↓		57		↓	56		
Connecticut	30		↑	↓	30	↑	↑	30	↑		28		
D.C.	8		↑	↓	7	↑	↑	7	↓	↓	7		
Delaware	8			↓	8			7			7		
Florida	187			↓	187	↓	↓	180	↓	↓	170		
Georgia	105	↓	↑	↓	107			99		↓	91		
Hawaii	15		↓	↓	15			13			10		
Iowa	48			↓	68			34			32		
Idaho	12		↓	↓	15			15			14	↓	
Illinois	146			↓	147			140	↓	↓	137		
Indiana	102	↑	↑	↓	104			105	↑		98	↓	↓
Kansas	46			↓	52			43			41		
Kentucky	71	↑	↑	↓	72	↑	↑	65		↓	61		
Louisiana	75		↑	↓	78	↓	↓	75	↑		81		
Massachusetts	67			↓	66	↑	↑	62		↓	61		
Maryland	47	↓		↓	38	↑	↑	10			8	↑	↑
Maine	22		↑		22	↑	↑	24	↑		21		
Michigan	95	↑	↓	↓	97			91		↓	86		
Minnesota	49			↓	51	↑	↑	49		↓	50		
Missouri	74		↓	↓	75			72	↓	↓	69		↓
Mississippi	46	↑	↑		46	↑	↑	41			43	↑	

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LEGEND

↓ 2012 state SIR is significantly lower than comparison group in column header

↑ 2012 state SIR is significantly higher than comparison group in column header

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STATE HAI PROGRESS

HEALTHCARE ASSOCIATED INFECTIONS PROGRESS

STATE	CLABSI				CAUTI			SSI - Colon Surgery			SSI - Abdominal Hysterectomy		
	# Facilities Reporting	2012 STATE SIR vs. 2011 State SIR	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2008 Nat'l Baseline	# Facilities Reporting	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2009 Nat'l Baseline	# Facilities Reporting	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2008 Nat'l Baseline	# Facilities Reporting	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2008 Nat'l Baseline
Montana	12			↓	13			14		↓	14		
North Carolina	96		↓	↓	100	↑	↑	93		↓	89		↓
North Dakota	6		↓	↓	6	↓	↓	6	↑	↑	6		
Nebraska	19		↑	↓	20			20	↑		20		
New Hampshire	24			↓	23			26		↓	23		
New Jersey	72		↑	↓	72	↓	↓	71	↓	↓	66		
New Mexico	34			↓	34			27		↓	24		
Nevada	23	↓		↓	24			22	↑		19		
New York	174	↓	↑	↓	175	↑	↑	175		↓	162	↑	↑
Ohio	135		↓	↓	135	↓	↓	127		↓	123		
Oklahoma	55		↓	↓	61	↓	↓	61		↓	59		
Oregon	47		↓	↓	46	↑	↑	49		↓	46	↓	↓
Pennsylvania	175		↓	↓	190	↓	↓	162		↓	148		
Puerto Rico	18	↓	↑		18			0			0		
Rhode Island	11			↓	10	↑	↑	11	↑		11	↑	
South Carolina	65	↓	↑	↓	64	↑	↑	57	↑		54		
South Dakota	14	No significant change	↓	↓	18	↓	↓	14	No significant change	No significant change	14	No significant change	No significant change
Tennessee	94	↓		↓	95	↑	↑	90	↑		90		
Texas	277			↓	284	↓	↓	281		↓	281	↓	↓
Utah	26			↓	26	↑	↑	30	↑	↑	30		
Virginia	81	↓		↓	81	↓	↓	76		↓	67		
Vermont	7		↓	↓	5			6	↑	↑	11		
Washington	63			↓	61			62		↓	60	↓	↓
Wisconsin	78	↓	↓	↓	85	↓	↓	77		↓	71		
West Virginia	40		↓	↓	43	↓	↓	36			32		↓
Wyoming	20			↓	24			12			13		

LEGEND

↓ 2012 state SIR is significantly lower than comparison group in column header

↑ 2012 state SIR is significantly higher than comparison group in column header

No arrow indicates there was not a significant change

STATE HAI PROGRESS

HEALTHCARE ASSOCIATED INFECTIONS PROGRESS

STATE	CLABSI				CAUTI			SSI - Colon Surgery			SSI - Abdominal Hysterectomy		
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Arkansas	49			↓	51			40			39		
Arizona	58		↑	↓	58	↑	↑	54	↑		51	↑	
California	352	↓	↓	↓	338	↓	↓	317	↓	↓	305		↓
Colorado	51	↓	↓	↓	50	↓		57		↓	56		
Connecticut	30		↑	↓	30	↑	↑	30	↑		28		
D.C.	8		↑	↓	7	↑	↑	7	↓	↓	7		
Delaware	8			↓	8			7			7		
Florida	187			↓	187	↓	↓	180	↓	↓	170		
Georgia	105	↓	↑	↓	107			99		↓	91		
Hawaii	15		↓	↓	15			13			10		
Iowa	48			↓	68			34			32		
Idaho	12		↓	↓	15			15			14	↓	
Illinois	146			↓	147			140	↓	↓	137		
Indiana	102	↑	↑	↓	104			105	↑		98	↓	↓
Kansas	46			↓	52			43			41		
Kentucky	71	↑	↑	↓	72	↑	↑	65		↓	61		
Louisiana	75		↑	↓	78	↓	↓	75	↑		81		
Massachusetts	67			↓	66	↑	↑	62		↓	61		
Maryland	47	↓		↓	38	↑	↑	10			8	↑	↑
Maine	22		↑		22	↑	↑	24	↑		21		
Michigan	95	↑	↓	↓	97			91		↓	86		
Minnesota	49			↓	51	↑	↑	49		↓	50		
Missouri	74		↓	↓	75			72	↓	↓	69		↓
Mississippi	46	↑	↑		46	↑	↑	41			43	↑	

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LEGEND

↓ 2012 state SIR is significantly lower than comparison group in column header

↑ 2012 state SIR is significantly higher than comparison group in column header

No arrow indicates there was not a significant change

STATE HAI PROGRESS

HEALTHCARE ASSOCIATED INFECTIONS PROGRESS

STATE	CLABSI				CAUTI			SSI - Colon Surgery			SSI - Abdominal Hysterectomy		
	# Facilities Reporting	2012 STATE SIR vs. 2011 State SIR	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2008 Nat'l Baseline	# Facilities Reporting	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2009 Nat'l Baseline	# Facilities Reporting	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2008 Nat'l Baseline	# Facilities Reporting	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2008 Nat'l Baseline
Montana	12			↓	13			14		↓	14		
North Carolina	96		↓	↓	100	↑	↑	93		↓	89		↓
North Dakota	6		↓	↓	6	↓	↓	6	↑	↑	6		
Nebraska	19		↑	↓	20			20	↑		20		
New Hampshire	24			↓	23			26		↓	23		
New Jersey	72		↑	↓	72	↓	↓	71	↓	↓	66		
New Mexico	34			↓	34			27		↓	24		
Nevada	23	↓		↓	24			22	↑		19		
New York	174	↓	↑	↓	175	↑	↑	175		↓	162	↑	↑
Ohio	135		↓	↓	135	↓	↓	127		↓	123		
Oklahoma	55		↓	↓	61	↓	↓	61		↓	59		
Oregon	47		↓	↓	46	↑	↑	49		↓	46	↓	↓
Pennsylvania	175		↓	↓	190	↓	↓	162		↓	148		
Puerto Rico	18	↓	↑		18			0			0		
Rhode Island	11			↓	10	↑	↑	11	↑		11	↑	
South Carolina	65	↓	↑	↓	64	↑	↑	57	↑		54		
South Dakota	14	No significant change	↓	↓	18	↓	↓	14	No significant change	No significant change	14	No significant change	No significant change
Tennessee	94	↓		↓	95	↑	↑	90	↑		90		
Texas	277			↓	284	↓	↓	281		↓	281	↓	↓
Utah	26			↓	26	↑	↑	30	↑	↑	30		
Virginia	81	↓		↓	81	↓	↓	76		↓	67		
Vermont	7		↓	↓	5			6	↑	↑	11		
Washington	63			↓	61			62		↓	60	↓	↓
Wisconsin	78	↓	↓	↓	85	↓	↓	77		↓	71		
West Virginia	40		↓	↓	43	↓	↓	36			32		↓
Wyoming	20			↓	24			12			13		

LEGEND

↓ 2012 state SIR is significantly lower than comparison group in column header

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STATE HAI PROGRESS

HEALTHCARE ASSOCIATED INFECTIONS PROGRESS

STATE	CLABSI				CAUTI			SSI - Colon Surgery			SSI - Abdominal Hysterectomy		
	# Facilities Reporting	2012 STATE SIR vs. 2011 State SIR	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2008 Nat'l Baseline	# Facilities Reporting	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2009 Nat'l Baseline	# Facilities Reporting	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2008 Nat'l Baseline	# Facilities Reporting	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2008 Nat'l Baseline
Alabama	76		↑	↓	90	↓	↓	74	↓	↓	64	↓	↓
Alaska	11		↑		12			9	↑		9		
Arkansas	49			↓	51			40			39		
Arizona	58		↑	↓	58	↑	↑	54	↑		51	↑	
California	352	↓	↓	↓	338	↓	↓	317	↓	↓	305		↓
Colorado	51	↓	↓	↓	50	↓		57		↓	56		
Connecticut	30		↑	↓	30	↑	↑	30	↑		28		
D.C.	8		↑	↓	7	↑	↑	7	↓	↓	7		
Delaware	8			↓	8			7			7		
Florida	187			↓	187	↓	↓	180	↓	↓	170		
Georgia	105	↓	↑	↓	107			99		↓	91		
Hawaii	15		↓	↓	15			13			10		
Iowa	48			↓	68			34			32		
Idaho	12		↓	↓	15			15			14	↓	
Illinois	146			↓	147			140	↓	↓	137		
Indiana	102	↑	↑	↓	104			105	↑		98	↓	↓
Kansas	46			↓	52			43			41		
Kentucky	71	↑	↑	↓	72	↑	↑	65		↓	61		
Louisiana	75		↑	↓	78	↓	↓	75	↑		81		
Massachusetts	67			↓	66	↑	↑	62		↓	61		
Maryland	47	↓		↓	38	↑	↑	10			8	↑	↑
Maine	22		↑		22	↑	↑	24	↑		21		
Michigan	95	↑	↓	↓	97			91		↓	86		
Minnesota	49			↓	51	↑	↑	49		↓	50		
Missouri	74		↓	↓	75			72	↓	↓	69		↓
Mississippi	46	↑	↑		46	↑	↑	41			43	↑	

