A Layered Infection Prevention Approach With UV
A University Based Health System Experience

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Objectives

• Review the concept of the layered approach to infection prevention

• Outline the multi-faceted performance improvement efforts aimed at reducing *Clostridiodes difficile* infection at a university hospital setting

• Describe the implementation of UV technology and change in multi-drug resistant organism (MDRO) rates
Bundles: Why Do We Need Them?

Recommendations

Practice
• Changes to culture practice
• Active surveillance for infection
• Screening for colonization

0.58/1,000 patient days  ➔  0/1,000 patient days
0.57/1,000 patient days  ➔  0.09/1,000 patient days
Preventable Patient Harm: a Multidisciplinary, Bundled Approach to Reducing *Clostridium difficile* Infections While Using a Glutamate Dehydrogenase/Toxin Immunochromatographic Assay/Nucleic Acid Amplification Test Diagnostic Algorithm

Katharina Schultz, Emily Sickbert-Bennett, Ashley Marx, David J. Weber, Lauran M. DiBlase, Stacy Campbell-Bright, Lauren E. Bode, Mike Baker, Tom Belhorn, Mark Buchanan, Shari Goldbach, Jacci Harden, Emily Hoke, Beth Huenniger, Jonathan J. Juliano, Michael Langston, Heather Ritchie, William A. Rutala, Jason Smith, Shelley Summerlin-Long, Lisa Teal, Peter Gilligan

- Antimicrobial prescribing
- Diagnostic stewardship
- Isolation policy
- Cleaning practices

11/10,000 patient days → 6.3/10,000 patient days
Multidisciplinary Approach and Clostridium difficile Infection in Adult Surgical Patients

Megan C. Turner, MD, MHS, Shay L. Behrens, BA, Wendy Webster, MA, MBA, Kirk Huslage, MSPH, BSN, Becky A. Smith, MD, Rebekah Wrenn, PharmD BCPS, Regina Woody, RN, Christopher R. Mantyh, MD, FACS

- Antimicrobial stewardship
- Increased UV cleaning
- Hand hygiene and PPE signage
- Diagnostic stewardship

1.27% → → → 0.91% (CDI rate among surgical patients)
“These interventions (effective surface disinfection, thoroughness indicators) are not enough to achieve consistent and high rates of cleaning/disinfection.”

What Makes A Successful Bundle?

• Culture, culture, culture
• Multidisciplinary teams
• Education
• Ongoing monitoring
What Does This Look Like?

Environmental contamination with MDRO

Cleaning and Disinfection Failures

Antimicrobial Stewardship

Missed Hand Hygiene Opportunities

Source Patient

Transmission

model available here
What Does a “Layered Approach” Look Like?

- Environmental contamination
- Rx Stewardship
- Staff Engagement
- Leadership Rounds
- RCAs following events
- Cleaning and Disinfection
- Hand Hygiene
- Strategic Goals
- HCW Education
- Supplemental Disinfection

(model available here)
The Layered Approach in Action

A large university-based healthcare system includes 566 bed university hospital (UH 1979), 87 bed pediatric hospital (2007 conjoined to UH) and 56 bed community hospital (2015)

- 32 inpatient units, 110+ clinics medical school affiliated
- 2.7 million outpatient visits, 50,000 admissions, 16,000 employees
- Net revenue $3.2 billion 2014-2015 Hospital Compare for CDI:

<table>
<thead>
<tr>
<th>No. of Infections Reported (A)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>211</td>
<td>161,597</td>
<td>157.957</td>
<td>1.336</td>
<td>Worse than the National Benchmark</td>
</tr>
</tbody>
</table>
Pre-2016 CDI Prevention Strategies

In 2015 the following were already in place

• Environmental
  — A sporicidal disinfectant for all hospital discharges (not just CDI)
  — A QA monitoring program for 18 high touch objects (HTOs)
  — Some use of UV light supplemental disinfection in select areas (since 2011)

• Rx Management: An active and engaged antimicrobial stewardship team (since 2002)

• Accountability: Leadership HAI rounds (CNO, Associate CMO) on all units
Testing: Delegation Protocol

In an effort to rapidly identify patients and get them isolated, the organization created a nursing delegated protocol for testing

• 3 loose stools and RN can order CDI-PCR

Extensive chart of review of all patients testing positive revealed widespread inappropriate testing across the board
CDI Testing Algorithm - Part 1

**Adult Inpatient Testing Algorithm for Clostridium difficile infection (CDI)**

*In the FIRST 48 hours of admission*

- **Does the patient complain of or have any unexplained loose stools prior to admission?**
  - **Yes** → ORDER the Test; Place on enhanced contact isolation.
  - **No** → Do NOT Test

