

Diagnostic Stewardship to improve Antimicrobial Stewardship

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Objectives

- Define diagnostic stewardship
- Identify DS opportunities at each step in the diagnostic process
- Discuss recent studies of the impact of DS on antimicrobial use at various steps

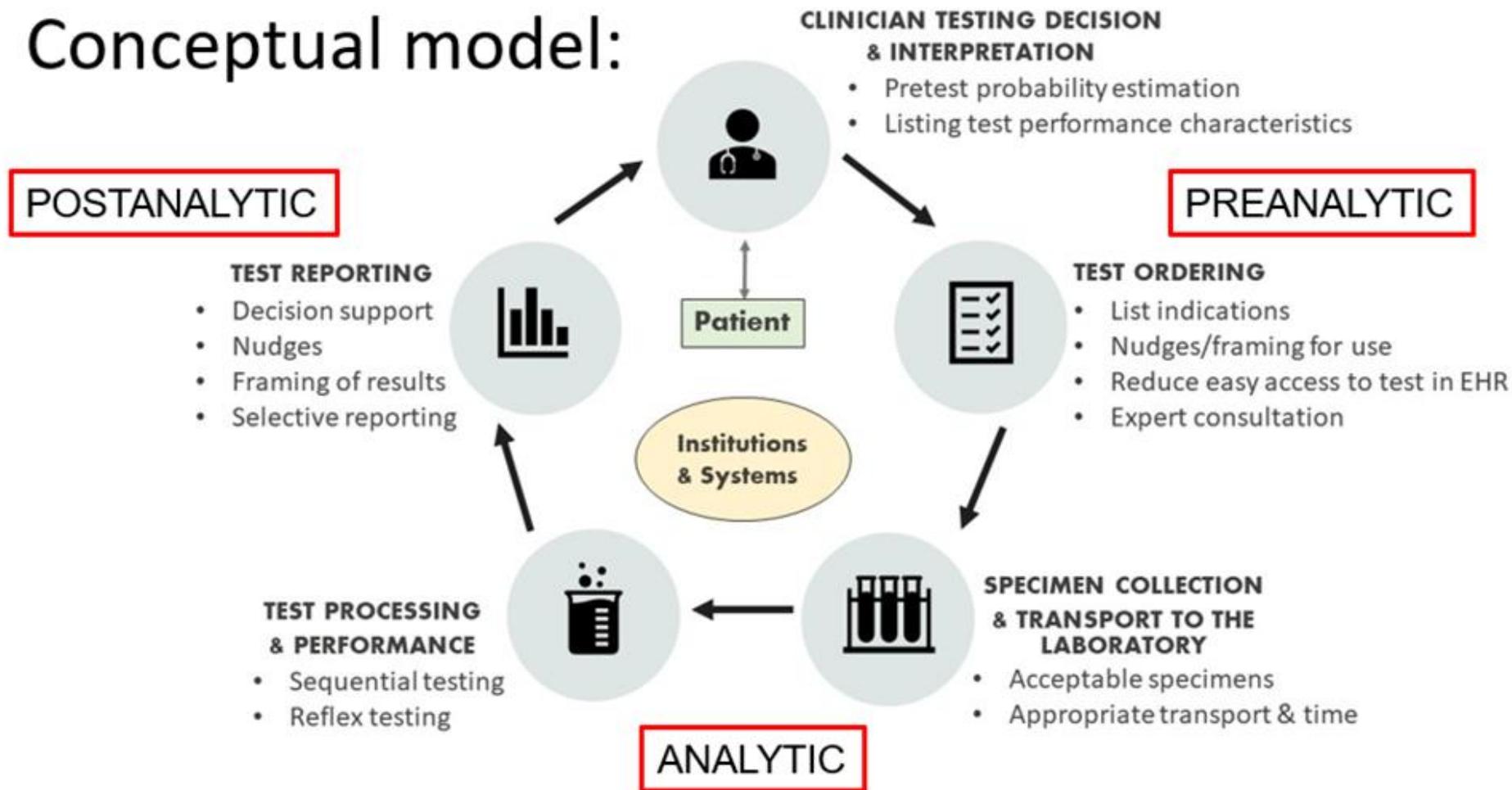
What is Diagnostic Stewardship?

