Urine Culture Quality as a Patient Safety Priority: Evidence, Burden, and Innovation

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Objectives

01

Review the Hospital Onset Bacteremia and Fungemia quality metric, its clinical and economic disease burden, and the relevance of urine culture contamination

02

Describe the clinical, operational and economic burden of urine culture contamination

03

Review insights from an on-going real-world study of closed system urine collection kits and EHR algorithms for urine culture ordering and collection in the Emergency Department

Hospital Onset Bacteremia & Fungemia (HOB)[1,2]

According to the NHSN (National Healthcare Safety Network):*

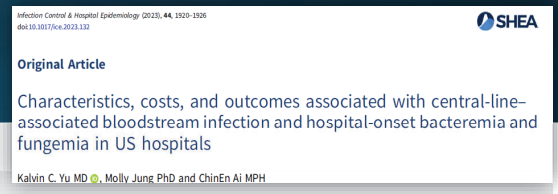
Hospital-onset bacteremia and fungemia (HOB) is a bloodstream infection where bacterial or fungal pathogens are detected from a blood culture specimen collected on day four or later of hospital admission.

- HOB is a subset of Hospital Acquired Infection
- HOB includes bloodstream infections from broader sources (i.e. irrespective of procedure or device)
- It covers a wider range of infections than the traditional targets of infection prevention and control
- To address existing patient safety risks, growing costs, and reporting challenges, the Centers for Disease Control and Prevention (CDC) is actively refining a new quality measure addressing HOB*

HOB as a Metric[3]

Measure	Numerator	Denominator
Primary Metric: HOB Event		
HOB Event	Pathogenic bacteria or fungi from blood culture on hospital day ≥4 *(excluding patients with prior matching cultures and HOB events)*	Total no. of inpatient admissions
Complementary Metrics: For Quality Improvement, NHSN Risk Adjustment		
Blood Culture Utilization	Testing Prevalence: Admissions with at least 1 blood culture Testing Intensity: Total blood cultures among patients with at least 1 blood culture	
Blood Culture Contamination	Skin commensal organism in 1 of 2 blood culture sets	Total no. of blood culture sets
Community-Onset Bacteremia & Fungemia Event	Pathogenic bacteria or fungi from blood culture prior to hospital day 4 *(excluding patients with prior matching cultures and COB events)*	Total no. of inpatient admissions
Matching Commensal HOB Event	Skin commensal from ≥2 blood cultures, AND ≥4 days of antibiotic treatment	Total no. of inpatient admissions
Non-Measure HOB Event	HOB events among patients with conditions that highly predict non-preventability	Total no. of inpatient admissions

HOB is broader than CLABSI and carries substantial clinical & economic burden[4]



Sample size

- 41 acute care hospitals
- 403 CLABSI, 1574 non-CLABSI HOB, 1745 control group
- Main sources of HOB (respiratory, urine, SSTI, other HAIs)

In-Hospital Mortality

- 31.3% CLABSI, 28.3% non-CLABSI HOB, 8.3% controls

Relative Mortality Risk

- 3.77 CLABSI, 3.2 non-CLABSI HOB

LOS (days) – HOB vs control

- 12.1–17.4 days added LOS depending on ICU status

30-day Readmission Rates

- 1.41 CLABSI, 1.28 non-CLABSI HOB

Hospital Costs ($) – HOB vs Control

- $25,207–$55,001 added incremental cost per HOB event

Top 3 Identifiable Sources of Non-CLABSI HOB

- Urine (12.7%)
- Respiratory (10.4%)
- Skin & Soft Tissue (5.9%)

HOB incidence > 4x CLABSI at the facility level | ~2-8% of blood culture results indicated commensals

HO-UTI is broader than CAUTI and carries substantial clinical & economic burden[5]

Retrospective observational study,
43 acute-care hospitals

CAUTI per NHSN definition,

non-CAUTI HOUTI defined as a positive, noncontaminated, non-commensal culture collected on day 3 or later with a new antimicrobial prescribed within 2 days of the first positive urine culture

8% of CAUTIs evolve into an HOB event

For every 1 CAUTI that turns into HOB, 3 non-CAUTI HOUTIs do the same

	CAUTI (n=434)	Non-CAUTI HOUTI (n=3177)
Incremental Total Cost ($)	9,807	6,874
Incremental LOS Day (Days)	3.01	2.97
Readmission Relative Risk	0.82	1.17
Mortality Relative Risk	3.78	1.03

Downstream Impact of “Indeterminant” Urine Cultures[6]