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LEGEND

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STATE HAI PROGRESS

HEALTHCARE ASSOCIATED INFECTIONS PROGRESS

STATE	CLABSI				CAUTI			SSI - Colon Surgery			SSI - Abdominal Hysterectomy		
	# Facilities Reporting	2012 STATE SIR vs. 2011 State SIR	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2008 Nat'l Baseline	# Facilities Reporting	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2009 Nat'l Baseline	# Facilities Reporting	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2008 Nat'l Baseline	# Facilities Reporting	2012 STATE SIR vs. 2012 Nat'l SIR	2012 STATE SIR vs. 2008 Nat'l Baseline
Montana	12			↓	13			14		↓	14		
North Carolina	96		↓	↓	100	↑	↑	93		↓	89		↓
North Dakota	6		↓	↓	6	↓	↓	6	↑	↑	6		
Nebraska	19		↑	↓	20			20	↑		20		
New Hampshire	24			↓	23			26		↓	23		
New Jersey	72		↑	↓	72	↓	↓	71	↓	↓	66		
New Mexico	34			↓	34			27		↓	24		
Nevada	23	↓		↓	24			22	↑		19		
New York	174	↓	↑	↓	175	↑	↑	175		↓	162	↑	↑
Ohio	135		↓	↓	135	↓	↓	127		↓	123		
Oklahoma	55		↓	↓	61	↓	↓	61		↓	59		
Oregon	47		↓	↓	46	↑	↑	49		↓	46	↓	↓
Pennsylvania	175		↓	↓	190	↓	↓	162		↓	148		
Puerto Rico	18	↓	↑		18			0			0		
Rhode Island	11			↓	10	↑	↑	11	↑		11	↑	
South Carolina	65	↓	↑	↓	64	↑	↑	57	↑		54		
South Dakota	14	No significant change	↓	↓	18	↓	↓	14	No significant change	No significant change	14	No significant change	No significant change
Tennessee	94	↓		↓	95	↑	↑	90	↑		90		
Texas	277			↓	284	↓	↓	281		↓	281	↓	↓
Utah	26			↓	26	↑	↑	30	↑	↑	30		
Virginia	81	↓		↓	81	↓	↓	76		↓	67		
Vermont	7		↓	↓	5			6	↑	↑	11		
Washington	63			↓	61			62		↓	60	↓	↓
Wisconsin	78	↓	↓	↓	85	↓	↓	77		↓	71		
West Virginia	40		↓	↓	43	↓	↓	36			32		↓
Wyoming	20			↓	24			12			13		

LEGEND

↓ 2012 state SIR is significantly lower than comparison group in column header

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HEALTHCARE ASSOCIATED INFECTIONS PROGRESS

NATIONAL

Healthcare-associated infections (**HAIs**) are infections patients can get while receiving medical treatment in a healthcare facility. The **standardized infection ratio** (**SIR**) is a statistic used to track HAI prevention progress over time; lower SIRs indicate better progress. The infection data are collected through CDC's National Healthcare Safety Network (NHSN). HAI data gives healthcare facilities and public health agencies knowledge to design, implement, and evaluate HAI prevention efforts.

NATIONAL PROGRESS OVERVIEW	NATIONAL SIR	CHANGES IN INFECTION VS. NATIONAL BASELINE
Central Line-associated Bloodstream Infections (**CLABSI**)	0.56	↓ 44%
Catheter-associated Urinary Tract Infections (**CAUTI**)	1.03	↑ 3%
Surgical Site Infections, Colon Surgery (**SSI**)	0.80	↓ 20%
Surgical Site Infections, Abdominal Hysterectomy Surgery (**SSI**)	0.89	↓ 11%
Hospital-onset *Clostridium difficile* Infections	0.98	↓ 2%
Hospital-onset MRSA Bloodstream Infections	0.96	↓ 4%*

WHAT IS THE STANDARDIZED INFECTION RATIO?

The **standardized infection ratio** (**SIR**) is a statistic used to track healthcare-associated infection prevention progress over time. The SIR for a facility or state is adjusted to account for factors that might cause infection rates to be higher or lower, such as hospital size, teaching status, the type of patients a hospital serves, and surgery and patient characteristics.

Learn how well your hospital prevents infections: **www.medicare.gov/hospitalcompare**

- 2012 HAI Progress Report: **www.cdc.gov/hai/progress-report/**
- Preventing HAIs: **www.cdc.gov/hai**
- NHSN: **www.cdc.gov/nhsn**

WHAT DOES THE STANDARDIZED INFECTION RATIO MEAN?

IF THE NATIONAL SIR IS:

MORE THAN 1 — There were more infections reported in the nation in 2012 compared to the national baseline data, **indicating there has been an increase in infections.**

1 — There were about the same number of infections reported in the nation in 2012 compared to the national baseline data, **indicating no progress has been made.**

LESS THAN 1 — There were fewer infections reported in the nation in 2012 compared to the national baseline data, **indicating progress has been made in preventing infections.**

*Overall healthcare-associated invasive MRSA has decreased 31% since 2008.

THIS REPORT IS BASED ON 2012 DATA, PUBLISHED MARCH 2014

HEALTHCARE ASSOCIATED INFECTIONS PROGRESS

NATIONAL

Healthcare-associated infections (**HAIs**) are infections patients can get while receiving medical treatment in a healthcare facility. The **standardized infection ratio** (**SIR**) is a statistic used to track HAI prevention progress over time; lower SIRs indicate better progress. The infection data are collected through CDC's National Healthcare Safety Network (NHSN).

CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS

CLABSIs ↓ 44% LOWER COMPARED TO NAT'L BASELINE

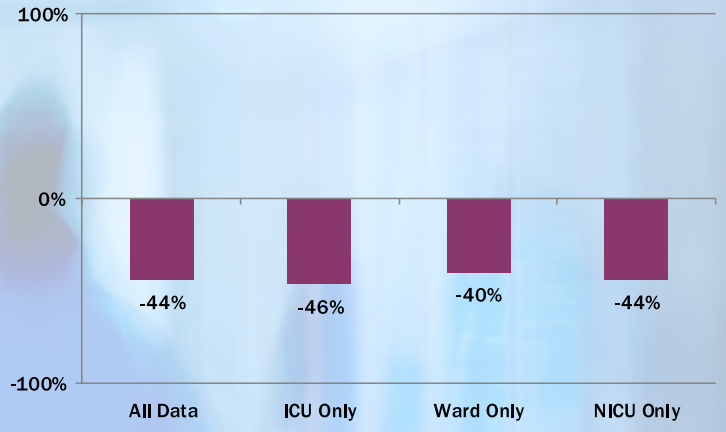
A **central line** is a tube that a doctor usually places in a large vein of a patient's neck or chest to give important medical treatment. When not put in correctly or kept clean, central lines can become a freeway for germs to enter the body and cause deadly infections in the blood.

US hospitals reported a significant decrease in CLABSIs between 2011 and 2012.

3,516 hospitals across the nation reported CLABSI data in 2012.

11% **11% of hospitals have an SIR significantly worse than the national SIR of 0.56.**

Changes in CLABSI vs. 2008 National Baseline



CATHETER-ASSOCIATED URINARY TRACT INFECTIONS

CAUTIs ↑ 3% HIGHER COMPARED TO NAT'L BASELINE

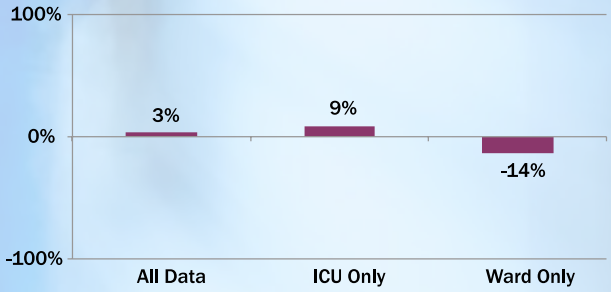
When a urinary catheter is not inserted correctly, not kept clean, or left in a patient for too long, germs can travel through the catheter and cause a **catheter-associated urinary tract infection** in the urinary system, which includes the bladder and kidneys.

US hospitals reported a significant increase in CAUTIs between 2011 and 2012.

3,597 hospitals across the nation reported CAUTI data in 2012.

13% **13% of hospitals have an SIR significantly worse than the national SIR of 1.03.**

Changes in CAUTI vs. 2009 National Baseline



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- Preventing HAIs: **www.cdc.gov/hai**
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THIS REPORT IS BASED ON 2012 DATA, PUBLISHED MARCH 2014

NATIONAL

HEALTHCARE ASSOCIATED INFECTIONS PROGRESS

Healthcare-associated infections (**HAIs**) are infections patients can get while receiving medical treatment in a healthcare facility. The **standardized infection ratio** (**SIR**) is a statistic used to track HAI prevention progress over time; lower SIRs indicate better progress. The infection data are collected through CDC's National Healthcare Safety Network (NHSN).

SURGICAL SITE INFECTIONS

SSIs: 10 COMMON SURGERIES ↓ 20% LOWER COMPARED TO NAT'L BASELINE

When germs get into an area where surgery is or was performed, patients can get a **surgical site infection.** Sometimes these infections involve the skin only. Other SSIs can involve tissues under the skin, organs, or implanted material.

US hospitals reported a significant decrease in the number of SSIs overall between 2011 and 2012.