“modifying the process of ordering, performing, and reporting diagnostic tests to **improve the treatment** of infections and other conditions”

Morgan, Malani and Diekema. JAMA 2017

RIGHT TEST, RIGHT PATIENT  RIGHT ACTION

Conceptual model:



Pre-analytic: Test ordering

- Education & computer decision support
 - *C. difficile* is a key target for these approaches
 - Guideline-based approaches to culturing
 - Eliminate drivers of unnecessary testing (order sets)
- Goal: ***Focus testing on population with higher pre-test likelihood of disease in question***

Rock C, et al. Am J Infect Cont 2018;46:456.

Winkler, et al. Antimicrob Steward Health Epidem 2023;3:e95.

Clinical Decision Support Systems to Reduce Unnecessary *Clostridioides difficile* Testing Across Multiple Hospitals

Clare Rock,¹ Oluchi Abosi,² Susan Bleasdale,³ Erin Colligan,⁴ Daniel J. Diekema,⁵ Prashila Dullabh,⁴ Ayse P. Gurses,¹ Krysta Heaney-Huls,⁴ Jesse T. Jacob,⁶ Sheetal Kandiah,⁶ Sonam Lama,⁴ Surbhi Leekha,⁷ Jeanmarie Mayer,⁸ Alfredo J. Mena Lora,³ Daniel J. Morgan,⁷ Patience Osei,¹ Sara Pau,¹ Jorge L. Salinas,⁵ Emily Spivak,⁸ Eric Wenzler,⁹ and Sara E. Cosgrove¹; for the Centers for Disease Control and Prevention Prevention Epicenters Program

- Intervention: 15 hospital study of CDS to improve *C. difficile* testing, focus on duplicate testing and laxative use
 - Multidisciplinary team (HE, AS, informatics, human factors)
 - Pragmatic, tailored to each participating site
 - Qualitative assessment of user experience
- Outcomes: *C difficile* testing rates, HO-CDI rates (NHSN), and oral vancomycin or fidaxomicin use

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- Results:
 - 25% reduction in *C. difficile* testing
 - 15-27% reduction in po vancomycin/ fidaxomicin use
 - 31-58% reduction in NHSN HO-CDI LabID-events
 - “Hard stop” (e.g. requiring call to micro lab) more effective than soft stop or ASP team intervention

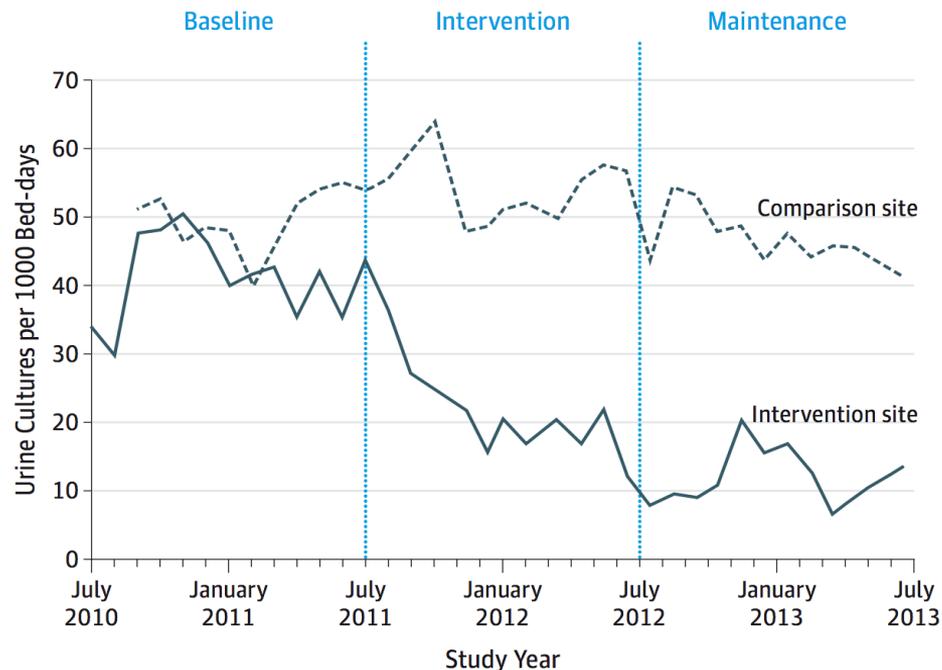
Guideline-based educational intervention to improve urine culture ordering

