Role of Diagnostic Stewardship in an Infection Prevention Program

John Segreti, MD
Hospital Epidemiologist
Rush University Medical Center
Scope of the Problem

- Healthcare-associated infections (HAIs) are associated with increased morbidity and mortality, prolonged hospital stays, and unnecessary cost.
- Surveillance definitions (as used by NHSN) cannot be used to distinguish true infections from false-positive tests.
- Overdiagnosis of HAIs could lead to inappropriate antimicrobial use and unnecessary cost, antimicrobial resistance and adverse drug events.
- Hospitals may incur penalties for HAI test overuse, including lost reimbursement, financial penalties, and damage to institutional reputation and rankings.

ICHE, 2018;39:214-218
Introduction

- Diagnostic stewardship means selecting the right test for the right patient at the right time, to optimize clinical care and antimicrobial use
- Diagnostic stewardship has the potential to address falsely inflated HAI rates due to overtesting.

ICHE, 2018;39:214-218
CLABSI
Draw blood cultures from CVC?

• Blood cultures are sometimes obtained from intravascular catheters for convenience. Some people think this is the best way to get cultures if CLABSI is suspected

• A culture obtained from an intravascular catheter was found to be a diagnostic test for bacteremia with better sensitivity and better negative predictive value but with less specificity and lower positive predictive value compared to a culture taken by peripheral venipuncture

• Estimated that in a group of 1000 patients, eight additional patients with true bacteremia would be identified and 59 falsely diagnosed as having bacteremia by a blood culture obtained from an intravascular catheter compared to results of the peripheral blood culture.

Journal of Medical Microbiology (2008), 57, 1–8
Potential harms of contaminated blood cultures

• A retrospective case-control study design was used in which false-positive blood culture cases were matched with suitable controls

• 254 false-positive blood cultures occurred in the study site hospital over a one-year period, patients with false-positive blood cultures added 1372 extra hospital days and incurred additional hospital costs of £1,270,381 ($1,905,572) per year

Journal of Hospital Infection 77 (2011) 233-236
Potential harms of contaminated blood cultures

• Of all blood cultures positive for coagulase-negative staphylococci collected in 1 year at an academic hospital, 100 were selected randomly for review and designated true positives or contaminated.

• For the 85 patients whose cultures were determined to be contaminated, chart abstractions revealed substantial unnecessary antibiotic administration, additional laboratory tests and procedures, and hospital readmissions.

Infect Control Hosp Epidemiol 2011;32(6):623-625
Why not avoid drawing blood from CVC?

• A new blood culture policy discouraged drawing blood samples from central lines. Phlebotomists were reeducated regarding aseptic technique when obtaining blood samples by venipuncture.

• The proportion of blood cultures that were contaminated decreased from 84 (1.6%) of 5,274 during January-June 2010 to 21 (0.5%) of 4,245 during January-June 2012 (P < .001).

• Based on estimated excess hospital costs of $3,000 per contaminated blood culture, the reduction in blood culture contaminants yielded an estimated annualized savings of $378,000 in 2012 when compared to 2010.

• In mid-2010, 3 (30%) of 10 reported CLABSIs were suspected to represent blood culture contamination compared with none of 6 CLABSIs reported from mid-November 2010 through June 2012 (P = 0.25).
Does not drawing from CVC harm the patient?

• We examined the impact of phlebotomist-only blood draws and central line avoidance for blood culture at Rush starting in September, 2013.

• Policy implementation led to 29%, 31%, and 38% decreases in blood culture performance, positivity, and contamination, respectively; an 86% decrease in blood cultures drawn from central lines; and a 66% decrease in central line–associated bloodstream infections.

• Our policy coincided with an 11% decrease in intravenous vancomycin, daptomycin, or linezolid use, whereas there was no change in piperacillin-tazobactam, cefepime/ceftazidime, or carbapenem use.

• Hospital lengths of stay and mortality rates were unchanged in the general hospital population and were stable or improved in patients with kidney disease, liver disease, cancer, and abdominal solid-organ transplants.

Infect Dis Clin Pract 2018;26: 91–96)
CAUTI
The Problem with CAUTIs

• Indwelling urinary catheters are used commonly during hospitalization, particularly in Intensive Care units where they are used in 48%-65% of adult patients.

• Patients with catheters often develop asymptomatic shedding of bacteria in the urine (asymptomatic bacteriururia) and the risk of colonization of catheters increases by 5% each day.

• Urinalysis and cultures sent in this population as a reflexive response to fever may result in the over diagnosis of catheter-associated urinary tract infection, which contributes to unnecessary and excessive antibiotic use, selection for resistant organisms, increased risk for Clostridiodes difficile infections, as well as a false elevation in catheter-associated urinary tract infection (CAUTI) rates.

