



Reducing *Clostridium difficile* Infection in the Acute Care Setting

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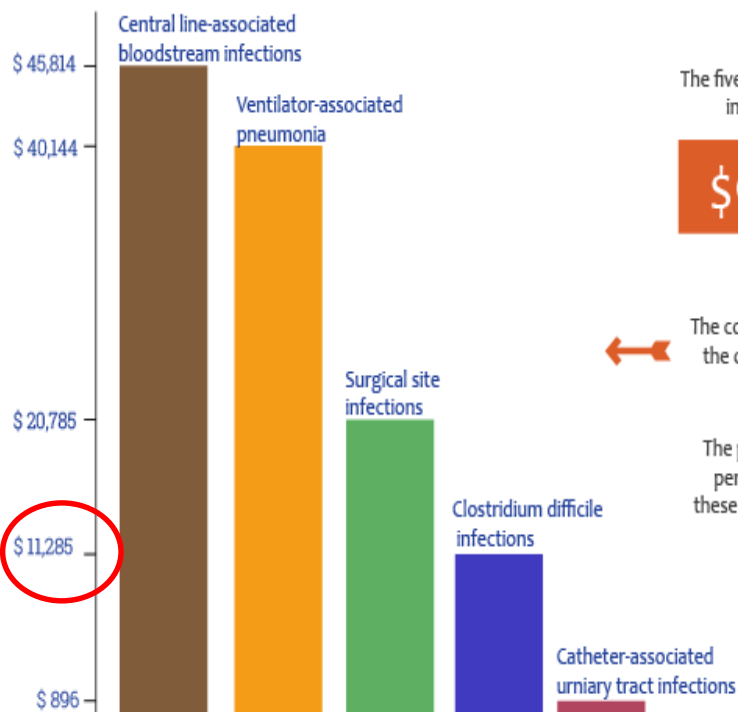




Background/Local Problem

Costs of the five most common hospital-acquired infections (HAIs) in the US

Costs per case



The five most common hospital-acquired infections (HAIs) cost the US

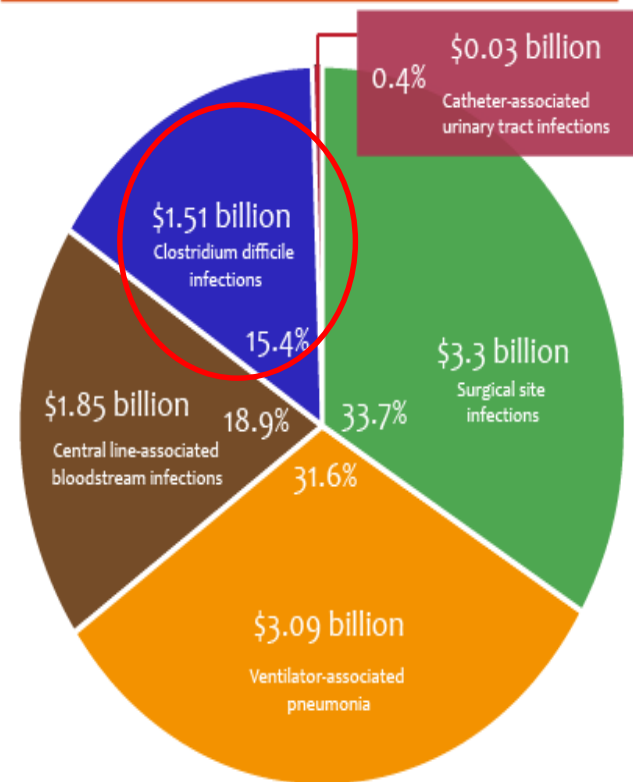
\$9.8 billion

annually.

The column graph on the left shows the cost per infection for each of these infections.

The pie-chart on the right displays the percentage contribution of each of these infections to this total annual cost.

Percentage share of total annual costs



Data source: Eyal Zimlichman, Daniel Henderson, Orly Tamir, Calvin Franz, Peter Song, Cyrus K. Yamin, Carol Keohane, Charles R. Denham, & David W. Bates. Health Care-Associated Infections: A Meta-analysis of Costs and Financial Impact on the US Health Care System. *JAMA Internal Medicine*.