10% **10% of hospitals have an SIR worse than the national SIR of 0.80.**

PROCEDURE CATEGORY	# FACILITIES REPORTING	# PROCEDURES REPORTED	2012 NATIONAL SIR	PERCENT CHANGE SINCE 2008
Hip arthroplasty	1,653	232,613	0.84	16% decrease*
Knee arthroplasty	1,663	341,048	0.77	23% decrease*
Colon surgery	3,318	288,362	0.80	20% decrease*
Rectal surgery	299	5,927	0.76	24% decrease*
Abdominal hysterectomy	3,172	299,412	0.89	11% decrease*
Vaginal hysterectomy	663	29,762	0.89	11% decrease
Coronary artery bypass graft	718	106,494	0.71	29% decrease*
Other cardiac surgery	334	37,002	0.68	32% decrease*
Peripheral vascular bypass surgery	135	4,399	0.74	26% decrease*
Abdominal aortic aneurysm repair	202	1,787	0.32	68% decrease*
These 10 procedures combined	3,554	1,346,806	0.80	20% decrease*

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- NHSN: www.cdc.gov/nhsn

* Statistically significant decrease since 2008

Almost all US hospitals report SSI data following colon surgeries and abdominal hysterectomy surgeries to NHSN.

SSIs: COLON SURGERY ↓ 20% LOWER COMPARED TO NAT'L BASELINE

SSIs: ABDOMINAL HYSTERECTOMY ↓ 11% LOWER COMPARED TO NAT'L BASELINE

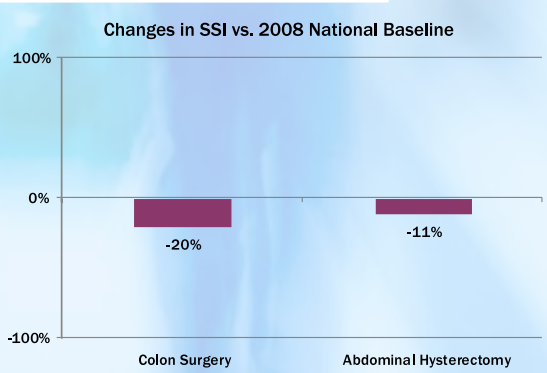
SURGICAL SITE INFECTIONS: COLON SURGERY AND ABDOMINAL HYSTERECTOMY SURGERY

US hospitals did not see a significant change in SSIs following colon surgery between 2011 and 2012.

288,362 colon surgeries were reported to NHSN in 2012.

3,318 hospitals across the nation reported SSI colon surgery data in 2012.

8% **8% of hospitals have a colon surgery SIR significantly worse than the national SIR of 0.80.**



US hospitals did not see a significant change in SSIs following abdominal hysterectomy surgery between 2011 and 2012.

299,412 abdominal hysterectomy surgeries were reported to NHSN in 2012.

3,172 hospitals across the nation reported SSI abdominal hysterectomy surgery data in 2012.

7% **7% of hospitals have an abdominal hysterectomy SIR significantly worse than the national SIR of 0.89.**

THIS REPORT IS BASED ON 2012 DATA, PUBLISHED MARCH 2014

HEALTHCARE ASSOCIATED INFECTIONS PROGRESS

NATIONAL

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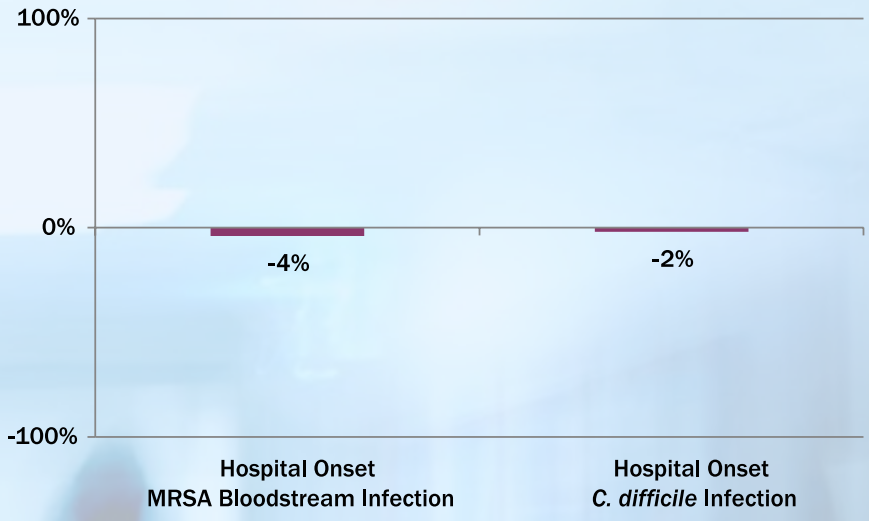
Changes in MRSA and *C. difficile* infections vs. 2011 National Baseline



Methicillin-resistant *Staphylococcus aureus* (MRSA) ↓ 4%* LOWER COMPARED TO NAT'L BASELINE

HOSPITAL-ONSET BLOODSTREAM INFECTIONS

MRSA is a type of staph bacteria usually spread by direct contact with an infected wound or from contaminated hands. In a healthcare setting, such as a hospital or nursing home, MRSA can cause serious bloodstream infections.

*Overall healthcare-associated invasive MRSA has decreased 31% since 2008.

1,175 hospitals across the nation reported MRSA bloodstream infection data in 2012.

8% **8% of hospitals have an SIR significantly worse than the national SIR of 0.96.**

HOSPITAL-ONSET INFECTIONS

Clostridium difficile (*C.difficile*) ↓ 2% LOWER COMPARED TO NAT'L BASELINE

When a person takes antibiotics, good bacteria that protect against infection are destroyed for several months. During this time, patients can get sick from ***C. difficile***, bacteria that cause potentially deadly diarrhea. *C. difficile* is usually spread by contact with contaminated surfaces or contaminated hands.

1,681 hospitals across the nation reported *C. difficile* data in 2012.

13% **13% of hospitals have an SIR significantly worse than the national SIR of 0.98.**

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THIS REPORT IS BASED ON 2012 DATA, PUBLISHED MARCH 2014

Hospital Reports

Apr 1, 2013 - Mar 31, 2014

All Sessions
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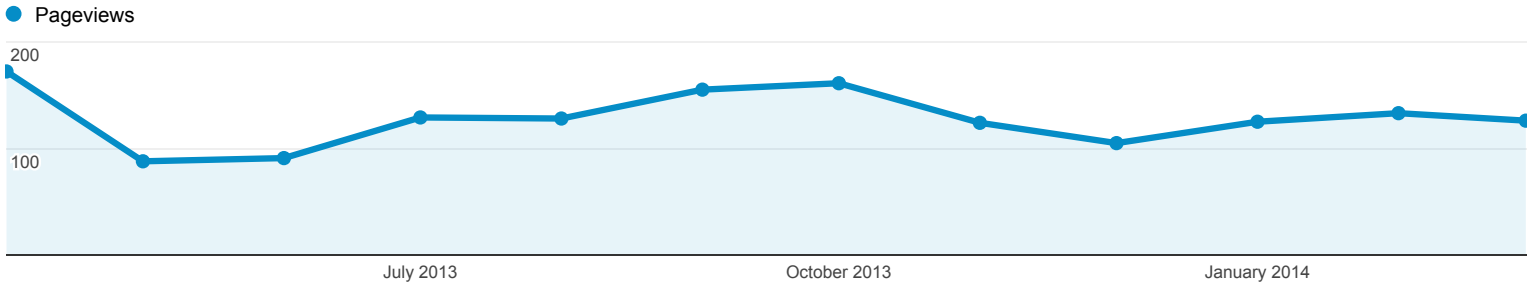
Report Tab



	Month of Year	Pageviews	Unique Pageviews	Avg. Time on Page	% Exit	Bounce Rate
		1,537 % of Total: 0.04% (3,614,321)	1,078 % of Total: 0.04% (2,436,999)	00:01:02 Site Avg: 00:01:47 (-41.83%)	37.54% Site Avg: 36.66% (2.39%)	62.95% Site Avg: 49.70% (26.66%)
1.	**201304**	172 (11.19%)	120 (11.13%)	00:00:46	36.63%	53.62%
2.	**201305**	88 (5.73%)	67 (6.22%)	00:01:06	48.86%	69.77%
3.	**201306**	91 (5.92%)	65 (6.03%)	00:00:45	35.16%	65.79%
4.	**201307**	129 (8.39%)	97 (9.00%)	00:00:59	42.64%	68.00%
5.	**201308**	128 (8.33%)	93 (8.63%)	00:00:31	46.88%	66.67%
6.	**201309**	155 (10.08%)	101 (9.37%)	00:00:52	29.03%	72.97%
7.	**201310**	161 (10.47%)	106 (9.83%)	00:01:01	32.92%	54.17%
8.	**201311**	124 (8.07%)	87 (8.07%)	00:01:43	37.10%	63.41%
9.	**201312**	105 (6.83%)	80 (7.42%)	00:01:42	42.86%	65.12%
10.	**201401**	125 (8.13%)	86 (7.98%)	00:00:48	32.80%	56.76%
11.	**201402**	133 (8.65%)	87 (8.07%)	00:01:28	33.83%	66.67%
12.	**201403**	126 (8.20%)	89 (8.26%)	00:00:54	38.89%	58.33%