**NOTE:** It is important to consider whether the diarrhea could be a result of recent or overuse of medications or therapies associated with diarrhea including: stool softeners, laxatives, enemas, bowel preps, etc. Further, more than 55% of positive CDI tests are in clinic or on admission to suggesting CDI is more common in the community than traditionally believed. Do not test asymptomatic patients but thoroughly evaluate GI symptoms on admission and consider CDI early on as a potential causative pathogen in symptomatic patients.
CDI Testing Algorithm - Part 2-OPTION 2

Does the patient have LESS than 3 unexpected liquid/loose stools beyond their known or established baseline within the past 24 hours?¹ ² ⁴

Yes → Do NOT Test

No → Can the diarrhea be the result of the patient currently or recently (past 48 hours) being introduced to a new medication or therapy associated with diarrhea such as any of the following: stool softeners, laxatives, enemas, bowel preps, lactulose, tube feeds, or IV contrast?⁵

Yes → Do NOT Test Consider altering therapy. Re-evaluate 24 hours after suspending affecting agent. If agent cannot be suspended, exercise clinical judgment and if appropriate proceed to the next ("No") step below.

No → Place patient on enhanced contact isolation. Maintain isolation until diarrhea resolves or an alternative, non-infectious cause of diarrhea has been determined.

Is the patient: low-risk (i.e. afebrile, no elevated WBC, no abdominal pain, no recent antibiotic use, not an IBD patient nor any recent/frequent healthcare encounters)?³

Yes → Do NOT Test Pre-test probability is low. Consider alternative causes of diarrhea.

No → ORDER the Test Continue enhanced contact isolation. Do not test for cure.

DISCLAIMER:
Laboratory limit: 1 Test every 7 days.
Complex patients, including obstruction cases, may not readily conform to this algorithm. As always, sound clinical judgement should be applied in conjunction with the information provided here. In some instances, expert opinion should be solicited.

References:

Last reviewed/revised: 10/2015
Contact CCOM for revisions.
Clostridium difficile – Pediatric/Adult – inpatient/Ambulatory Guideline
Prevent Transmission: Environmental

The organization used a sporicidal agent for all patient rooms (regardless of CDI) for years

- Bleach til Apr 2015 → H2O2 + per oxy acetic acid

The organization used a quality assurance monitoring program starting in 2011

- Expanded list of “HTOs” from 18 (CDC default) → 36
The Expanded List

Room Door Handle-Outside
Nurse Server Handle Pulls
Alcohol Gel Dispenser
Chair: Arm *
Chair: Seat
Dry Erase Marker
Patient Visitor Guide
In Room Dining Menu
Room Door Handle-Inside *
and Push Buttons
Call Button/TV Remote *
IV Pole *
Patient Belonging Shelf
Window Sill/Ledge
Monitor Screen
BloodPressure Cuff
Telephone *
Flashlight

Light Switch: Room *, Bathroom *
Other
Toilet Seat: Bottom
Toilet Seat: Top *
Toilet Flush Handle *
Toilet BedPan Sprayer *
Shower Faucet
Shower Door Handle
Bathroom Door Handle-Inside *
Bathroom Door Handle-Outside
Bathroom Hand Rail *
Mattress
Bed Rail *
Bed Controls
BedSide Table Top *
Bedside Table Handle *
Soap Dispenser
Trash Can Lid
Horizontal Sink Surface
Sink Handles *
HTO Expansion

Median = 93

<table>
<thead>
<tr>
<th>Month</th>
<th>HTOs Passed Compliance</th>
<th>HTOs Passed</th>
</tr>
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<tbody>
<tr>
<td>Jul-16</td>
<td>93%</td>
<td>573</td>
</tr>
<tr>
<td>Aug-16</td>
<td>94%</td>
<td>1307</td>
</tr>
<tr>
<td>Sep-16</td>
<td>91%</td>
<td>487</td>
</tr>
<tr>
<td>Oct-16</td>
<td>95%</td>
<td>760</td>
</tr>
<tr>
<td>Nov-16</td>
<td>91%</td>
<td>1987</td>
</tr>
<tr>
<td>Dec-16</td>
<td>93%</td>
<td>2031</td>
</tr>
<tr>
<td>Jan-17</td>
<td>93%</td>
<td>2156</td>
</tr>
<tr>
<td>Feb-17</td>
<td>95%</td>
<td>2081</td>
</tr>
<tr>
<td>Mar-17</td>
<td>94%</td>
<td>1809</td>
</tr>
<tr>
<td>Apr-17</td>
<td>96%</td>
<td>1668</td>
</tr>
<tr>
<td>May-17</td>
<td>94%</td>
<td>1454</td>
</tr>
<tr>
<td>Jun-17</td>
<td>94%</td>
<td>1743</td>
</tr>
<tr>
<td>Jul-17</td>
<td>94%</td>
<td>1743</td>
</tr>
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New UV