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Background/Local Problem

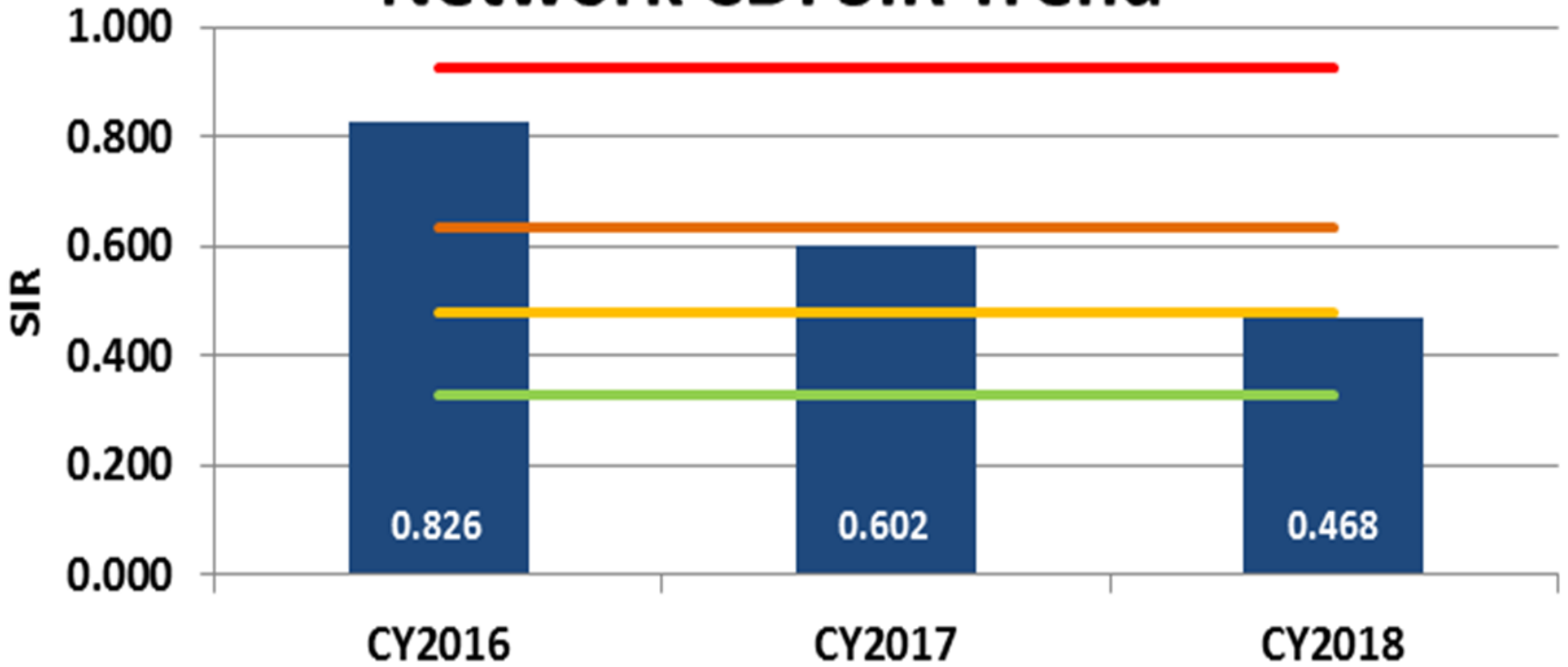


<i>C. difficile</i> Infection (Hospital Onset)	CY2016	CY2017	CY2018
SLA	17	14	13
SLB	49	37	36
SLRA	24	17	10
SLMI	9	7	1
SLMO* open Oct 2016	5	13	7
SLQ	6	1	0
SLWA	15	15	8
Raw Number of Infections	125	104	75
Rate per 10k Patient Days	5.81	4.62	3.07
Excludes GH and SH Campuses			



Standardized Infection Ratio (SIR)

Network CDI SIR Trend



■ Network CDI SIR — National Median 0.928 — 75th Percentile 0.636
— 85th Percentile 0.477 — 90th Percentile 0.327



CMS Hospital Compare

Local Peers	Hospital Onset CDI SIR Performance (Data Period 10/1/16 to 9/30/17)
St. Luke's Allentown/Bethlehem	Better than National Benchmark
St. Luke's Miners	No different than National Benchmark
St. Luke's Quakertown	No different than National Benchmark
St. Luke's Anderson	No different than National Benchmark
St. Luke's Warren	No different than National Benchmark
St. Luke's Monroe	No different than National Benchmark
Easton Hospital	No different than National Benchmark
Grandview Hospital	No different than National Benchmark
Geisinger Hospital	Worse than National Benchmark
LVHN-Cedar Crest	Better than National Benchmark
LVHN-Muhlenberg	No different than National Benchmark
LVHN-Pocono	Better than National Benchmark
Palmerton Hospital	Results cannot be calculated for this reporting period
Gnaden Huetten Hospital	No different than National Benchmark
Sacred Heart Hospital	Better than National Benchmark