Rows 1 - 12 of 12

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Main Page

Apr 1, 2013 - Mar 31, 2014

All Sessions
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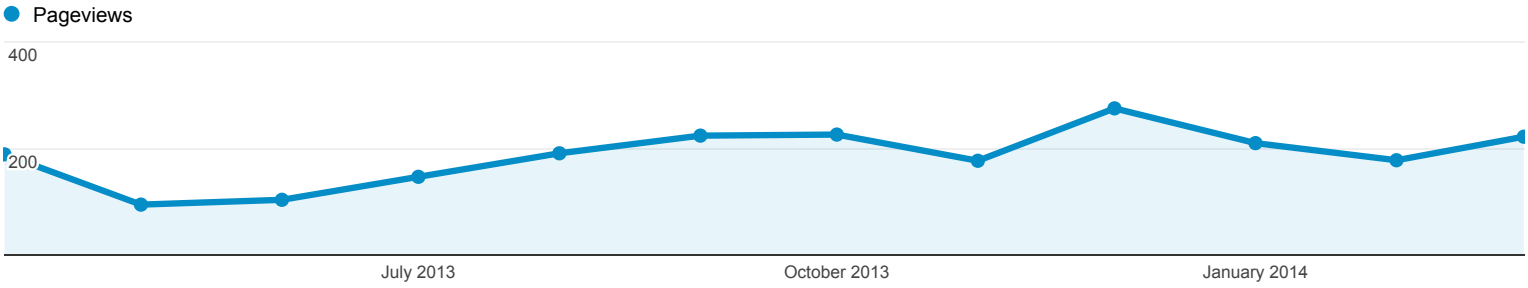
Report Tab



	Month of Year	Pageviews	Unique Pageviews	Avg. Time on Page	% Exit	Bounce Rate
		2,238 % of Total: 0.06% (3,614,321)	1,446 % of Total: 0.06% (2,436,999)	00:00:50 Site Avg: 00:01:47 (-53.47%)	23.24% Site Avg: 36.66% (-36.63%)	52.91% Site Avg: 49.70% (6.45%)
1.	**201304**	189 (8.45%)	125 (8.64%)	00:00:21	20.11%	51.43%
2.	**201305**	95 (4.24%)	75 (5.19%)	00:00:29	27.37%	54.55%
3.	**201306**	104 (4.65%)	70 (4.84%)	00:00:49	19.23%	33.33%
4.	**201307**	147 (6.57%)	99 (6.85%)	00:00:54	24.49%	66.67%
5.	**201308**	191 (8.53%)	121 (8.37%)	00:00:53	26.18%	56.25%
6.	**201309**	224 (10.01%)	122 (8.44%)	00:00:49	18.30%	38.64%
7.	**201310**	226 (10.10%)	149 (10.30%)	00:00:54	20.35%	36.17%
8.	**201311**	177 (7.91%)	110 (7.61%)	00:01:24	15.25%	31.03%
9.	**201312**	275 (12.29%)	195 (13.49%)	00:00:50	44.00%	77.42%
10.	**201401**	210 (9.38%)	135 (9.34%)	00:01:02	17.62%	35.14%
11.	**201402**	178 (7.95%)	107 (7.40%)	00:00:41	16.85%	34.29%
12.	**201403**	222 (9.92%)	138 (9.54%)	00:00:39	21.62%	54.55%

Rows 1 - 12 of 12

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Vital Signs: Improving Antibiotic Use Among Hospitalized Patients

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Background: Antibiotics are essential to effectively treat many hospitalized patients. However, when antibiotics are prescribed incorrectly, they offer little benefit to patients and potentially expose them to risks for complications, including *Clostridium difficile* infection (CDI) and antibiotic-resistant infections. Information is needed on the frequency of incorrect prescribing in hospitals and how improved prescribing will benefit patients.

Methods: A national administrative database (MarketScan Hospital Drug Database) and CDC's Emerging Infections Program (EIP) data were analyzed to assess the potential for improvement of inpatient antibiotic prescribing. Variability in days of therapy for selected antibiotics reported to the National Healthcare Safety Network (NHSN) antimicrobial use option was computed. The impact of reducing inpatient antibiotic exposure on incidence of CDI was modeled using data from two U.S. hospitals.

Results: In 2010, 55.7% of patients discharged from 323 hospitals received antibiotics during their hospitalization. EIP reviewed patients' records from 183 hospitals to describe inpatient antibiotic use; antibiotic prescribing potentially could be improved in 37.2% of the most common prescription scenarios reviewed. There were threefold differences in usage rates among 26 medical/surgical wards reporting to NHSN. Models estimate that the total direct and indirect effects from a 30% reduction in use of broad-spectrum antibiotics will result in a 26% reduction in CDI.

Conclusions: Antibiotic prescribing for inpatients is common, and there is ample opportunity to improve use and patient safety by reducing incorrect antibiotic prescribing.

Implications for Public Health: Hospital administrators and health-care providers can reduce potential harm and risk for antibiotic resistance by implementing formal programs to improve antibiotic prescribing in hospitals.

Introduction

Antibiotics offer tremendous benefit to patients with infectious diseases and are commonly administered to patients cared for in U.S. hospitals. However, studies have demonstrated that treatment indication, choice of agent, or duration of therapy can be incorrect in up to 50% of the instances in which antibiotics are prescribed (*1*). One study reported that 30% of antibiotics received by hospitalized adult patients, outside of critical care, were unnecessary; antibiotics often were used for longer than recommended durations or for treatment of colonizing or contaminating microorganisms (*2*).

Incorrect prescribing of antibiotics exposes individual patients to potential complications of antibiotic therapy, without any therapeutic benefit. One such complication is infection with *Clostridium difficile*, an anaerobic, spore-forming bacillus that causes pseudomembranous colitis, manifesting as diarrhea that often recurs and can progress to sepsis and death; CDC has estimated that there are about 250,000 *C. difficile* infections (CDI) in hospitalized patients each year (*3*). Other complications related to unnecessary use of antibiotics include infection with antibiotic-resistant bacteria (*4*) and complications from adverse events (*5*).

Evidence is accumulating that interventions to optimize inpatient antibiotic prescribing can improve patient outcomes (*6*). To assist health-care providers to reduce incorrect inpatient prescribing, information is needed regarding how frequently incorrect prescribing occurs in hospitals and how improving prescribing will benefit patients. In this report, current assessments of the scope of inpatient antibiotic prescribing, the potential for optimizing prescribing, and the potential benefits to patients are described.

Methods

The objectives of this evaluation were to 1) describe the extent and rationale for antibiotic prescribing in U.S. acute care hospitals, 2) present data illustrating the potential for improving prescribing in selected clinical scenarios, and 3) estimate the potential reductions in CDI among patients when antibiotic

use is improved. For this report, antibiotics include parenteral, enteral, and inhaled antibacterial agents.

The first objective was accomplished using proprietary administrative data from the Truven Health MarketScan Hospital Drug Database (HDD) and data from CDC's Emerging Infections Program (EIP). EIP is a network of state health departments, academic institutions, and local collaborators funded by CDC to assess the effect of emerging infections and evaluate methods for their prevention and control.* Antibiotic prescribing data and patient demographics were obtained from HDD, which contains individual billing records for all patients from a large sample of U.S. hospitals.† Antibiotic agents and doses provided were identified for all patients discharged during 2010. Age group-specific proportions of hospitalizations during which antibiotics were prescribed were calculated by antibiotic group. In 2011, EIP performed an antibiotic use prevalence survey in acute care hospitals within the 10 EIP sites. Each hospital selected a single day on which to conduct the survey on a random sample of inpatients. EIP data collectors gathered information on antibiotics given to patients and determined the rationale for antibiotic use.

For the second objective, additional data from the EIP were used to determine the frequency of opportunities to improve prescribing for selected urinary tract infections (UTIs) and prescribing of intravenous vancomycin. In addition, data reported during October 2012–June2013 to the National Healthcare Safety Network (NHSN) Antimicrobial Use Option were analyzed; key percentile distributions of usage rates and differences in usage (between usage at 90th percentile and at 10th percentile) were calculated. This difference should be small when comparing usage rates among patient care locations caring for similar types of patients.

The third objective was accomplished through development of a dynamic model that was used to interpret the findings of an observational study and predict changes in CDI with changes in antibiotic use. First, a retrospective cohort study was conducted to quantify the relative risk for CDI using hospital discharge data and pharmacy data from two large academic centers, in New York and Connecticut, linked to active population-based CDI surveillance data from the EIP (*6*). The primary outcome was hospital-associated CDI (CDI >2 days after hospital admission and ≤180 days after discharge). Primary exposure of interest was receipt of inpatient broad-spectrum antibiotics (i.e., 3rd and 4th generation cephalosporins, beta-lactam/beta-lactamase inhibitor combinations, and fluoroquinolones) during hospitalization. A multivariate logistic model was used to estimate an adjusted risk ratio controlling for age, sex, Gagne comorbidity score (*7*), hospital, and hospital CDI rates. A stochastic, compartmental model of hospital CDI that represented distinct states of infection (uncolonized, colonized, and symptomatic) was constructed. Antibiotic use was classified with respect to type (high- and low-risk) and where the patient was in the treatment pathway (untreated, treated, and post-treatment). The model was calibrated based on the results of the epidemiologic analyses described in this report and drew other parameter estimates from stochastic distributions based on a previously published agent-based model (*8*).§

Results

In 2010, based on data obtained from all 323 hospitals by MarketScan HDD, 55.7% of patients received an antibiotic during their hospitalization, and 29.8% received at least 1 dose of broad-spectrum antibiotics (Figure 1). The EIP evaluated 11,282 patients in 183 hospitals in 2011, of whom 4,189 (37.1%) had received one or more antibiotics to treat active infections; half (49.9%) of all treatment antibiotics were prescribed for treatment in one or more of three scenarios: lower respiratory infections, UTIs, or presumed resistant Gram-positive infections (Table 1). Prescribing scenarios at a convenience sample of 36 hospitals across eight EIP sites were reviewed. Reviews of 296 instances of treatment in two specific scenarios (UTIs in patients without indwelling catheters, and treatment with intravenous vancomycin) identified that antibiotic use could potentially have been improved in 37.2% (39.6% of 111 UTI patients, 35.7% of 185 vancomycin patients); improvement opportunities mostly involved better use of diagnostic testing (Table 2).