American Journal of Infection Control 48 (2020) 1375–1380
Catheter-associated bacteriuria usually represents colonization, is rarely symptomatic, and is rarely the cause of fever or secondary bloodstream infection, even in immunocompromised patients, unless there is urinary tract obstruction, the patient has had recent urologic manipulation or surgery, or is granulocytopenic.

In the presence of a urinary catheter, pyuria does not reliably predict infection.

The concentration of urinary bacteria needed to cause symptomatic urinary tract infection or fever is unclear.

There are no data to show that higher counts are more likely to represent symptomatic infection than lower one.
Possible Solution

• Remove indwelling catheter when no longer needed
• Send urine cultures only in patients with UTI symptoms and no non-UTI diagnosis
• Allow cultures only for patients with:
  • Recent urologic procedure
  • Urinary tract obstruction
  • Renal transplant
  • Neutropenia
  • Pregnancy

American Journal of Infection Control 48 (2020) 1375–1380
Urine Culture Alert

You are ordering a urine culture in a patient with an indwelling urinary catheter. Urine cultures in catheterized patients usually represent colonization and are not clinically meaningful.

To proceed, you must verify that the patient fulfills one of the following IDSA/ACCM urinary tract criteria, or that urine culture is indicated per ID consultation:

1. Neutropenia (absolute neutrophil count less than 1000 cells/μL)
2. Kidney transplant
3. Recent urologic surgery (within 30 days)
4. Radiographic evidence of urinary tract obstruction (e.g., hydronephrosis)

If keeping order (uncommon), select an Acknowledge Reason (required)

Your compliance is audited by infection control.

Remove the following orders?

Remove Keep

Culture Urine
Print Label On Demand, ROUTINE, First occurrence today at 0931

Acknowledge Reason

Neutropenia Kidney Transplant Recent urologic surgery (within 30 days) Radiographic evidence of obstruction

Infectious Diseases consulted. Enter name...
Clostridioides difficile Infection
Original Investigation

Overdiagnosis of Clostridium difficile Infection in the Molecular Test Era

Christopher R. Polage, MD, MAS; Clare E. Gyorke, BS; Michael A. Kennedy, BS; Jhansi L. Leslie, BS; David L. Chin, PhD; Susan Wang, BS; Hien H. Nguyen, MD, MAS; Bin Huang, MD, PhD; Yi-Wei Tang, MD, PhD; Lenora W. Lee, MD; Kyoungmi Kim, PhD; Sandra Taylor, PhD; Patrick S. Romano, MD, MPH; Edward A. Panacek, MD, MPH; Parker B. Goodell, BS, MPH; Jay V. Solnick, MD, PhD; Stuart H. Cohen, MD

Published online September 8, 2015.
Findings

- No CDI-related complications occurred in Tox−/PCR+ patients vs 10 complications in Tox+/PCR+ patients (0% vs 7.6%, P < .001).
- One Tox−/PCR+ patient had recurrent CDI as a contributing factor to death within 30 days vs 11 CDI-related deaths in Tox+/PCR+ patients (0.6% vs 8.4%, P = .001).

Published online September 8, 2015.
Conclusions

• Among hospitalized adults with suspected CDI, virtually all CDI-related complications and deaths occurred in patients with positive toxin immunoassay test results.

• Patients with a positive molecular test result and a negative toxin immunoassay test result had outcomes that were comparable to patients without C difficile by either method.

• Exclusive reliance on molecular tests for CDI diagnosis without tests for toxins or host response is likely to result in overdiagnosis, overtreatment, and increased health care costs.

Published online September 8, 2015.
Impact of Mandatory Infectious Disease (ID) Specialist Approval on Hospital-Onset *Clostridium difficile* (HO-CDI) Testing and Infection Rates: Results of a Pilot Study

Michael Y. Lin, MD, MPH\(^1\), Tiffany Wiksten, RN, CIC\(^2\), Alexander Tomich, DNP, RN, CIC\(^2\), Mary K. Hayden, MD, FIDSA, FSHEA\(^1\) and John Segreti, MD, FIDSA, FSHEA\(^1\)

(1)Division of Infectious Diseases, Rush University Medical Center, Chicago, IL, (2)Infection Prevention and Control, Rush University Medical Center, Chicago, IL

October 5, 2018
IDWeek 2018
Background

• Inappropriate *C. difficile* testing is common\(^1,2\)

• The 2017 IDSA *C. difficile* guidelines recommend the use of nucleic acid amplification testing alone for detection of *C. difficile* infection (CDI) if appropriate stool specimens are collected (e.g., patients not receiving laxatives and ≥3 unformed stools in 24 hours)

• The potential role of ID specialists in enforcing appropriate *C. difficile* testing is unclear
Background (cont.)