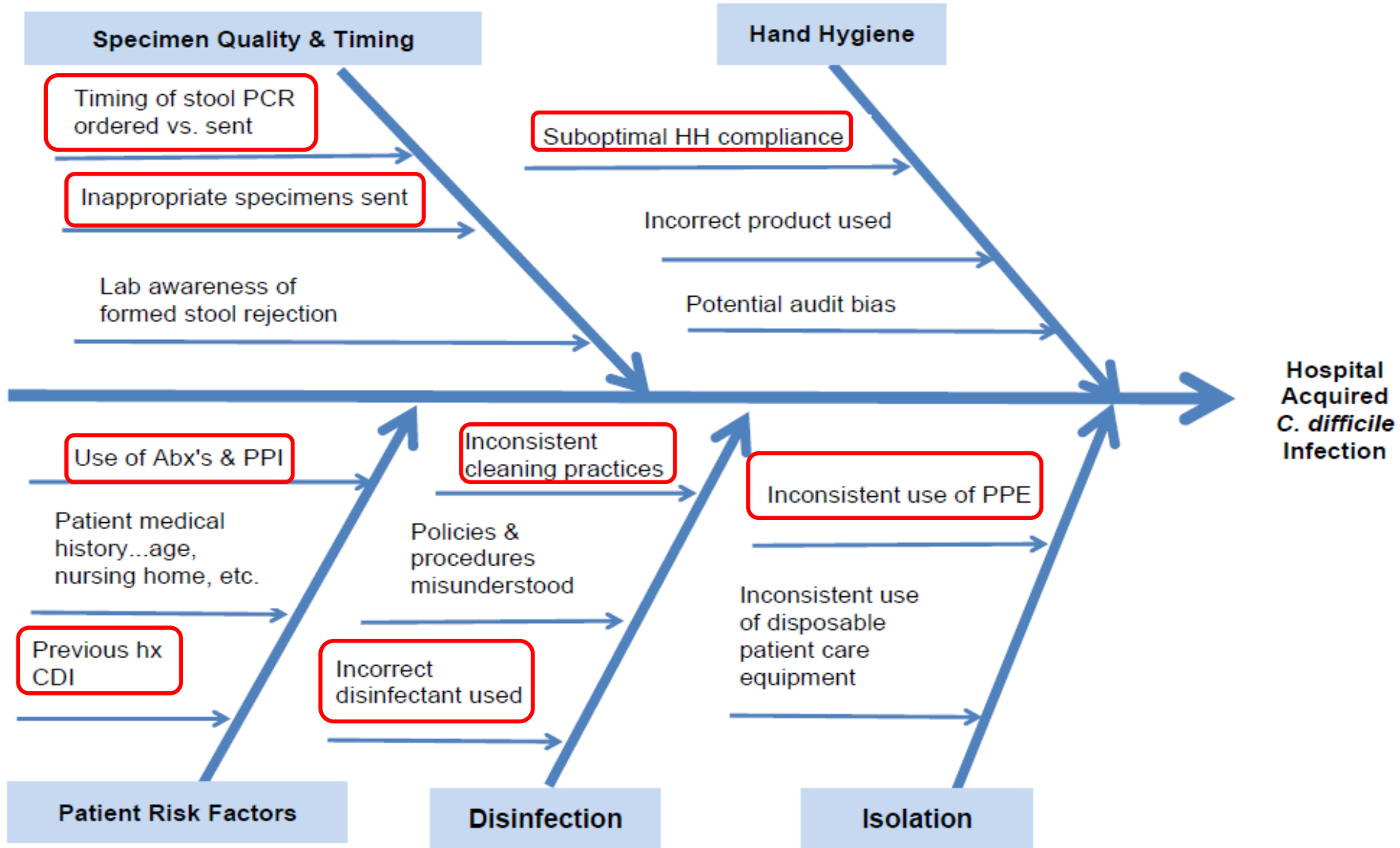


Key Players to Success

- Multidisciplinary Team:
 - Administrative Support
 - Infectious Disease Physician
 - Infection Preventionist
 - Environmental Services
 - Gastroenterologist
 - Infectious Disease Pharmacist
 - Microbiology Laboratory



Identified Causes





Plan: Initial Strategies Used

- Used process improvement cycle approach (Plan-Do-Check-Act)
- Developed a *C. difficile* order screening tool and imbedded in the order set
- Provided education regarding stool consistency requirements and canceling at lab if criteria not met
- Switched from targeted cleaning of CDI rooms with bleach to universal cleaning with a sporicidal
- Infectious Disease Pharmacist reviewed hospital onset CDI cases for antibiotic stewardship opportunities
- Infection Prevention reviewed each case for trends



Hand Hygiene Accountability

- The Joint Commission TST Program used to observe hand hygiene compliance; Just in time coaching performed when missed opportunity identified
- Monthly reports of compliance by type healthcare worker reported to hospital leadership; low performers report PI action plans at Infection Control Committee
- Investigated potential for use of electronic monitoring of hand hygiene compliance
- Implemented increased observations and monthly leadership rounding with real time feedback on units