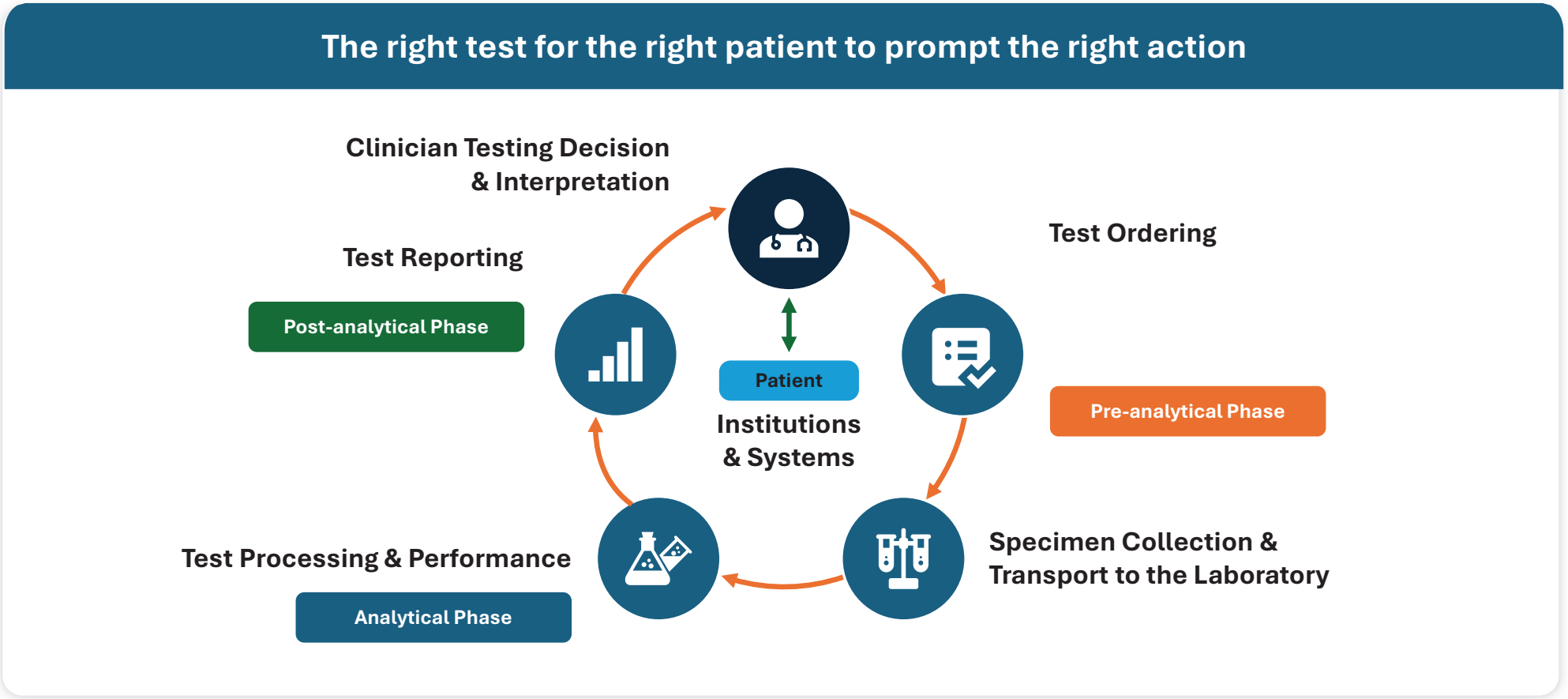
Patkar, A., Ai, C., Jung, M., Bastow, S., Thubian, N., & Yu, K. (2025). A real-world retrospective multi-hospital database evaluation of the clinical care gaps associated with urine contamination/false positive cultures and associated outcomes in the United States. ADLM 2025 Annual Scientific Meeting, Chicago, IL.

- Retrospective analysis across **159 U.S. hospitals** (1,252,986 urine cultures from 1,089,069 inpatient admissions
- **> 20% rate of indeterminant results**, varied by care setting
- **Antimicrobial use in two-thirds** of patients with indeterminant results
- **Operational impact**: Repeat urine culture testing, Excess resource utilization
- **Clinical impact**: Delayed time to diagnosis, Prolonged time to effective therapy, Increased risk of *C. diff*