- Pre-post study with control arm (2 VA systems)
- Based upon IDSA guidelines
- Audit and feedback
- Case based presentations

Results:

- Reduced urine cultures →
- Decrease in overtreatment of asymptomatic bacteriuria
 - 1.6 to 0.6/ 1000 bed days

Figure. Monthly Rates of Urine Culture Orders per 1000 Bed-days



“Deconstructing the urinalysis”

- Create different pathways for infectious vs noninfectious
- Require indications for UA that would reflex to culture
- Leverage NPV of pyuria

Results:

- Reduced urine cultures
- Decrease in abx treatment of asymptomatic bacteriuria

▼ URINALYSIS/CULTURE ORDER SET Manage My Version ▼

SUSPECTED UTI (URINARY TRACT INFECTION)

▼ SUSPECTED UTI (URINARY TRACT INFECTION)

Urinalysis w/Microscopic + Reflex to Culture

NON INFECTIOUS INDICATIONS

▼ NON INFECTIOUS INDICATIONS

Urinalysis with Microscopic If Indicated

Urinalysis w/Microscopic

Urinalysis without Microscopic

SCREENING PURPOSES OR NEUTROPENIC PATIENTS WITH URINARY SYMPTOMS

▼ SCREENING PURPOSES OR NEUTROPENIC PATIENTS WITH URINARY SYMPTOMS

Urine culture

Urinalysis with Microscopic If Indicated

Urinalysis w/Microscopic

Urinalysis without Microscopic

Association of Diagnostic Stewardship for Blood Cultures in Critically Ill Children With Culture Rates, Antibiotic Use, and Patient Outcomes

Results of the Bright STAR Collaborative

Charlotte Z. Woods-Hill, MD, MSHP; Elizabeth A. Colantuoni, PhD; Danielle W. Koontz, MA, MS; Annie Voskertchian, MPH; Anping Xie, PhD; Cary Thurm, PhD; Marlene R. Miller, MD, MSc; James C. Fackler, MD; Aaron M. Milstone, MD, MHS; and the Bright STAR Authorship Group