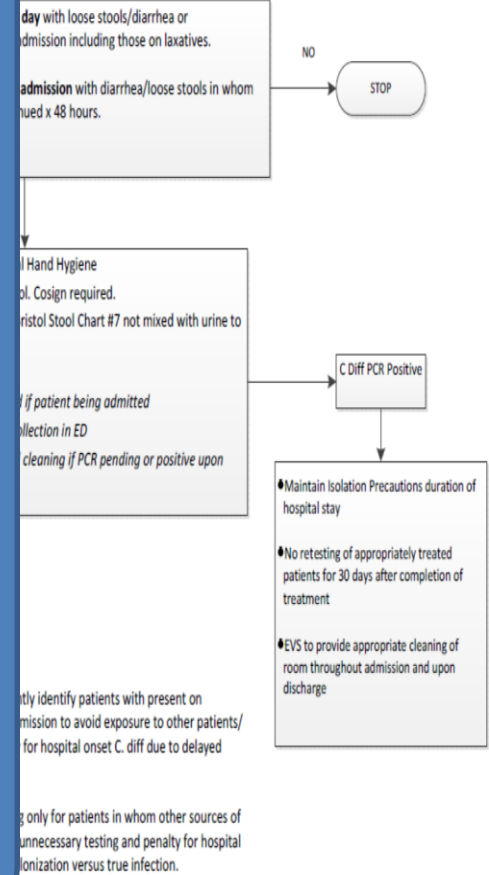
IT/Clinical Workflow Interventions

***New admit on day of admission, or following day with loose stools/diarrhea or c/o loose stools or diarrhea 24 hours prior to admission including those on laxatives.**

***Inpatients greater than 2 calendar days after admission with diarrhea/loose stools in whom all stool softeners/laxatives have been discontinued x 48 hours.**

YES

- Initiate Contact Precautions with Special Hand Hygiene
- Nurse to obtain C. diff order per protocol. Cosign required.
- Obtain and send stool consistent with Bristol Stool Chart #7 not mixed with urine to lab ASAP
- Provide patient education
- ED notifies PAC of need for isolation bed if patient being admitted
- ED to provide commode for specimen collection in ED
- ED to inform EVS of need for specialized cleaning if PCR pending or positive upon discharge from ED



could supersede this algorithm.



IT/Clinical Workflow Interventions

Clostridium difficile toxin by PCR Accept C

Frequency: **Once** STAT Daily

Starting: **Today** Tomorrow At:

First Occurrence: **Today 1009**

Scheduled Times

09/18/19 1009

Specimen Src: **Per Rectum** Per Stoma Rectum

Specimen Type: **Stool**

Comments:

Add-on: No add-on specimen found

Phase of Care:

Process Inst.: Considerations for C.Diff testing:

1. For patients that have been hospitalized for >48 hours, consider sending specimens ONLY in patients with greater or equal to 3 loose stools who have been off stool softens/laxatives for 48 hours.
2. For patients with a recent history of C-Diff infection in the past 30 days who are clinically improved, retesting is NOT recommended as tests may remain positive due to colonization.

Algorithm built into order



Do-Check-Act

- **Problem #1**: Stool collection task completes from nursing worklist after 48 hours
 - **Solution**: EMR report setup to monitor and request orders to be cancelled if appropriate
- **Problem #2**: Patients with a previous history of *C. difficile* were more likely to develop recurrent infection during their admission.
 - **Solution**: Tried Best Practice Advisory (BPA) at one campus to alert practitioners of patients' previous history and consider ordering PO Vancomycin...and then moved network-wide.



Clostridium difficile BPA

⚠ High-Risk for HA-C. difficile

This patient has a current or previous history of C. difficile and has been identified as being high risk for acquiring HA-Cdiff infection

@RESUFAST(CDIFFTOXINB)@



- Please limit systemic antibiotic: **use, spectrum, and duration** as much as possible
- If antibiotics need to be continued, consider adding C. difficile prophylaxis with PO Vancomycin
- If C. difficile prophylaxis will not be added, please document WHY

Order

Do Not Order

📄 Vancomycin (VANCOCIN) Oral Solution 125 mg Q12 hrs - Continue for the duration of and for 48-72hr AFTER stopping all other antibiotics

Acknowledge Reason

Allergy/intolerant to prophylactic agent

Currently receiving C.Diff treatment

Other (specify reason in comments field)

✓ Accept

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Do-Check-Act

- **Problem #3**: Improper specimen collection trends identified (e.g. laxative use, recent previous positive test, recent negative test, and watery stools not charted in last 24 hours)
 - **Solution**: Developed Best Practice Advisory (BPA) to alert practitioners of potential factors to consider before ordering



Clostridium difficile BPA

⚠ C. diff testing alert! As your patient has met one of the following criteria, C. diff testing is not recommended at this time:

- Positive C. diff result in the past 14 days
- Negative C. diff result in the past 7 days

- Laxative administered to patient in last 48 hours
- Watery stools documented < 3x in last 24 hours

Extracted from EMR Lab



C. diff colonization testing is recommended only in patients with symptoms and no other causes (i.e. laxatives or medication). In addition, tests of cure or repeat testing in negative patients is not advised.

Extracted from EMR Medication Administration Record and Nursing Charting

Lab Results

Component	Value	Date/Time
CDIFFTOXINB	POSITIVE for C.difficile toxin by PCR. (A)	08/18/2019 08:50 PM

Remove the following orders?