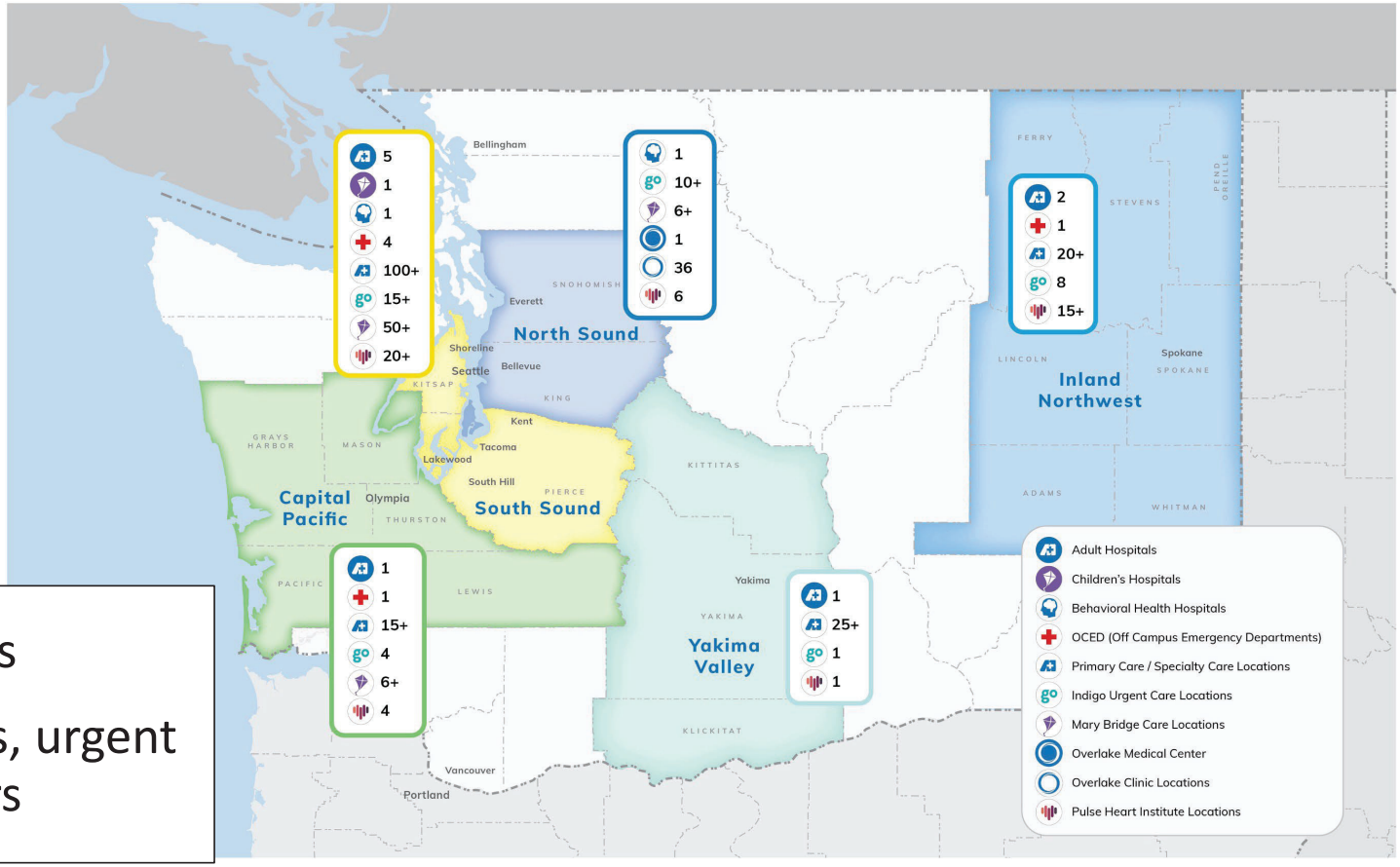
Treating ASB is common and may lead to downstream consequences[7-10]

Clinical Impact	Antimicrobial Impact	Economic Impact
50% treated without symptoms	44.3% inappropriate prescribing from contaminated specimens	Patients with suboptimal (12%) and inappropriate (30%) antibiotic treatments had higher healthcare costs compared to patients with appropriate treatment
Misdiagnosis of UTI	Increased antimicrobial exposure	Avoidable resource utilization
Unnecessary admissions	Increased risk of CDI and resistance	Increased total cost of care

Diagnostic Stewardship



MultiCare Health System



- 13 hospitals
- >300 clinics, urgent care centers

Quality improvement umbrella at MHS

Pre-Analytical excellence is the foundation of urine culture stewardship[11]

Preanalytical quality drives culture accuracy

Urine collected for culture should not be kept at room temperature for more than 30 minutes. Hold at refrigerator temperatures or utilize a preservative tube if not processed by the laboratory within 30 minutes.

Reflex testing can improve utilization

Reflexing to culture based on a positive pyuria screen may be considered. If a reflexive algorithm is implemented, it should be a locally approved policy guided by clinicians and laboratorians.

Contamination remains a persistent challenge

Three or more species of bacteria in a urine specimen usually indicates contamination at the time of collection, and interpretation remains challenging.

Appropriate culture ordering improves stewardship

In the absence of signs and symptoms consistent with urinary tract infection, a urine culture is typically not recommended.

Quality improvement umbrella at MHS

Need for Multi-disciplinary Implementation Approach

- Infection prevention concerns
- Stakeholder engagement and guidance
- Workflow optimization through preservation technology
- Diagnostic stewardship process improvement

Improving urine culture stewardship requires both high-quality specimens and evidence-based testing decisions
— implemented through coordinated, multidisciplinary change

Multimodal Urine Collection and Diagnostic Stewardship Interventions Across Hospitals: The MHS Experience

Study Overview

Study Design

- Retrospective, observational chart-data review
- Pre-post multi-modal interventional implementation study

Sample Characteristics

- Adults aged 18+ across 7 acute-care MHS hospitals
- Emergency Department (ED) focus

Intervention Focus

- Improve urine-collection practice
- Part of a Quality Improvement initiative

Implementation Journey

Challenge

Pre-implementation · 2024

- ~42% estimated urine culture contamination rate
- ~160,000 urine cultures collected in 2024 (high volume)

Multi-modal Interventions

Implementation · 2025

- Closed-system collection with preservative tubes, replacing open specimen cups
- EHR-enabled urinalysis with reflex-to-culture ordering
- Training and standardized workflow

Outcomes

Pre/post · 2024–2026

- Lower culture contamination rate
- Improved specimen quality
- Fewer unnecessary urine cultures
- Better diagnostic stewardship

Complete Data on file – preparing for journal peer-review submission.