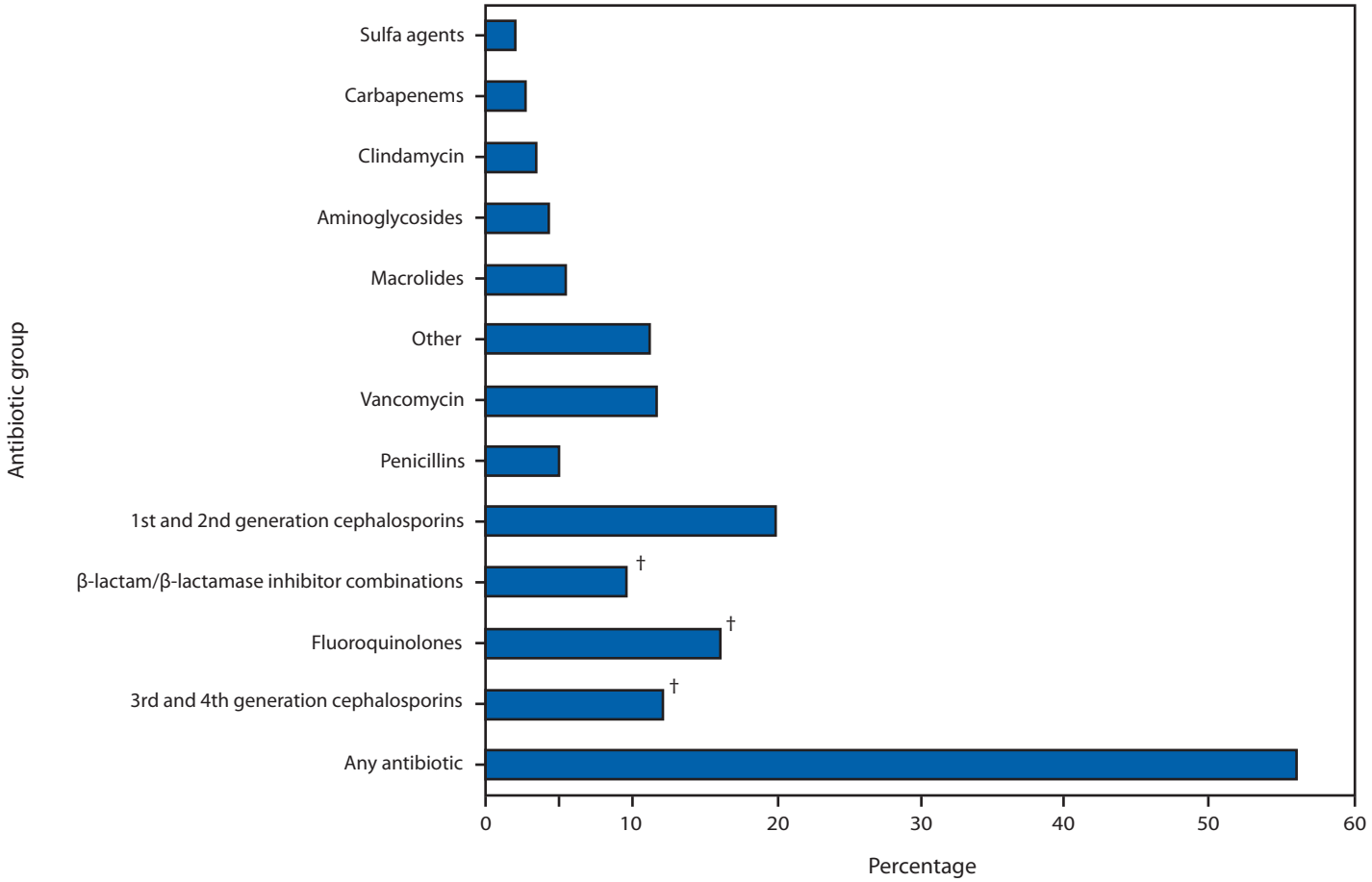
NHSN began receiving antibiotic use data in 2012. Among the 19 hospitals reporting to the NHSN Antimicrobial Use Option that had completed data validation and submitted antibiotic use data from one or more patient care locations, results were reported for 266 patient care locations. Among the six most common types of patient locations, critical care units reported higher rates of antibiotic use (median = 937 days of therapy/1,000 days-present) compared with ward locations (median = 549 days of therapy/1,000 days-present). The variability in usage rates within any one patient location type was highest (threefold difference between 90th and 10th percentile) among combined medical/surgical wards (i.e., 26 wards categorized as caring for a mixture of medical and surgical patients). When limiting the comparisons within combined medical/surgical wards, differences in usage were eightfold for fluoroquinolones, sixfold for antipseudomonal

* Additional information available at http://www.cdc.gov/ncezid/dpei/eip/index.html.

† A proprietary system integrating data systems from claims and hospital-based data systems among a convenience sample of hospitals and providers. Additional information available at http://truvenhealth.com.

§ Additional information available at http://www.cdc.gov/getsmart/healthcare/evidence/cdiff.html.

FIGURE 1. Percentage of hospital discharges with at least one antibiotic day, by antibiotic group — 323 hospitals, United States, 2010*



* Data provided by Truven Health MarketScan Hospital Drug Database.
† Antibiotics from these three groups, which are considered to place patients at high risk for developing *Clostridium difficile* infection, were administered to 29.8% of the patients.

TABLE 1. Prevalence of antibiotic use among randomly selected patients in 183 acute care hospitals — Emerging Infections Program health-care–associated infections and antimicrobial use prevalence survey, United States, 2011

Antibiotic use assessment	No.	(%)
Total no. of patients in the survey	**11,282**	—
Patients on any antibiotic to treat an active infection	4,189	(37.1)
Treatment indication for antibiotic*	7,199	—
For LRI (community onset), with or without BSI	1,596	(22.2)
For UTI (health-care or community onset), with or without BSI	993	(13.8)
For presumptive resistant Gram-positive infection treated with vancomycin (intravenous), linezolid, or daptomycin	1,270	(17.6)
No. of antibiotics with one or more treatment indications above	3,592	(49.9)

Abbreviations: LRI = lower respiratory tract infection; BSI = bloodstream infection; UTI = urinary tract infection.
* Indications are not mutually exclusive.

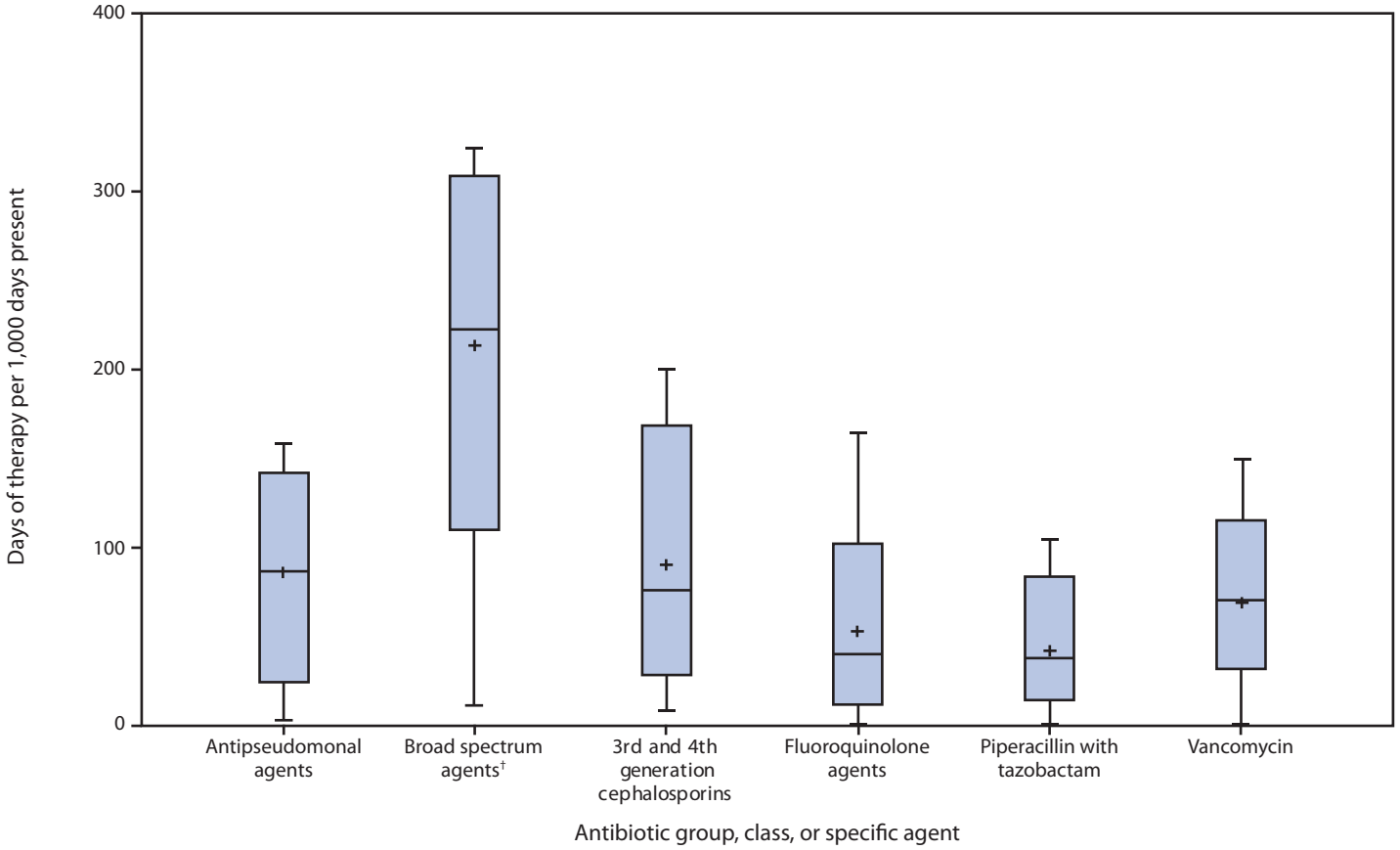
agents, threefold for broad-spectrum agents (antibiotics considered high risk for subsequent CDI), and threefold for vancomycin (Figure 2). Overall, in the cohort study, the risk for CDI among patients unexposed and exposed to antibiotics was 6.8 and 24.9 per 1,000 discharges respectively. Multivariate modelling adjusting for covariates, for all ages combined, estimated the adjusted relative risk for development of CDI within 180 days after inpatient exposure to broad-spectrum antibiotics to be 2.9 (95% confidence interval = 2.3–3.5). The dynamic model, which accounts for both direct and indirect effects, predicted that a 30% decrease in exposure to broad-spectrum antibiotics in hospitalized adults would lead to a 26% decrease in CDI (interquartile range = 15%–38%). Such a reduction in broad-spectrum use equates to an approximately 5% reduction in the proportion of hospitalized patients receiving any antibiotic.