Remove

Keep

Clostridium difficile toxin by PCR
Once, First occurrence today at 1301 Stool

✓ Accept

Dismiss



Do-Check-Act

- Problem #4: Identified pattern of particular providers repeatedly bypassing BPA's when first implemented
 - Solution: EMR report setup to monitor ordering provider BPA trends and provided feedback/education



IT/Clinical Workflow Interventions

1000

Task fires to Nursing worklist

1000

Neuro

None

Done

Skip

1015

Place patient in Contact and Hand Hygiene with Soap and Water Isolation Status

Routine

Done

Skip

Patient banner flagged

Campus: St. Luke's Hospital - An...	GMLOS: 3.1	Med List Status: RN Complete	Infection: C.Difficile	Ad
Bed: MS 207-01	Admit D/T: 08/20/2019 1532	Attend: GARWOOD, R	Weight: 57.2 kg (126 lb 1.7 oz)	Pr
Pt Loc: MS 207-01	Prblm: C. difficile diarrhea (Princi...	Allergies: Bactrim [Sulfamethoxaz...	Height: 5' 2" (1.575 m)	⌂
LOS: 3	Patient Class: Inpatient	Isolation: Contact and Hand Hyg...	Code: Level 1 - Full Code	

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IT/Clinical Workflow Interventions

SL Hospital - Ticket to Ride

Patient was previously in: ICU 220/ICU 220

Patient Information

Work Sheet (2022-03-16)

F

6/1/20

Morse High Fall Risk

Attending Provider: Sachinkumar
Kanagali, MD

Allergies: No Known Allergies

Isolation: Contact Hand

Infection: None

Code Status: Level 1 - Fu

[Advance Care Planning Activity](#)

Ht: 5' 6" (1.678 m)

Wt: 105 kg (232 lb 5.8 oz)

Admission Cmt: None

Principal Problem: Hypertensive
emergency [116.1] [More...](#)



Environmental Services (EVS)

- EVS Command Center report alerts when patient room is for *C. difficile* isolation
- Task assigned to housekeeper and able to track
- Special daily and discharge cleaning protocol for *C. difficile* rooms implemented
- ATP testing of CDC identified high frequency touch surfaces and equipment
- ATP results are reported out quarterly at Infection Control Committee, and trends are addressed in real time by EVS manager; staff re-educated and surfaces re-cleaned and re-tested



IT/Clinical Workflow Interventions


EVS Command Center

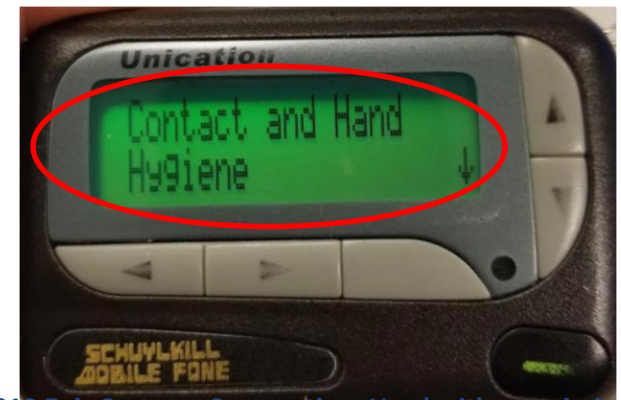


Location: St. Luke's University Hospital - Beth Sector view Assignments Housekeepers

Current Assignments 2 · 0 · 0

Requests 0 · 0 · 0

Request	Housekeeper	Status	Priority	Cur/Tot Mins
PPHP 524-01	Remaly, Patricia	Assigned	Normal (Pt Asgn)	14/29
 PPHP 828-01	Sonnon, Julie	Assigned	Normal	0/1



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Public Reporting

- Infection Preventionists utilize an EMR Dashboard for surveillance and public reporting of HAI


NHSN LabID Event Reporting ⋮ ⤴

🕒 Data collected: Mon 9/9 01:46 PM

Report Title	Results
LabID Events - C. diff.	9

- *C. difficile* Lab ID Event data is extracted to create Clinical Document Architecture (CDA)

Accurately
upload
data to
CDC
NHSN



Temporary report setting [6620212] as of Mon 9/9/2019 1:48 PM

⌵ Filters
🔍 Options
⚡ Quick Create
✎ Edit
✕ Void
⊕ Abstract All
📄 Hospital Chart
📊 Chart Review

Unit and Room	Attributed Location	Collected	Specimen Type	LabID Event	Collection Department
BE ARC ARC 457	BE ARC	09/03/2019 0342	Stool	✓	BE ARC
BE PPHP5 MS PPHP 510	BE ED	08/23/2019 1804	Stool	✓	BE ED
BE PPHP6 PPHP 619	BE PPHP 6	08/24/2019 1616	Stool	✓	BE PPHP 6
BE PPHP7 PPHP 730	BE PPHP 7	08/10/2019 1523	Stool	✓	BE PPHP 7