Determination of urine culture contamination

A urine culture was classified as contaminated if it met any of the following criteria:

Laboratory note indicating likely contamination

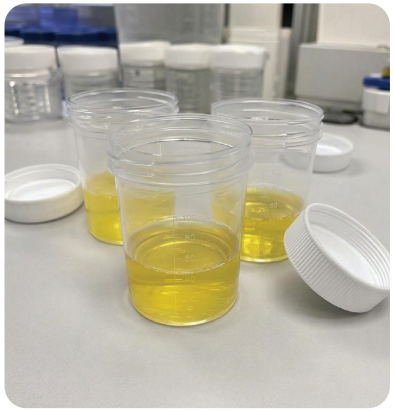
Presence of three or more organisms (per CLSI guidance)

Isolated organism(s) identified as common commensal
(*Lactobacillus spp.*)

Intervention 1

Transition from Open Urine Specimen Cups to Closed Collection System using Preservative Tubes

Transition to Closed Collection System



vs

Open Collection Cups

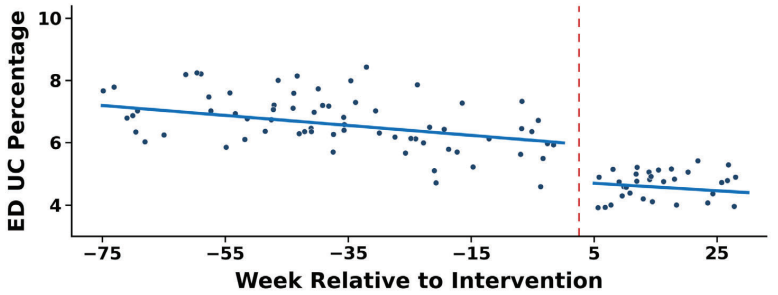
Exposed to air – higher contamination risk

Closed Collection System

Sealed transfer

Closed collection system evidence[12]

Parameters	February 2012	December 2012
Conclusive UCBEs	104 (69.3%)	126 (84%)
Sterile (%)	31.3	30
Isolated leukocyturia (%)	13.3	20.7
Infections (%)	24.7	33.3
Inconclusive UCBEs	46 (30.7%)	24 (16%)
Contaminations (%)	24.7	13.3
Isolated bacteriuria (%)	4	2.7
"To be checked" (%)	2	0



Intervention 2

Implementation of an EHR-enabled urinalysis with reflex to urine culture ordering workflow

Pre-Implementation

Urine Culture Ordering

No algorithm – ordered at the provider's discretion

Historical Reflex to Culture Criteria from Urinalysis

Positive leukocyte esterase (LE),positive nitrite, WBC >3/hpf, or bacteria present

WBCs are a more reliable urinalysis predictor of uropathogens[13,14]

- WBC is a better predictor for uropathogens than the presence of bacteria and squamous epithelial cells.
- Using a cutoff of >=10 WBC/hpf optimizes sensitivity and specificity for diagnosing UTI.
- Nitrite and LE suffer from poor sensitivity and specificity, depending on the patient populations. e.g. sensitivity low as 20%, while specificity of 40% in patients with high ASB prevalence.

Chart review on urine cultures and UA results at MHS

576 urine samples from EDs at MHS over 5 days in September 2022

Excluded high-risk patients: immunocompromised, age < 3, pregnant, or had genitourinary procedures

530 urine samples with microscopic UA results available

Chart review performed for culture results, appropriateness of cultures, antibiotic use related to UA cutoffs

Right-sizing urine culture testing: evidence and proposed changes

What the chart review showed at MultiCare

- Across all WBC ranges, most positive UAs were clinical false positives—yet many patients were still treated with antibiotics.
- 0–2 and 3–10 WBC groups showed no meaningful difference in culture results; low pyuria does not justify reflex culture.
- >10 WBC is a better threshold, but a positive culture still does not confirm infection—much is asymptomatic bacteriuria.
- Positive LE, nitrites, and bacteria without pyuria do not correlate with UTI.

Key Insight

Reflexing to culture only when pyuria is >10 WBC/hpf with symptoms — or for high-risk patients — would cut unnecessary cultures and antibiotic use.

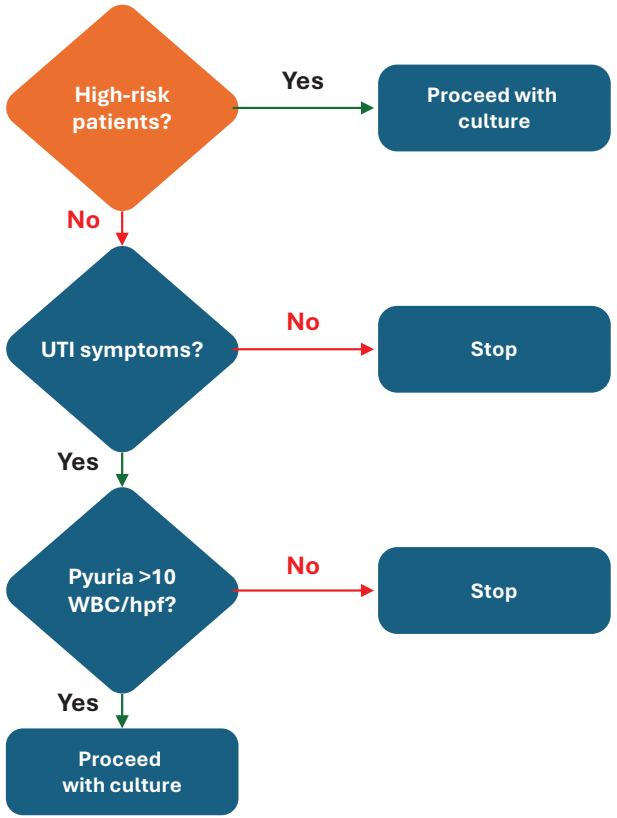
New reflex to culture workflow at MultiCare