TABLE 2. Assessment of antibiotic prescribing among inpatients in 36 hospitals treated for urinary tract infection (UTI) without indwelling catheter or treated with intravenous vancomycin — Emerging Infections Program health-care–associated infections and antimicrobial use prevalence survey, United States, 2011

Treatment	No.	(%)
Patients treated for UTI present on admission, without indwelling catheter	**111**	—
Urine culture was not ordered, although standard practice before treatment	18	(16.2)
Urine culture was positive, but no documented symptoms were present	23	(20.7)
Urine culture was negative, and no documented symptoms were present	3	(2.7)
No. of patients with potential for improvement in prescribing	44	(39.6)
Patients treated with intravenous vancomycin	**185**	—
No diagnostic culture obtained around antibiotic initiation, although standard practice with most infections	17	(9.2)
Diagnostic culture showed no Gram-positive bacterial growth, but patient still treated for long duration (>3 days) (excludes presumed SSTI, which often can be culture negative)	40	(21.6)
Diagnostic culture grew only oxacillin-susceptible *Staphylococcus aureus*, but patient still treated for long duration (>3 days) (likely missed opportunity to switch antibiotic based on culture result)	9	(4.9)
No. of patients with potential for improvement in prescribing	66	(35.7)
Combined UTI or vancomycin prescribing	**296**	—
Total no. of patients with potential for improvement in prescribing	110	(37.2)

Abbreviation: SSTI = skin and soft tissue infection.

FIGURE 2. Rate of antibiotic use, by antibiotic group, class, or specific agent, among medical and surgical patients in 26 wards at 19 acute care hospitals — National Healthcare Safety Network Antimicrobial Use Option, October 2012–June 2013*



* Horizontal lines represent median, 10th and 90th percentile values; whisker points are the minimum and maximum values. Plus sign is the mean value.
† Including fluoroquinolones, β-lactam/β-lactamase inhibitor combinations, and 3rd and 4th generation cephalosporins.

Key Points

- Antibiotics are commonly prescribed in hospitals.
- Evidence of incorrect prescribing and observed variability in current usage patterns suggest that improvements are needed and will benefit patients.
- CDC recommends that all hospitals implement antibiotic stewardship programs that include, at a minimum, seven core elements: 1) leadership support; 2) accountability through a single physician lead; 3) drug expertise through a single pharmacy lead; 4) action including at least one intervention, such as an "antibiotic timeout," to improve prescribing; 5) tracking prescribing and resistance patterns; 6) reporting local prescribing and resistance information directly to clinicians, and 7) education for clinicians.
- Urgent action is needed to promote correct antibiotic prescribing to ensure these lifesaving drugs work in the future.
- Additional information is available at http://www.cdc.gov/vitalsigns.

Conclusions and Comment

Antibiotics are prescribed for the majority of patients hospitalized in U.S. acute care hospitals, usually to treat infections. This post prescription review of two common prescribing scenarios for treating suspected infections identified opportunities to improve 37.2% of prescriptions, often by timely use of diagnostic tests or documentation of symptoms. This observation is similar to results of older studies (*1*) and a recent study (*2*) documenting that about 30%–50% of prescribing might be incorrect. Although the aspect of prescribing that could be improved has varied between studies, it usually involves the wrong dose or wrong duration (*2*). The EIP review focused on relatively objective criteria, including established standards around diagnostic testing and documentation of symptoms supporting the presence of infection. A threefold difference in overall antibiotic use in the most common patient care location, where more similar usage rates would be expected, considering similar types of patients are being cared for in these locations, is additional evidence of opportunities for improvement. This difference is a conservative measure made by comparing usage reported at the 90th percentile distribution compared with that at the 10th percentile distribution, among locations caring for similar types of patients. The magnitude of differences seen in some antibiotic groups might be the result of differences in formulary or clinical practice guidelines in place at different institutions. However, within similar location types, twofold differences were consistently measured. Although some of these differences might be attributable to differences in the mix of patients within these similar patient care locations, it is likely some might be explained by differences in prescribing practices. This type of monitoring system, which involves antibiotic use measurement to inform quality improvement activities, has been cited as an urgent need by a recent government report (*10*).

The data in this report confirm the findings of several previous studies demonstrating that antibiotic prescribing in hospitals is common and often incorrect. In particular, patients are often exposed to antibiotics without proper evaluation and follow-up. Misuse of antibiotics puts patients at risk for preventable health problems. These include immediate complications; antibiotics are among the most frequent causes of adverse drug events among hospitalized U.S. patients (*11*), and near-term complications, such as CDI, which can be severe and even deadly (*9*). The analysis of risk for CDI from exposure to broad-spectrum antibiotics during hospitalization found an exposed patient was at three times greater risk than a patient without this exposure. Elevated risks of similar magnitude were observed in previous studies (*12,13*). An estimated 30% reduction in use of these broad-spectrum antibiotics (which would reduce overall antibiotic use by only 5%) would prevent 26% of CDI related to inpatient antibiotic use. Reductions in CDI of this magnitude could also have additional positive effects in reducing transmission of *C. difficile* throughout the community.

An additional near-term complication of the unnecessary and incorrect use of inpatient antibiotics is the growing problem of antibiotic resistance in U.S. hospitals, creating treatment challenges not only for patients who are exposed to the antibiotics, but for other patients to whom these resistant bacteria spread (*3*). Some hospitalized patients now have infections for which there are no available antibiotic treatments (*14*). Urgent action is required to address this growing public health crisis. Improving the prescribing of antibiotics in hospitals is one important part of a broader strategy to counter the increase in antibiotic resistance. The CDC report, Antibiotic Threats in the United States, 2013, addresses other priority needs to reduce antibiotic resistance, including preventing infections and the spread of resistance, tracking resistance patterns, and developing new antibiotics and diagnostic tests (*3*).

Programs dedicated to improving antibiotic prescribing in hospitals are commonly referred to as antibiotic stewardship programs. Such programs serve to ensure optimal treatment for hospitalized patients with infection and reduce unnecessary antibiotic use to minimize harm to patients and prolong the length of time antibiotics are effective (*15*). Variability in the types of patients and available resources and expertise between hospitals calls for flexibility in how these programs

are implemented. However, experience demonstrates that these programs can be successful in a wide variety of hospital types to reduce overall and incorrect antibiotic prescribing, decrease drug costs, prevent adverse events caused by antibiotics, and reduce CDI rates and antibiotic resistance locally (*6,15*). Although cost savings from these programs will vary depending on the size of the facility and the extent to which interventions are implemented, published studies from mostly larger settings have consistently shown significant annual savings ($200,000–$900,000) (*1*).

Correct antibiotic treatment (e.g., prompt treatment of sepsis) is critical to saving lives of hospitalized patients with certain infectious diseases. Given the proven benefit of hospital stewardship programs to patients and the urgent need to address the growing problem of antibiotic resistance, CDC recommends that all hospitals implement an antibiotic stewardship program. CDC has developed guidance that can assist hospitals in either starting or expanding a program to improve antibiotic prescribing (*16*). Central to this guidance are seven core elements that have been critical to the success of hospital antibiotic stewardship programs (Box). In addition to highlighting these key elements for success of stewardship programs, the CDC guidance also provides background information on the proven benefits of improving antibiotic prescribing in hospitals and more details on the structural and functional aspects of successful programs. To accompany the guidance, CDC also has developed a stewardship assessment tool that includes a checklist to help facilities assess the status of their efforts to improve antibiotic prescribing and point out potential areas for further improvement (*16*).

BOX. Seven core elements critical to the success of hospital antibiotic stewardship programs

- Leadership commitment: Dedicating necessary human, financial, and information technology resources.
- Accountability: Appointing a single leader responsible for program outcomes. Experience with successful programs has shown that a physician leader is effective.
- Drug expertise: Appointing a single pharmacist leader responsible for working to improve antibiotic use.
- Action: Implementing at least one recommended action, such as systemic evaluation of ongoing treatment need after a set period of initial treatment (i.e., "antibiotic time out" after 48 hours).
- Tracking: Monitoring antibiotic prescribing and resistance patterns.
- Reporting: Regular reporting information on antibiotic use and resistance to doctors, nurses and relevant staff members.
- Education: Educating clinicians about resistance and optimal prescribing.

Source: CDC. Core elements of hospital antibiotic stewardship programs. Atlanta, GA: US Department of Health and Human Services, CDC; 2014. Available at http://www.cdc.gov/getsmart/healthcare/implementation/core-elements.html.

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Changing epidemiology of infections due to extended spectrum beta-lactamase producing bacteria

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Changing epidemiology of infections due to extended spectrum beta-lactamase producing bacteria

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Abstract

Background

Community-associated infections caused by extended-spectrum beta-lactamase (ESBL) producing bacteria are a growing concern.

Methods

Retrospective cohort study of clinical infections due to ESBL-producing bacteria requiring admission from 2006-2011 at a tertiary care academic medical center in Providence, RI.

Results

A total of 321 infections due to ESBL-producing bacteria occurred during the study period. Fifty-eight cases (18%) were community-acquired, 170 (53%) were healthcare–associated, and 93 (29%) were hospital-acquired. The incidence of ESBL infections per 10,000 discharges increased during the study period for both healthcare-associated infections, 1.9 per year (95% CI 1-2.8), and for community-acquired infections, 0.85 per year (95%CI 0.3-1.4) but the rate remained unchanged for hospital-acquired infections. For ESBL-producing *E. coli* isolates, resistance to both ciprofloxacin and trimethoprim-sulfamethoxazole was 95% and 65%, respectively but 94% of isolates were susceptible to nitrofurantoin.