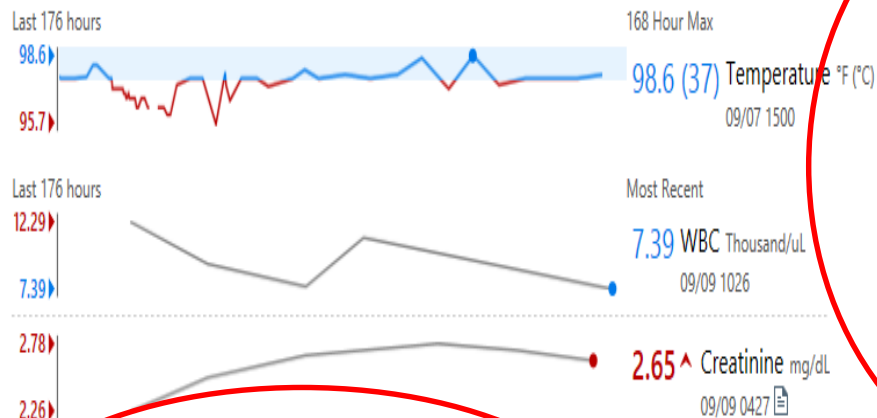
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Antimicrobial Stewardship

Antimicrobials

Temp/WBC Trend



Anti-Infectives

Medication	Dose/Rate, Frequency, Route	Last Action
ampicillin (OMNIPEN) 2,000 mg in sodium chloride 0.9 % 100 mL IVPB	2,000 mg, Q6H, IV	New Bag: 09/09 1439
cefTRIAxone (ROCEPHIN) 2,000 mg in dextrose 5 % 50 mL IVPB	2,000 mg, Q12H, IV	New Bag: 09/09 1254

Creatinine (168h ago through now)

Date/Time	Serum Creatinine
09/09/19 0427	2.65 mg/dL ^

Range: 0.60 - 1.30 mg/dL
CrCl: 25.7 mL/min !

Bug-Drug Mismatch : 0 [Comment](#)

De-Escalation : 0 [Comment](#)

Drug-Lab Mismatch : 0 [Comment](#)

IV to PO : 1 [Comment](#)

Antibiotics with potential IV to PO conversion: 1 points (Up 1 points since last review) - [Last updated: 09/09/19 1439] [\[Medications\] Comment](#)

This patient has been flagged for potential IV to PO conversion of an antimicrobial agent.

Dietary Orders (From admission, onward) [Hide](#)

Start	Ordered
09/09/19 1417	09/09/19 1416

Diet Renal; Renal Liberal; Yes; Fluid Restriction 1800 ML; No Diet effective now

IV to PO - Antibiotics (From admission, onward) [Hide](#)

Start	Dose/Rate	Route	Frequency	Ordered	Stop
09/01/19 1345	ampicillin (OMNIPEN) 2,000 mg in sodium chloride 0.9 % 100 mL IVPB 2,000 mg 200 mL/hr over 30 Minutes	Intravenous	Every 6 hours	09/01/19 1337	
09/01/19 1345	cefTRIAxone (ROCEPHIN) 2,000 mg in dextrose 5 % 50 mL IVPB 2,000 mg 100 mL/hr over 30 Minutes	Intravenous	Every 12 hours	09/01/19 1337	



Antimicrobial Stewardship

09/08/19 0434	2.73 mg/dL ^
Range: 0.60 - 1.30 mg/dL	
CrCl: 24.9 mL/min !	
09/07/19 0418	2.78 mg/dL ^
Range: 0.60 - 1.30 mg/dL	
CrCl: 24.5 mL/min !	
09/06/19 0457	2.73 mg/dL ^
Range: 0.60 - 1.30 mg/dL	
CrCl: 24.9 mL/min !	
09/05/19 1056	2.69 mg/dL ^
Range: 0.60 - 1.30 mg/dL	
CrCl: 25.3 mL/min !	
09/04/19 0434	2.52 mg/dL ^
Range: 0.60 - 1.30 mg/dL	
CrCl: 27 mL/min !	
09/03/19 0435	2.26 mg/dL ^
Range: 0.60 - 1.30 mg/dL	
CrCl: 30.1 mL/min !	

Antimicrobial Stewardship

Total Score: 2 ^

- 1 Antibiotics with potential IV to PO conversion
- 1 Duplicate Coverage

Days of Therapy : 18

[Comment](#)

Days of Therapy - Aminopenicillins; 1 day lookback: 9 points (Up 9 points since last review) - [Last updated: 09/09/19 1439]

[Comment](#)

Days of Therapy - 3rd Generation Cephalosporins; 3 day lookback: 9 points (Up 9 points since last review) - [Last updated: 09/09/19 1439]

[Comment](#)

Unnecessary Duplicate Coverage : 1

[Comment](#)

Duplicate Coverage : 1 points (Up 1 points since last review) - [Last updated: 09/09/19 1439]

[\[Medications\]](#) [Comment](#)

This patient has duplicate antibiotic coverage.