High-risk patients:

- Genitourinary surgery within 72 hours
- Absolute neutrophil count < 500 cells/µl
- Pediatric patients (< 3 years)
- Pregnant patients
- Renal transplant or complex urologic patients

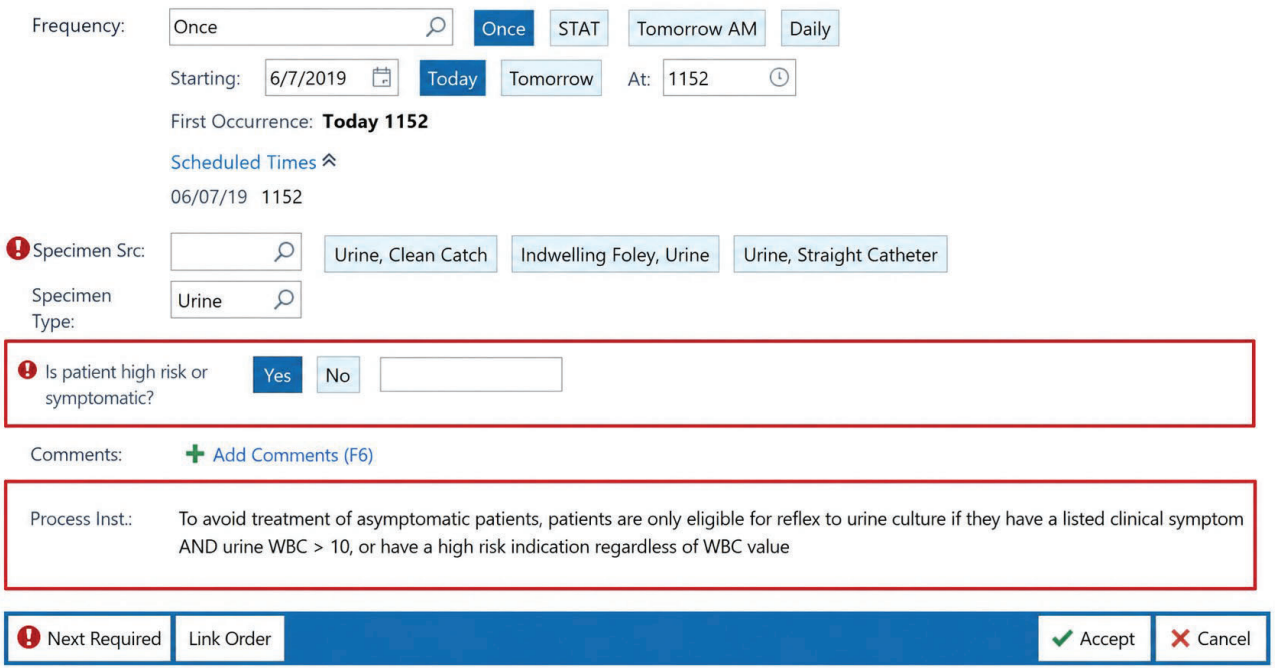
UTI Symptoms:

- Dysuria/frequency
- Flank Pain
- Suspected Sepsis (no other cause)
- Suprapubic pain
- Temp >100.4 °F with no other cause, or hypothermia
- Acute hematuria
- New/worsening incontinence