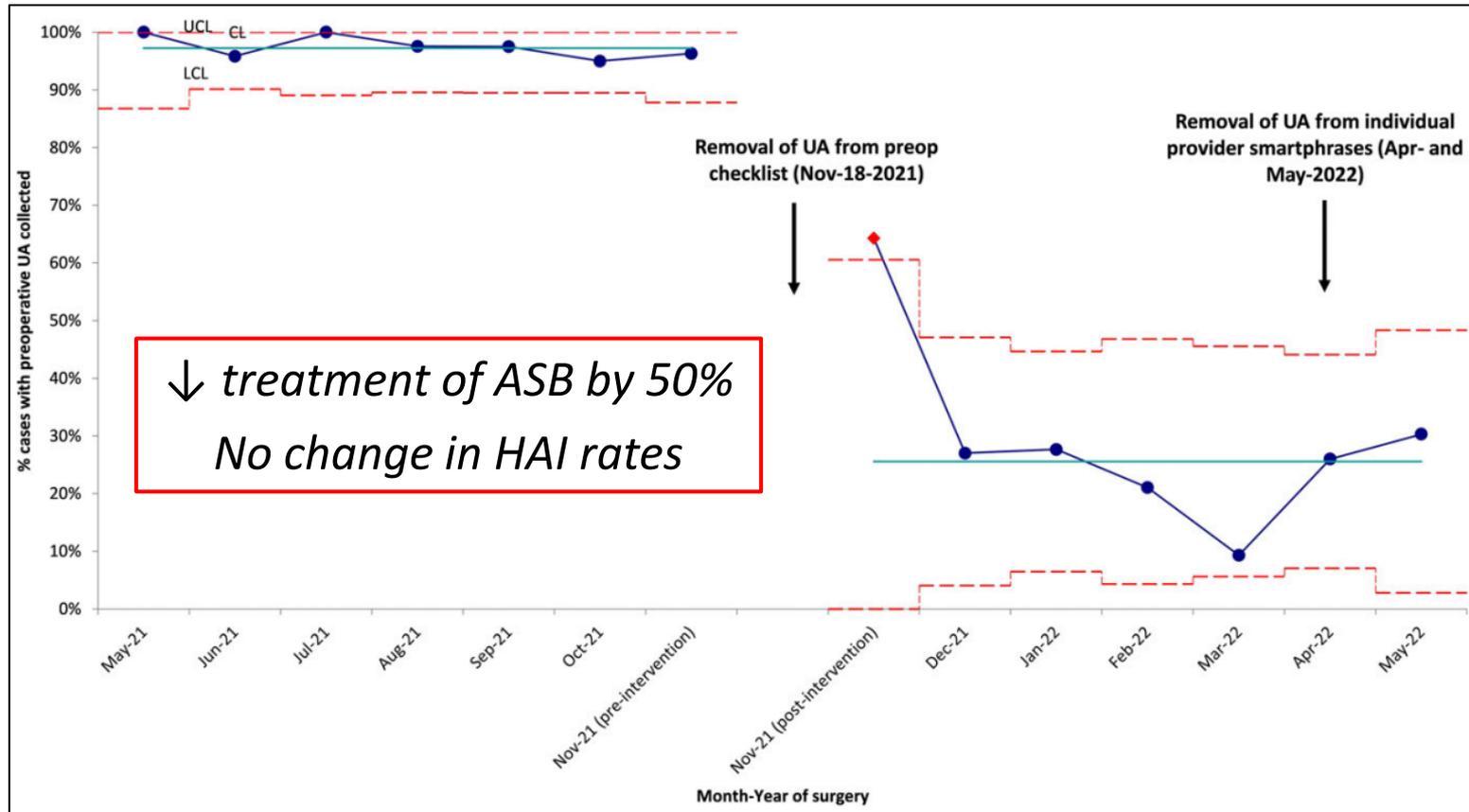
- Intervention: 14 PICU collaborative to optimize blood culture practices via diagnostic stewardship
 - Standardize practices (decision, source, frequency, pt safety)
- Outcomes: blood culture rates, antibiotic use, PICU rates of CLABSI, *C difficile*, mortality, LOS, sepsis

Table 2. Primary and Secondary Outcomes Before and After Implementation of the Bright STAR Collaborative in 14 PICUs