Antibiotics causing Duplicate Coverage (From admission, onward)

[Hide](#)

Start	Dose/Rate	Route	Frequency	Ordered	Stop
09/01/19 1345	ampicillin (OMNIPEN) 2,000 mg in sodium chloride 0.9 % 100 mL IVPB [134155488]	Intravenous	Every 6 hours	09/01/19 1337	
09/01/19 1345	cefTRIAxone (ROCEPHIN) 2,000 mg in dextrose 5 % 50 mL IVPB [134155489]	Intravenous	Every 12 hours	09/01/19 1337	

Broad Spectrum : 0

[Comment](#)

Restricted and High-Risk Antimicrobial : 0

[Comment](#)

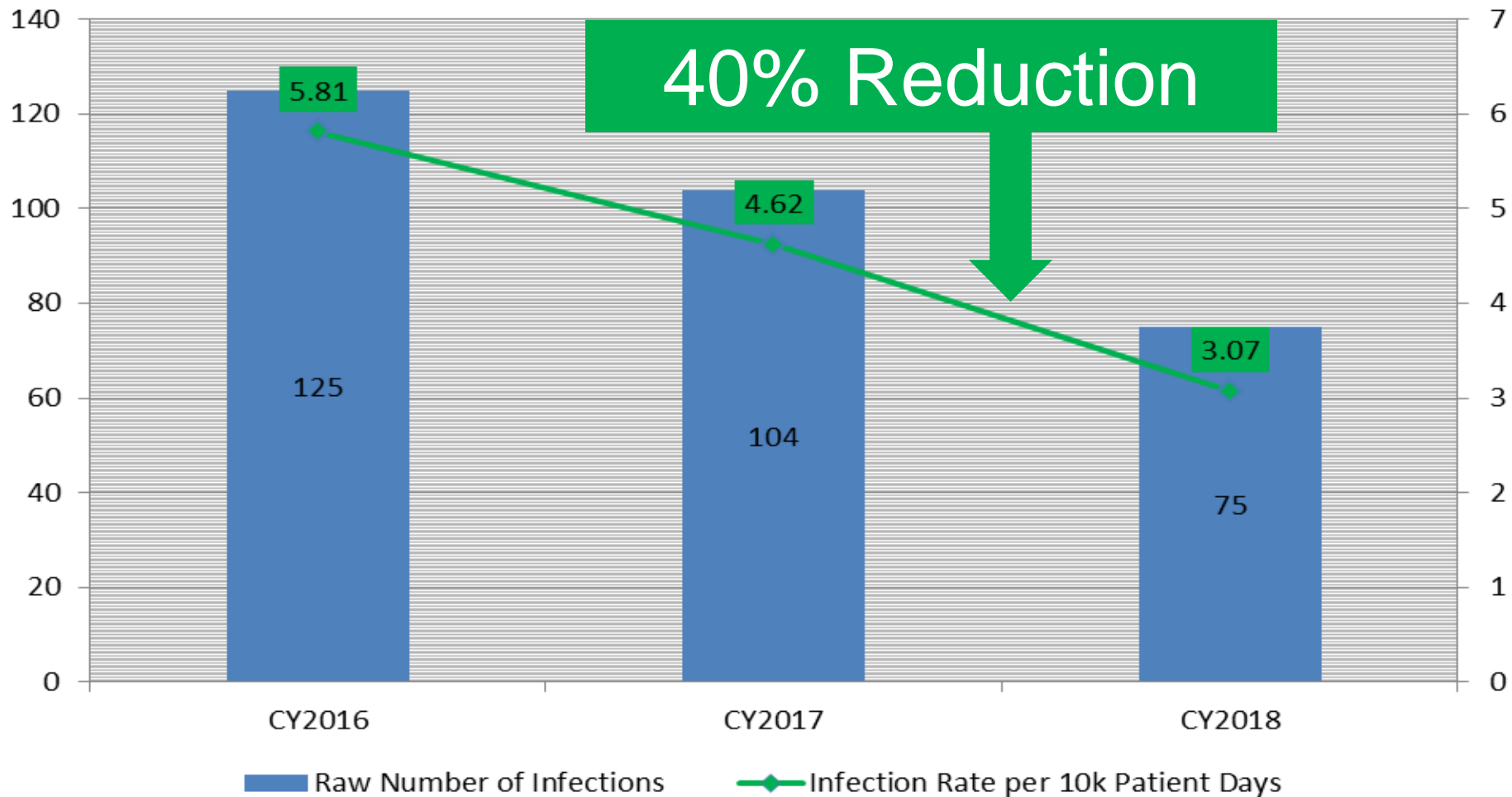
Duplicate Antipseudomonal : 0

[Comment](#)