Conclusions

Community-acquired and healthcare-associated infections due to ESBL-producing bacteria are increasing in our community, particularly urinary tract infections due to ESBL-producing *E. coli*. Most isolates are resistant to oral antibiotics commonly used to treat urinary tract

infections. Thus, our findings have important implications for outpatient management of such infections.

Keywords

Extended-spectrum beta-lactamase, Urinary tract infection, Antimicrobial resistance, Community-acquired infections, Ciprofloxacin

Background

ESBL-producing bacteria cause infections in hospitalized patients [1-3], patients housed in long-term care facilities [4,5], and they are gaining a foothold in community settings [6,7]. Human fecal carriage with these microorganisms is increasing, as well as their ubiquity in non-human species [8]. The increasing prevalence of infections due to ESBL-producing bacteria creates a challenge regarding appropriate antimicrobial therapy, especially in the community setting where oral antibiotics are used.

Most ESBLs are found in *Escherichia coli* and *Klebsiella pneumoniae*, frequently harboring resistance to other classes of antibiotics [9,10]. The majority of infections caused by these pathogens are urinary tract infections with occasional secondary bloodstream infections. In general, the preferred antibiotic class for management of infections due to ESBL-producing bacteria are carbapenems [11]. The purpose of this study was to better understand the changing epidemiology of ESBL-producing bacteria.

Methods

Study population

This study was conducted at Rhode Island Hospital, a tertiary care hospital licensed for 719 beds in Providence, RI.

Study design

This was an IRB-approved, retrospective cohort study of all adult patients hospitalized between January 2006 through December 2011 who had a positive clinical culture for an ESBL-producing microorganism.

Microbiology

Clinical cultures were identified and tested for antimicrobial susceptibility utilizing the Vitek 2 System (bioMérieux, Inc. Durham, NC). The detection of ESBL in *E. coli* and *K. pneumoniae* was done as previously described [12]. The phenotype confirmatory test for ESBL production was performed with use of ceftazidime (30 μg) and cefotaxime (30 μg), with and without clavulanic acid, against the isolates. The discs were placed on pre-inoculated Mueller-Hinton agar and incubated at 37°C. A difference of ≥5 mm between the zone diameters of either of the cephalosporin disks and their respective cephalosporin/clavulanate disk was considered phenotypic confirmation of ESBL production.

Demographic and clinical data

Cases were identified using infection control software (Theradoc, Hospira Inc. Lake Forest, IL). Cases were included if all three of the following were documented: an ESBL-producing microorganism was grown from a patient's clinical specimen; the treating physician noted that the patient had an infection in the medical record; and the physician treated the patient with antibiotics. All charts were reviewed by one of the study authors (SK) to determine the infection acquisition type (i.e., community-acquired, healthcare-associated or hospital-acquired) using the Centers for Disease Control and Prevention definitions [13]. The antibiogram was obtained from the electronic medical record.

Definitions

The site of infection was defined according to CDC definitions [14]. If a culture was obtained more than 48 hours after hospital admission, it was classified as hospital-acquired. If a culture was obtained within 48 hours after admission, it was classified as a healthcare-associated infection if a) within the prior 90 days the patient resided in a long-term care facility or, had an prior admission to an acute-care facility in our hospital system, or an outside hospital as mentioned in the admission note; b) or had undergone hemodialysis or received an intravenous medications or had undergone hemodialysis; or c) if they underwent an invasive procedure within the last 30 days prior to admission. Otherwise, a patient was considered to have a community-acquired infection.

Statistical analysis

Age comparisons between the three groups were analyzed using a two-tailed t test. Sex differences among the three groups were analyzed using chi-square testing. Linear regression was performed to determine whether changes in the incidence of infection were statistically significant (SPSS, Chicago, IL). This analysis was repeated including only the first occurrence of an infection in a given patient. Differences in antibiotic resistance between acquisition groups were analyzed using either a chi-square test or a Fischer exact test when appropriate. Use of a two-tailed test of significance with a P-value <0.05 was employed to determine statistical significance.

Results

During the study period, there were 321 incident infections due to ESBL-producing bacteria. Twenty-six patients experienced more than one infection. One patient had two different ESBL-producing bacteria in the same clinical sample at one time. The number of infections due to these pathogens increased consistently from 23 infections in 2006 to 81 in 2011 (Figure 1). Overall, 58 cases (18%) were community-acquired, 170 (53%) healthcare–associated, and 93 (29%) hospital-acquired. The incidence of infection due to ESBL-producing bacteria per 10,000 discharges increased significantly during the study period for health-care associated infections, 1.9 per year (95% CI 1-2.8; p = .003) and for community-acquired infections, 0.85 per year (95%CI 0.3-1.4; p = .01). There was no significant change in the hospital-acquired infection group. When this analysis was repeated after removing 26 recurrent episodes of infections, none of the significant changes over time became non-significant (data not shown).

Figure 1 Origin of infection due to ESBL-producing bacteria. Incidence of infections due to ESBL-producing bacteria by classification of origin over the study period.

The mean age among the three groups was 69, 70 and 65 years in the community, healthcare and hospital-acquired infection groups, respectively. The difference in age between the healthcare-associated and the hospital-acquired infection groups was significant (p = 0.04). There were fewer males (26%) in the community-acquired group compared with healthcare-associated (42%) and hospital-acquired groups (41%; p = 0.1).

Urinary tract infection predominated (80%), followed by bloodstream infection (10%), skin and soft-tissue infection (5%), pneumonia (3%) and intra-abdominal infection (1%). There was a marked shift in the predominant organism in all three acquisition types from *K. pneumoniae* to *E. coli* (Figure 2). For the entire study period, *E. coli* accounted for 78%, 66% and 65% of the community, healthcare-associated, and hospital-acquired groups, respectively.

Figure 2 ESBL-producing bacteria. ESBL-producing bacteria identified during the study period.

Resistance to trimethoprim-sulfamethoxazole (TMP-SMZ) and ciprofloxacin was commonly observed among *E. coli* isolates (Table 1); however, 94% of *E. coli* isolates were susceptible to nitrofurantoin with no difference between acquisition groups (p = 0.8). In contrast, 76% of all *K. pneumoniae* isolates were resistant to nitrofurantoin.

Table 1 Antimicrobial resistance of ESBL-producing *E. coli*

Antimicrobial	Community acquired		Healthcare associated		Hospital acquired		Total		P Value
	Bacteria	n(%) Resistant	Bacteria	n(%) Resistant	Bacteria	n(%) Resistant	Bacteria	n(%) Resistant	
TMP-SMZ*	51	32 (69)	111	75 (68)	57	45 (79)	219	152 (69)	0.2
Ciprofloxacin	52	48 (92)	111	109 (98)	57	53 (92)	220	210 (95)	0.1
Nitrofurantoin	50	3 (6)	85	7 (8)	43	1 (2)	178	11 (6)	0.5

Legend: *Trimethoprim-sulfamethoxazole.

Discussion

The number of infections due to ESBL-producing bacteria are increasing, especially community or non-hospital healthcare-associated infections as demonstrated by others [15,16]. Although the focus of infection control measures has been on transmission of such pathogens within hospitals, many of the infections ESBL-producing bacteria appear to arise outside of the acute-care setting where there is limited infection control resources [17].

We found high levels of resistance to TMP-SMZ and ciprofloxacin in all acquisition types. *E. coli* resistance to TMP-SMZ was similar to other studies [18]; however, ciprofloxacin resistance among *E. coli* in our study (95%) is higher than found in other reports [10,15,16,19-21]. The level of ciprofloxacin resistance we documented in our community-acquired ESBL-producing *E. coli* (92%) is also higher than the level of resistance among all *E. coli* isolates tested at our hospital in 2011(31%) [22]. While it is known that many ESBL-producing bacteria harbor additional resistance genes, it remains unclear why our isolates had such high levels of ciprofloxacin resistance. One possibility is that the CTX-M was the predominant gene regulating beta-lactamase production in most of our isolates. While we did

not investigate the molecular mechanisms of resistance in our study, we wonder whether our isolates which showed the persistently increasing predominance of *E. coli* may indeed be the advance of CTX-M in our region, as has been found in rectal colonizers in other patients admitted to our hospital (L.A. Mermel, unpublished data, February 2013). Of note, a US multi-centered study documented 99% ciprofloxacin resistance among CTX-M-containing *E. coli* [23] and a recent US multi-centered study of community-acquired *E. coli* ESBL infections found the majority contained CTX-M genes [15]. This finding raises concern for treatment failure in the community setting given the levels of resistance to antimicrobial agents commonly used for cystitis, namely TMP-SMZ and ciprofloxacin. We found a low level of nitrofurantoin resistance in our *E. coli* isolates. As such, patients in our study with community-acquired infections may have been outpatient treatment failures owing to initial empiric therapy with either ciprofloxacin or TMP-SMZ, prompting hospital admission. While we did not have susceptibility data to fosfomycin, a recent study found no resistance among community-acquired ESBL-producing *E. coli* [16]. Thus, it seems prudent to consider the use of nitrofurantoin or fosfomycin as empiric therapy for acute uncomplicated cystitis in those at risk for, or with a history of infection or colonization with an ESBL-producing *E. coli*.

What accounts for the increasing numbers of ESBL-producing *E. coli* and the increase in community-acquired infections? Traditionally, *K. pneumoniae* made up the majority of infections due to ESBL-producing pathogens and the majority of those occurred in hospital settings. However, 88% of our community-acquired isolates of ESBL-producing bacteria in 2011 were *E. coli*, a marked shift from four years earlier when it was 55%. The presence of ESBL-producing *E. coli* as commensal flora in healthy livestock has been documented throughout Europe and Asia with as many as 40% of poultry populations colonized with these bacteria and their presence has been identified in retail meats [8,24,25]. Additionally, several studies have found ESBL-producing *E. coli* in the fecal flora of healthy companion animals, namely cats and dogs, and recently such isolates have been detected in US animals, where the predominant strain was CTX-M [8,26]. Beyond domesticated animals, ESBL-producing *E. coli* have been found in wildlife in several continents and many such isolates have been shown to be genotypically-related to human isolates [27].