Outcome	Mean monthly rate (95% CI) ^a		Postimplementation vs preimplementation		P value ^a
	Preimplementation	Postimplementation	Relative rate (95% CI) ^a	Absolute rate difference (95% CI) ^a	
Primary outcome					
Blood cultures					<.001
Secondary out					
Central line-associated infection ^c					<.001
<i>Clostridioides</i>					.80
Broad-spectrum					<.001
New initiation antibiotics ^{f,e}					<.001
Secondary out					
Mortality ^{g,h}					.25
PICU length of					.07
PICU readmission ^{g,h}	3.09 (2.31 to 4.13)	3.33 (2.50 to 4.44)	1.08 (0.99 to 1.17)	0.25 (-0.02 to 0.52)	.07
Hospital readmission ^{g,h}	2.12 (1.68 to 2.67)	2.06 (1.61 to 2.64)	0.97 (0.89 to 1.07)	-0.06 (-0.25 to 0.14)	.56
Sepsis ^{g,h}	6.64 (5.57 to 7.91)	7.07 (5.48 to 9.12)	1.06 (0.89 to 1.28)	0.43 (-0.87 to 1.73)	.50
Severe sepsis/septic shock ^{g,h}	4.79 (3.96 to 5.79)	4.99 (4.08 to 6.11)	1.04 (0.86 to 1.27)	0.20 (-0.75 to 1.16)	.67

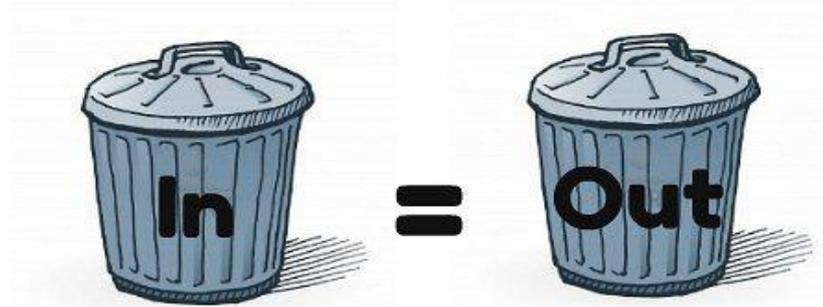
Blood cx rates ↓ 33%
CLABSI rates ↓ 36%
Broad spectrum antibiotic use ↓ 8-13%
No change in balancing measures

Stewardship of CABG order sets at MGH:



Pre-analytic: Collection and Transport

- Blood culture practices
 - Reduce contaminants
 - Increase pathogen yield
- ↓ swab, wound & drain samples
- Track sample handling/transport
 - Delays, lack of refrigeration



Madden, et al. Infect Cont Hosp Epidem 2018;39:214.
Doern, et al. Clin Micro Rev 2019; Nov 13 [Epub]

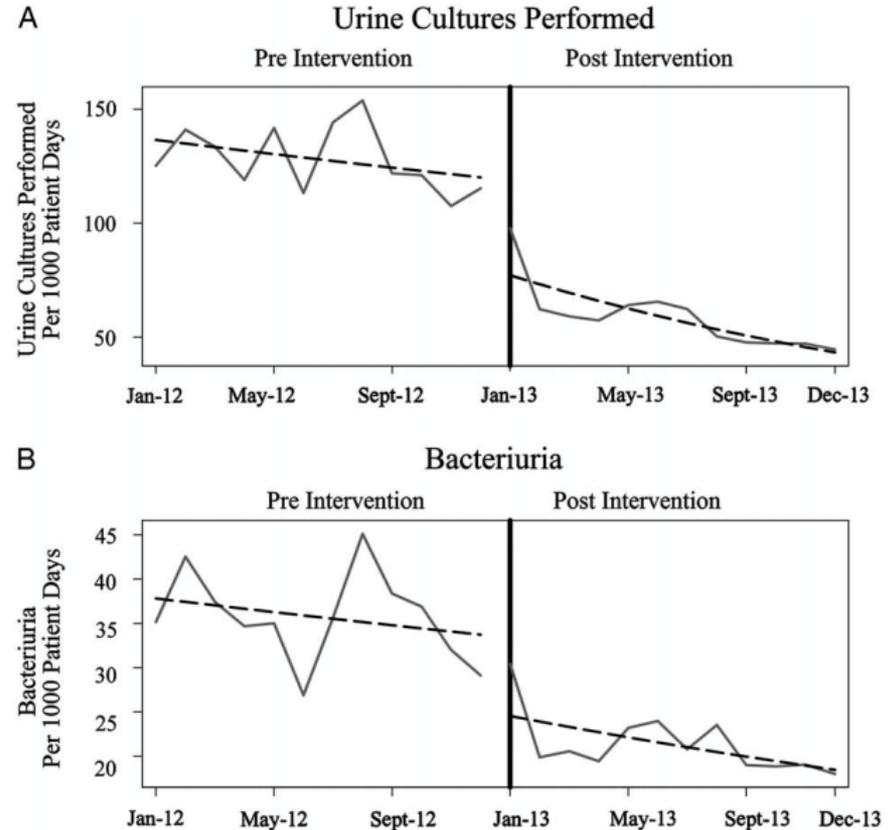
Analytic: sample is now in the lab....