Reflex-to-Culture Ordering: Provider Workflow and Interpretation

UA with reflex to culture order

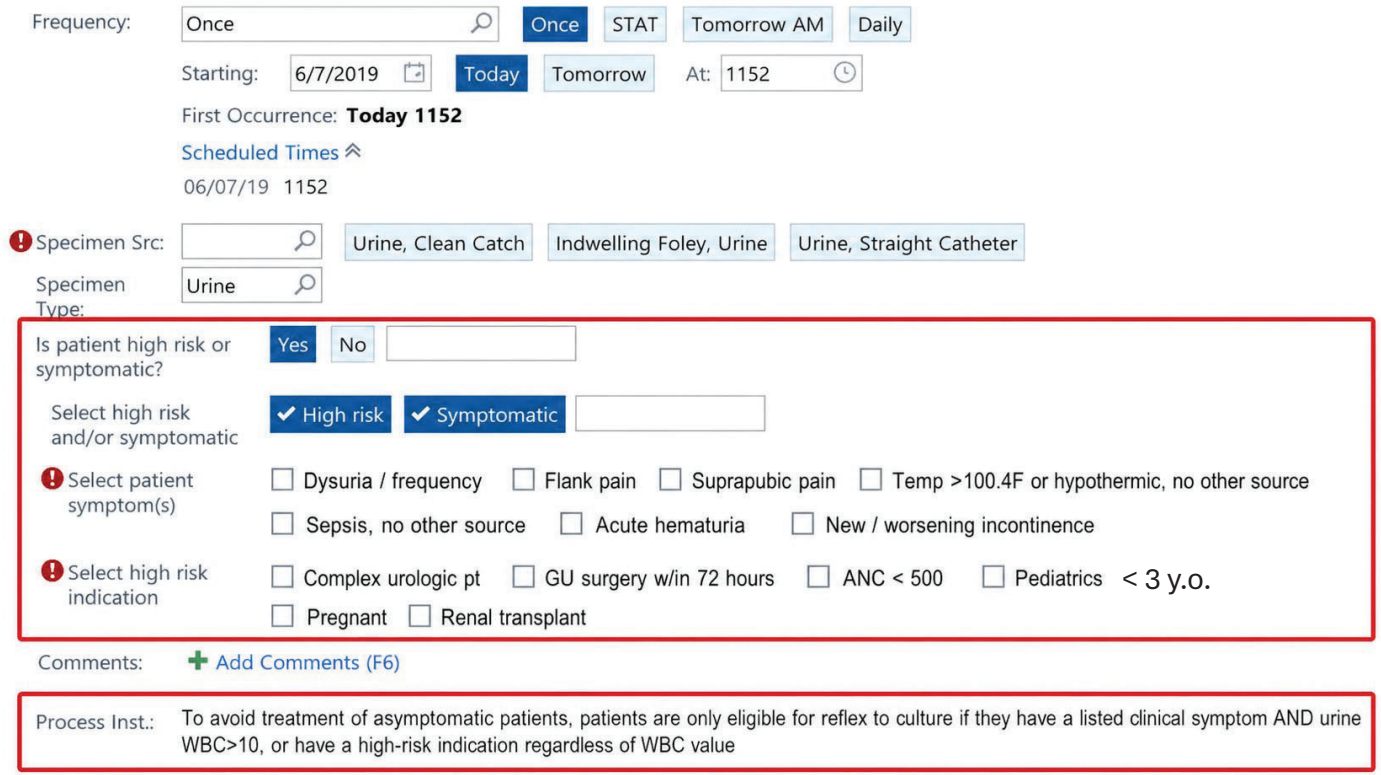


Reflex-to-Culture Ordering: Provider Workflow and Interpretation

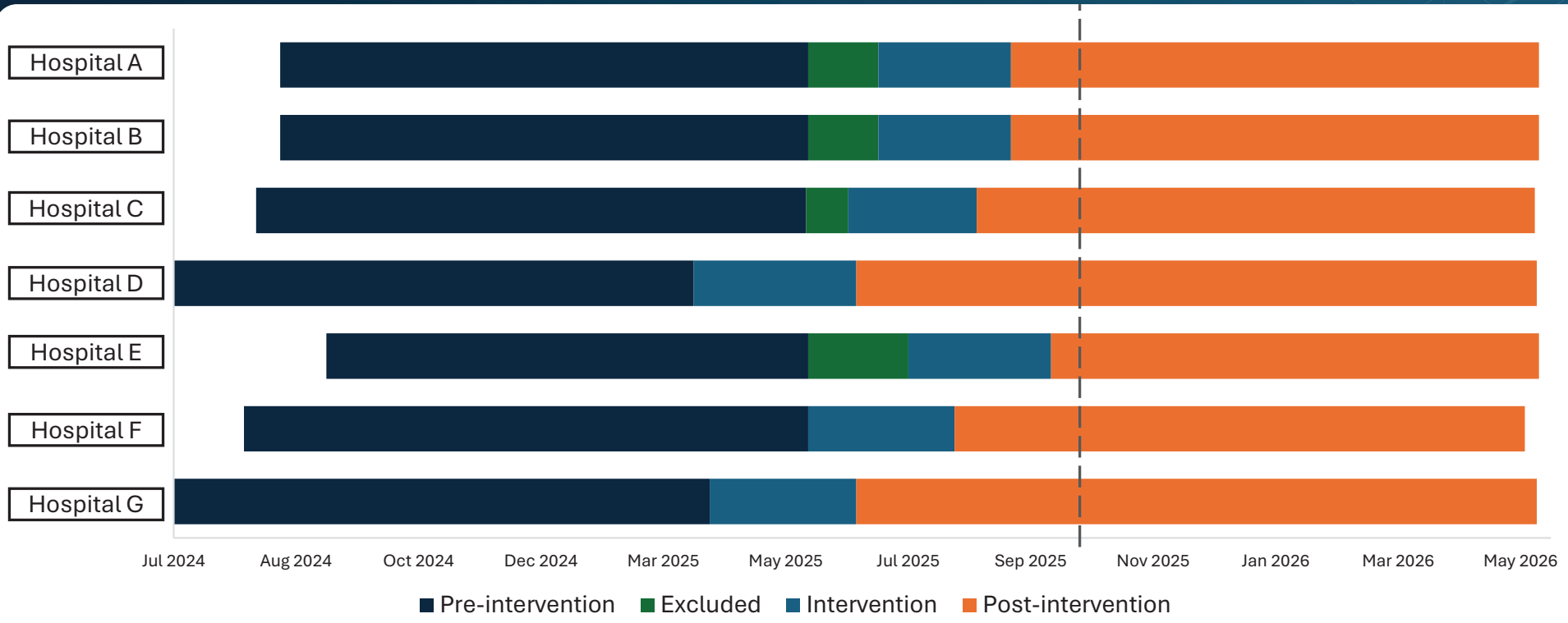
If **“Yes”**, ordering provider must select what applies.

If **“No”**, UA will be sent, *but specimen will not be cultured.*

If the patient is neither high risk nor symptomatic, a culture will not reflex despite the results.



Site-Specific Timelines of Urine Kit Intervention, Exclusion Period, and EHR Implementation



Complete Data on file – preparing for journal peer-review submission.

Results

Early data insights

Complete Data on file – preparing for journal peer-review submission.