Outcome

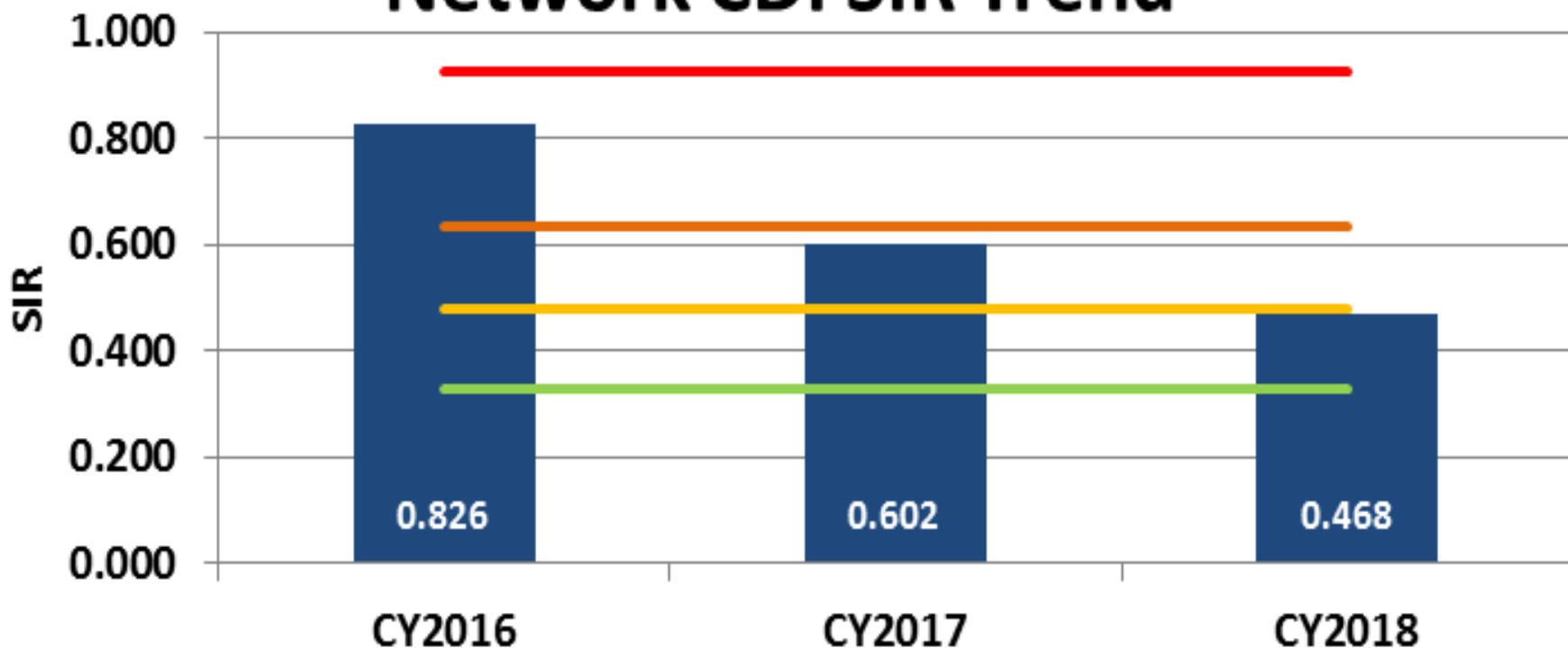
Network Hospital Onset *C. difficile* Infections





National Benchmark Performance

Network CDI SIR Trend



■ Network CDI SIR

— National Median 0.928

— 75th Percentile 0.636

— 85th Percentile 0.477

— 90th Percentile 0.327



Outcome

- **Potential Cost Reduction:**
 - Cost: \$11,285 per CDI in 2012 U.S. dollars

 - 50 less CDI CY2016-CY2018

 - \$564,250.00 potential savings over a 3 year period



Lessons Learned

- Standardizing care and practice at each campus
- Multidisciplinary team- key players to success
- Harnessing use of IT technology
- Review loop and accountability
- Financial impacts



Clinical Technology Governance





Future State

STOP

STRICT CONTACT AND HAND HYGIENE PRECAUTIONS

VISITORS MUST REPORT TO NURSE BEFORE ENTERING

- Perform hand hygiene before entering room
- Everyone must wear gown & gloves before entering room
- Use patient-dedicated or single-use disposable equipment such as stethoscope, BP cuff, thermometer, etc.
- Disinfect equipment with sporicidal between patients
- Remove gown & gloves before leaving room
- Perform hand hygiene with soap & water when leaving room
- Limit transport for essential purposes only
- Patient: Wear clean gown & wash hands with soap & water
- Transporter: Perform hand off communication to receiving department

1. New visual cue to match EMR isolation status
2. Two-step PCR to EIA reflexive testing
3. Procalcitonin trial in progress
4. Handwashing Protocols