Regarding limitations in our study, it is possible that patients were misclassified as community-acquired given the lack of available documentation in the medical record. Given the lack of admission screening, it is possible that some cases deemed hospital-acquired infections were community-acquired. Our community-acquired cohort is likely a biased subset as they required hospital admission, thus indicating that they likely were more ill than those whom developed such infections and remained in the community. Additionally, our antibiotic resistance patterns for the community-acquired and healthcare-associated organisms likely present a biased sample as only those patients ill enough to require admission are represented. Use of the Vitek 2 system alone for identification of ESBL-producing *Enterobacteriacae* is insufficient.[28] As such, our laboratory used confirmatory testing as noted in the Methods section. Lastly, our laboratory uses CLSI breakpoints for susceptibilty testing. The CLSI has updated recommendations for interpretation of antibiotic susceptibility testing results in the 2010 and 2011 CLSI guidelines, in part adopting European Committee for Antimicrobial Susceptibility Testing (EUCAST) strategies. The CLSI now recommends higher zone diameter susceptibility breakpoints for 3rd generation cephalosporins and carbapenems; fluoroquinolone breakpoints were unchanged. Thus, our data must be interpreted in context, based on previously used CLSI breakpoints rather than revised CLSI breakpoints or those recommended by EUCAST [29].

Conclusion

In summary, our study noted the emergence of community-acquired infections due to ESBL-producing bacteria, a marked increase in healthcare-associated infections, as well *E. coli* becoming the predominant pathogen in all three acquisition groups. We found high levels of TMP-SMZ and ciprofloxacin resistance. This has implications regarding empiric therapy for urinary tract infections since these frequently utilized antibiotics in the outpatient setting are ineffective for such pathogens. Another important finding is the susceptibility of ESBL-producing *E. coli* to nitrofurantoin. Further elucidation of underlying genetic makeup of ESBL-producing pathogens will assist in better understanding the epidemiology of these emerging infections.

Abbreviations

ESBL, Extended-spectrum beta-lactamase; TMP-SMZ, Trimethoprim-sulfamethoxazole

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

SZK and LAM are both fully responsible for the entirety of the study from conception through critical revisions of the manuscript. Both SZK and LAM had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Both authors approved the final manuscript.

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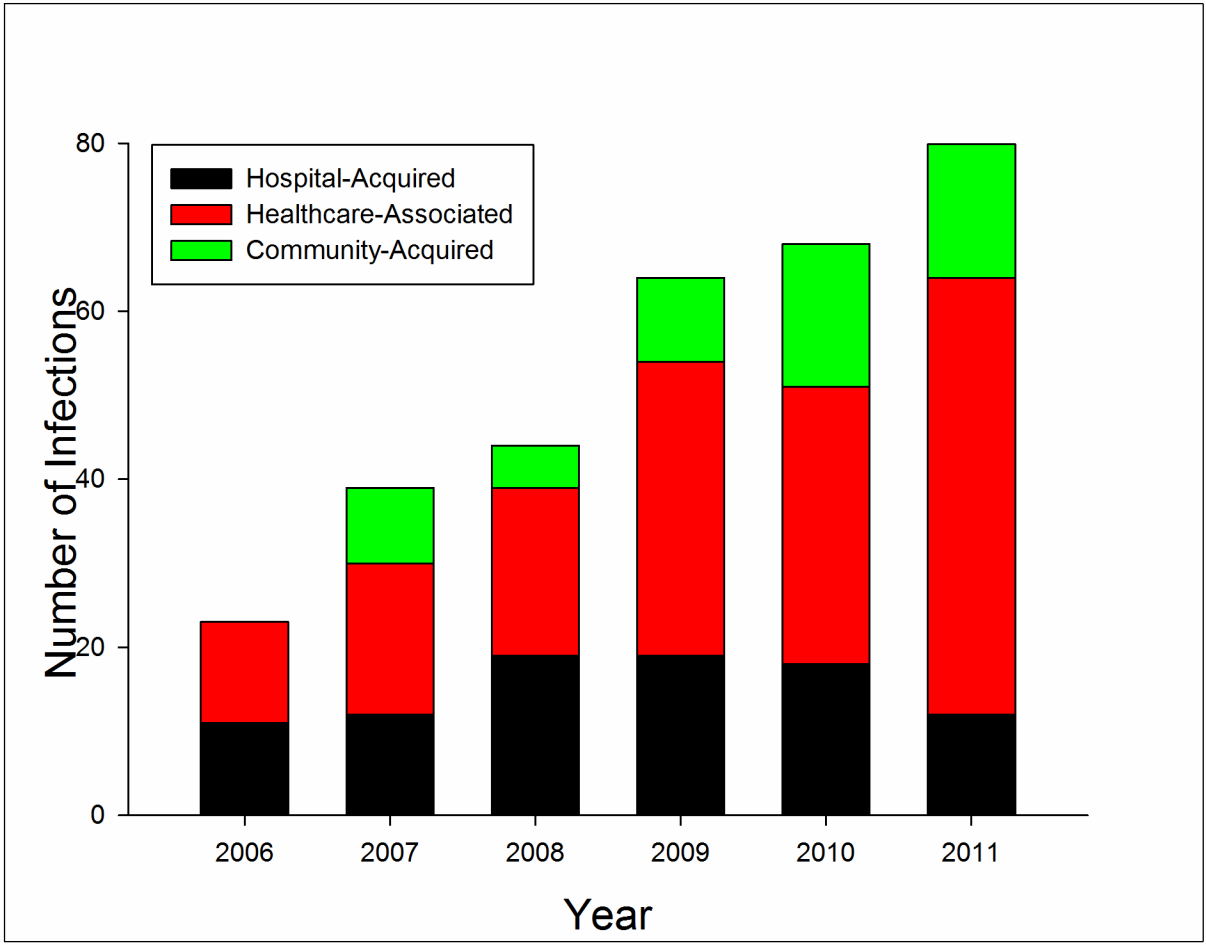
Hospital-Acquired
Healthcare-Associated
Community-Acquired
Number of Infections
0
20
40
60
80
2006
2007
2008
2009
2010
2011
Year

Figure 1

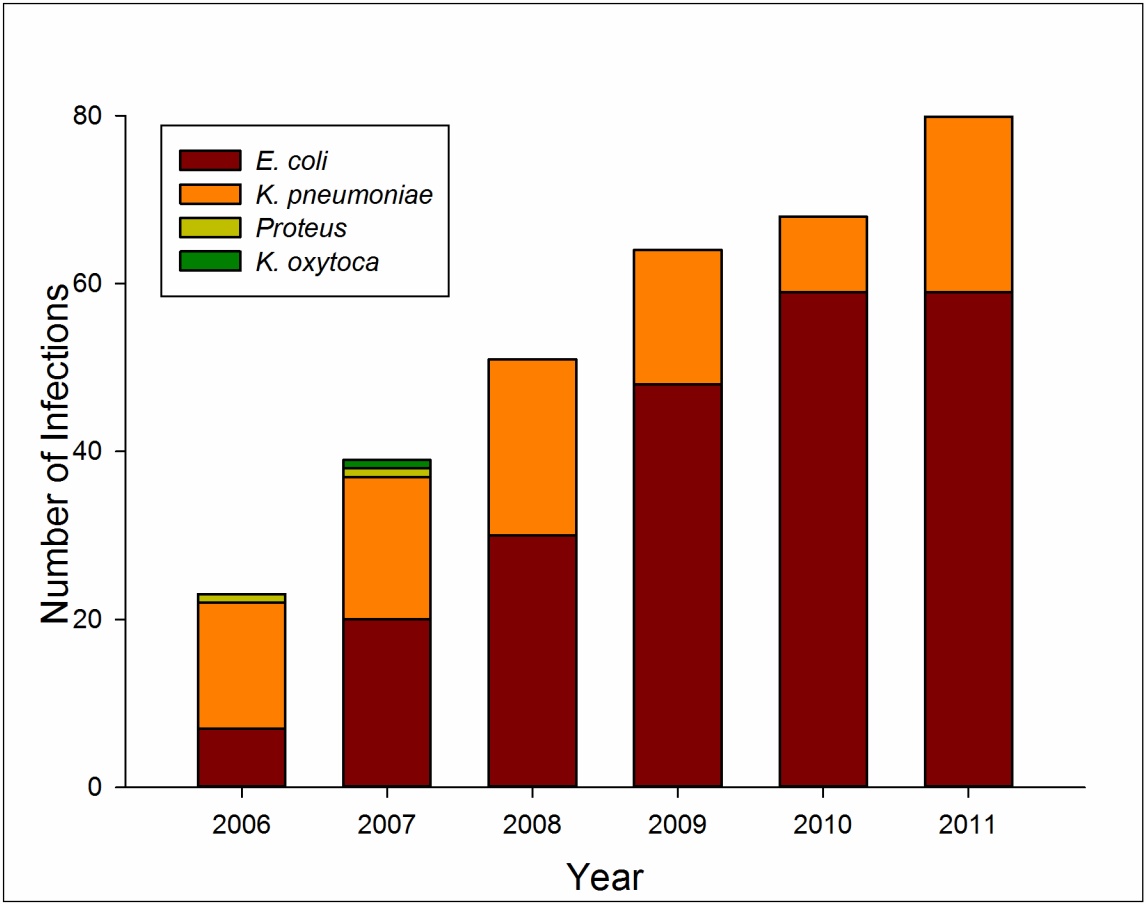
80
60
40
20
0
Number of Infections
E. coli
K. pneumoniae
Proteus
K. oxytoca
2006
2007
2008
2009
2010
2011
Year

Figure 2