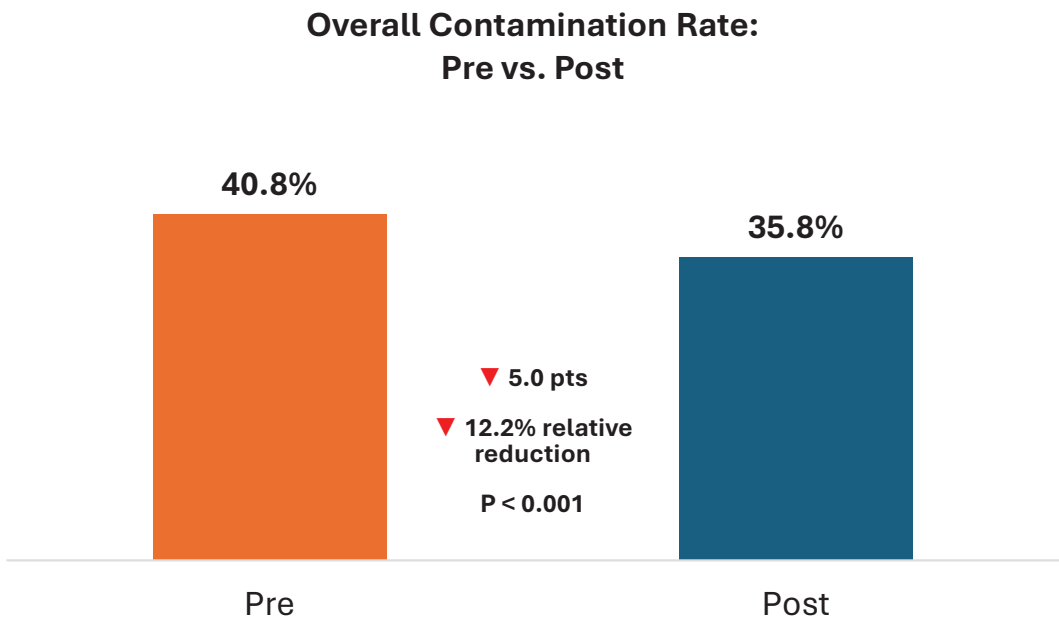
Urine Culture Contamination Impact

Early data insights

Decreasing urine culture contamination rates in ER

Pre vs. Post Interventions
(urine kit + EHR intervention)

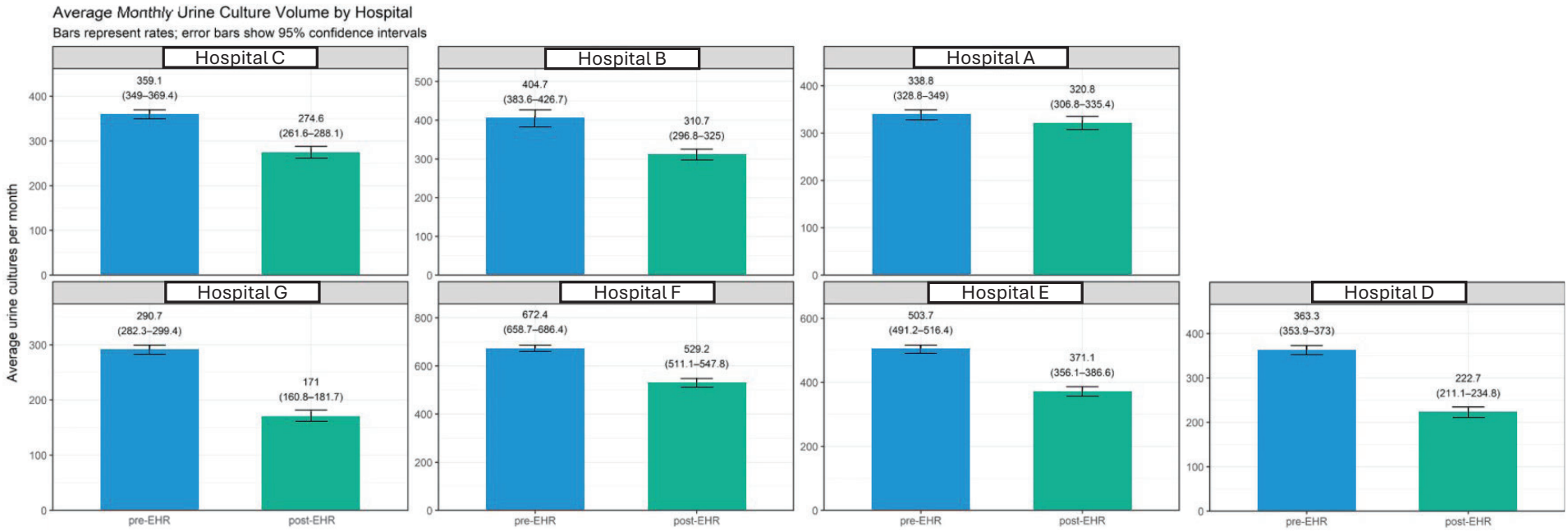
Date of comparison: same month utilized for Pre and Post urine kit intervention period



6 out of 7 hospitals showed significance

Complete Data on file – preparing for journal peer-review submission.