- Rush University Medical Center (RUMC) uses PCR-based testing for detection of toxigenic *C. difficile*
- Since March 2015, Rush University Medical Center (RUMC) has used electronic decision support to discourage inappropriate *C. difficile* testing; however, ~42% of all testing was still inappropriate
- In November 2017, RUMC instituted a policy that all *C. difficile* testing on hospital day 4 or later needed ID attending approval.
  - Approval could be given either through a dedicated pager (staffed by 2 ID physicians between 8 AM and 5PM, 7 days/week) or by the ID consult attending if already involved in patient’s care
Clostridium difficile Alert

BestPractice Advisory - Noble, Donna

C. difficile testing after 72 hours of hospitalization requires approval. Testing will not be performed at night. If you suspect C. difficile infection, place your patient on enhanced contact precautions and page 4129 between the hours of 8am and 5pm. If your suspicion for C. difficile associated diarrhea is high you may also consider starting empiric therapy.

Remove the following orders?

- Remove
- Keep

- C. Difficile Toxin by PCR
- Print Label On Demand, ROUTINE First occurrence Today at 1618, Stool

More info about Ordering Process

Acknowledge Reason

Enter approving physician's name in the...

Accept
Methods

• At a single academic hospital (RUMC)
• Retrospective observation study comparing CDI testing and infection rates during baseline period (1/2016 – 11/2017) and intervention period (12/2017 – 8/2018)

• Outcomes:
  • HO-CDI testing and infection rates (defined by CDC LabID event) per 10,000 patient days
  • CO-CDI testing and infection rates
  • CDI test positivity rate
  • Number of approval pager calls, rates of C. difficile testing approval, and time burden

• We used Poisson models to compare rates between two periods; Fisher’s exact tests for differences of proportions.
Impact of Mandatory ID Specialist Testing Approval on Hospital-Onset CDI Testing and Infection Rates

![Graph showing the impact of mandatory ID specialist testing approval on hospital-onset CDI testing and infection rates.](image)

- **Baseline period (23 months):**
  - HO-CDI testing rate: 76.8
  - HO-CDI infection rate: 32.6

- **Intervention period (9 months):**
  - HO-CDI testing rate: 10.6
  - HO-CDI infection rate: 4.6

*P < .001*

- **58% reduction in HO-CDI testing.**
- **57% reduction in HO-CDI rate.**
Hospital-Onset C. difficile Infection Rate over Time

[Bar chart showing HO-CDI events per 10,000 patient days from Jan-16 to Jul-18. The chart highlights a decrease in HO-CDI rate after an intervention in July 2017.]
Impact of Mandatory ID Specialist Testing Approval on Community-Onset CDI Testing and Infection Rates

**Baseline period (23 months)**
- CO-CDI testing rate: 108.6
- CO-CDI infection rate: 16.8

**Intervention period (9 months)**
- CO-CDI testing rate: 123.3
- CO-CDI infection rate: 20.6

*P = .001*

*P = .01*
## Reasons for *C. difficile* Test Non-Approval

<table>
<thead>
<tr>
<th>Reason</th>
<th>N</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laxative use in prior 48 hours</td>
<td>32</td>
<td>(46)</td>
</tr>
<tr>
<td>Did not meet diarrhea criteria</td>
<td>28</td>
<td>(40)</td>
</tr>
<tr>
<td>&lt;3 BM/day</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>&lt;1 day of diarrhea</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>No diarrhea</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Clinical syndrome not suggestive of <em>C. difficile</em> infection</td>
<td>8</td>
<td>(11)</td>
</tr>
<tr>
<td>Negative <em>C. difficile</em> test in prior 7 days</td>
<td>1</td>
<td>(1)</td>
</tr>
<tr>
<td>Recent positive <em>C. difficile</em> test</td>
<td>1</td>
<td>(1)</td>
</tr>
</tbody>
</table>
Conclusions

• An ID specialist-led *C. difficile* testing approval process was feasible and associated with a >50% decrease in HO-CDI testing and infection rates, due to enforcement of appropriate testing

• ID specialists can provide a key role in enforcing appropriate *C. difficile* testing
Conclusions

• Diagnostic stewardship is an important component for patient treatment and patient safety
• Requires interdisciplinary collaboration
• Laboratory methods should continually be reassessed to ensure that patients benefit
• ID clinicians should help ensure that testing is appropriately ordered and interpreted
• Successful implementation of this strategy will decrease “false-positive” HAIs