Brought in 14+ machines throughout all units of adult and pediatric units

- Reviewed one year’s worth of discharge data to determine number of CDI isolation discharges/transfers
- Strategically placed machines to maximize efficiency between units

Patient discharge/transfer notifications to EVS included isolation room status

All rooms turned over in usual manner-via sporicidal disinfectant-before UV utilized

UV instruments track utilization by room
UV By the Numbers

56,536 in 39 months

The organization used the machines on average 1,481 times per month

1. All inpatient room terminal discharge or transfer cleans that are for patients in enhanced (CDI) contact precautions. (91.6%, ~85 times a month)

2. All inpatient room terminal discharge or transfer cleans that are for patient in other isolation precautions (e.g. contact, droplet, airborne). (79.6% ~485 times a month)

3. Inpatient room terminal discharge or transfer cleans in 6 high patient risk units whenever possible due to the population’s inherent high risk for infection. (82.5% ~900 times a month)

4. Burn unit tub and shower rooms at end of day (100%)
### From That (2014) to This (2019)

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**Table 6 of 6 Clostridium difficile (C.diff.) intestinal infections**

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<tr>
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<tr>
<td>69</td>
<td>175254</td>
<td>135.347</td>
<td>0.510</td>
<td>Better than the National Benchmark</td>
</tr>
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Standardized infection ratio (SIR) national benchmark = 1.
Lower SIRs are better. A score of (0) – meaning no C.diff. infections - is best.
What role did UV play? How can you tell?

Same rules as MRSA Blood and CDI LabID event applied to all resistant organisms.

- Retrospectively reviewed back to 9/1/2015
- Period 1: 9/1/2015 – 8/31/2016
- Washout: September 2016
- Period 2: 10/1/2016 – 10/31/2018

- Note there are more patient days in Period 2

MRSA, VRE, extended spectrum beta-lactamase (ESBL) Gram-negative organisms and Amp-C beta-lactamases (Amp-C)
# MDROs

<table>
<thead>
<tr>
<th>Organisms</th>
<th>Pre-UV (9/2015-8/2016)</th>
<th>Post UV (10/2016 - 9/2018)</th>
<th>Rate Ratio, (95% CI), p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methicillin-Resistant <em>Staphylococcus aureus</em></td>
<td>64</td>
<td>84</td>
<td>2.51 (0.63 (0.45, 0.89) p=0.008)</td>
</tr>
<tr>
<td>Vancomycin-Resistant Enterococci</td>
<td>46</td>
<td>67</td>
<td>2.00 p=0.08</td>
</tr>
<tr>
<td>AmpC</td>
<td>2</td>
<td>4</td>
<td>0.12 p=0.92</td>
</tr>
<tr>
<td>AmpC and ESBL</td>
<td>7</td>
<td>6</td>
<td>0.18</td>
</tr>
<tr>
<td>ESBL</td>
<td>26</td>
<td>57</td>
<td>1.70 p=0.92</td>
</tr>
<tr>
<td><em>Clostridium difficile</em></td>
<td>151</td>
<td>186</td>
<td>5.69 (0.60 (0.48, 0.74) p= 0.000)</td>
</tr>
<tr>
<td>All Organisms (Total)</td>
<td>296</td>
<td>404</td>
<td>12.37 (0.66 (0.57, 0.79) p=0.000)</td>
</tr>
<tr>
<td>Total minus CDI</td>
<td>145</td>
<td>218</td>
<td>6.52 (0.73 (0.59, 0.90) p=0.004)</td>
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Summary

Neither failure nor success can usually be attributed nor sustained due to a single intervention.

A layered approach, especially as it relates to the disinfecting the environment improves the probability of sustained success in the long term.

Supplemental disinfection strategies, such as using UV disinfection following routine environmental cleaning and disinfection can have a statistically significant impact on MDRO acquisition, including C. diff infections and other MDROs when deployed as part of a comprehensive program.

UV was successfully integrated into the organization’s standard operating procedure and its use is associated with a dramatic and sustained reduction in MDROs.
Thank you