Results: Average Monthly Urine Culture Volume by Hospital: Pre- vs. Post-EHR-Enabled Reflex



Improvements in urine culture quality in ER

Evaluation period: Pre and Post EHR implementation (includes Urine closed collection preservative kits intervention)

Improved specimen quality

Reduction in contamination rates

More actionable results

Increase in negative results

Maintained clinical detection

Similar rate of positive results

Improved collection and ordering practices enhanced urine culture quality while maintaining the ability to identify clinically significant infections

Downstream impact of contaminated urine cultures

Contaminated urine cultures were frequently associated with antimicrobial exposure, with ~40% of patients receiving antibiotics despite no evidence of an alternative infection source

Risk of C. *difficile* at least 3 times higher when exposed to antimicrobials, regardless of urine culture result

Summarizing the Journey: Study findings

QI Journey:

Standardize Collection → Improve Specimen Quality → Reduce Low-value Testing → Sustain Through Feedback

Findings: Pre-Post Observational Study and Reassessment

Workflow changes reduced variation and improved specimen quality

- Closed collection / preserved workflow supports consistent handling and transport
- EMR/EHR ordering and reflex-to-culture criteria support appropriate utilization

Contamination remains a measurable QI opportunity

- High proportion of urine cultures categorized as contaminated
- Need for repeat urine cultures after contamination
- Unnecessary antibiotic use in urine contamination
- Near equal *C. difficile* risk in true UTI with antibiotics and contamination

Reassessment identified adoption gaps and practice variability

- Residual urine cups reached the lab, including ED specimens without orders/times
- Stocking, labeling, disposal, and workflow convenience affected standardization
- Observed collection from Foley bag instead of sampling port; kit awareness varied

Lessons Learned

Diagnostic stewardship starts before the result

Appropriate ordering and high-quality collection are both required to improve culture value

Multidisciplinary implementation is essential

Lab, Nursing, IP, ASP Pharmacy, Quality, Informatics, and educators must align on decisions and workflows

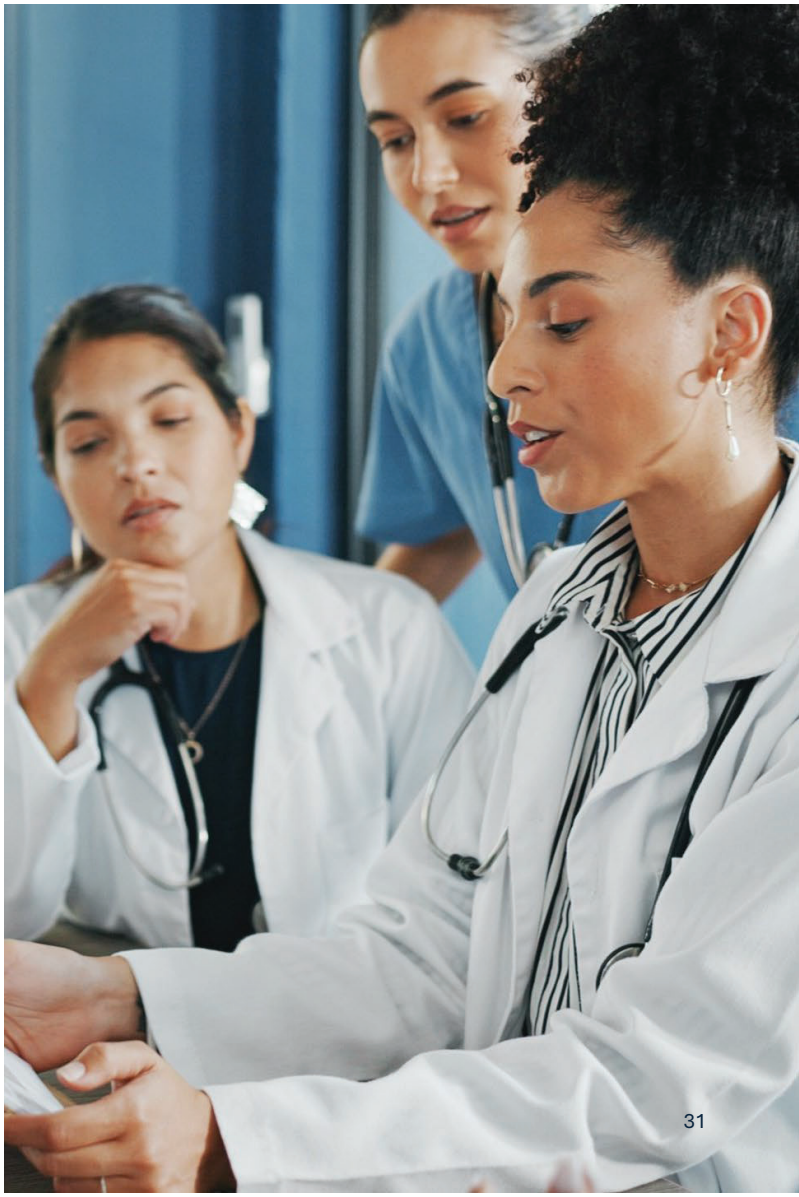
Adoption must be measured, not assumed

Compare baseline → confirm adoption → identify variation → prioritize targeted action

Feedback loops turn implementation into sustained behavior change

Share metrics, audit practice, educate at the point of variation, and celebrate wins

Stock correct kits in high-use locations; remove ambiguity in labels, disposal, and collection steps



Quality In, Clarity Out

The right specimen, collected the right way, enables the right clinical decision.

Improved specimen quality

Increase clinical relevance of cultures

Better stewardship

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Questions?

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