Specimen screening/rejection approaches

- Sputum culture screening criteria
 - Evaluate # squamous epithelials vs. neutrophils
 - Reduces workup of oropharyngeal colonizers
- Urine culture screening criteria
 - “Reflex” protocols: test only when pyuria present
- *C. difficile* testing only on loose stool

Impact of “reflex urine culture”

- Quasi-experimental study of reflex protocol in ICU pts
- Culture only if >10 WBC/hpf
- Results:
 - Fewer cultures
 - Lower bacteriuria rates
 - Fewer antibiotic starts for index urine culture
 - 23% vs. 41%, $p=0.002$



Analytic: Test selection

- Rapid testing to improve outcomes
 - Early detection, identification +/- susceptibility
- Modify testing algorithms to improve specificity
 - Adding *C difficile* toxin EIA to toxin gene detection
- Host response diagnostics: PCT, CRP & beyond

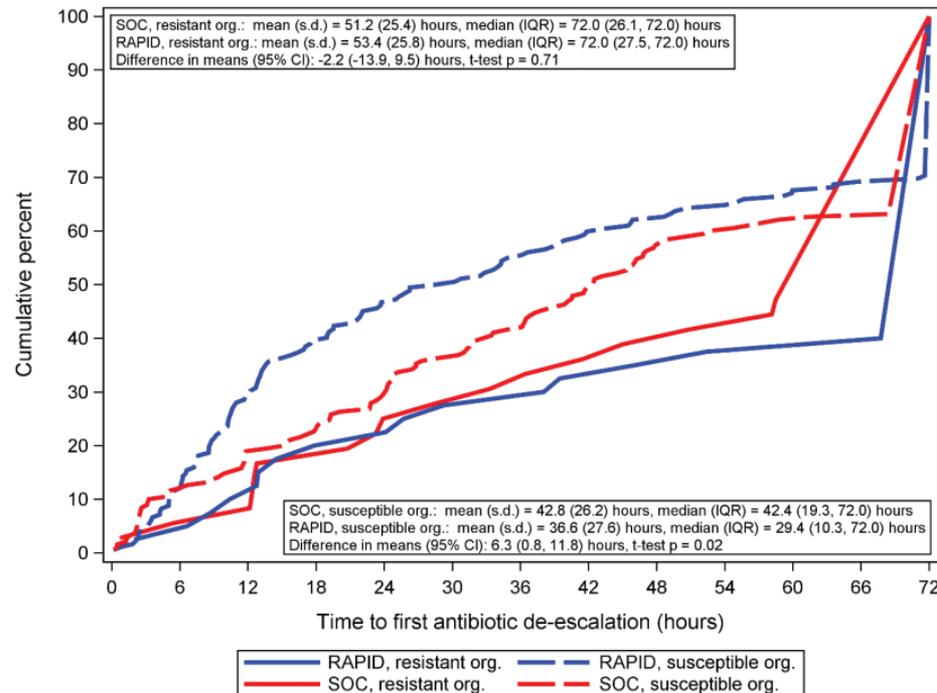
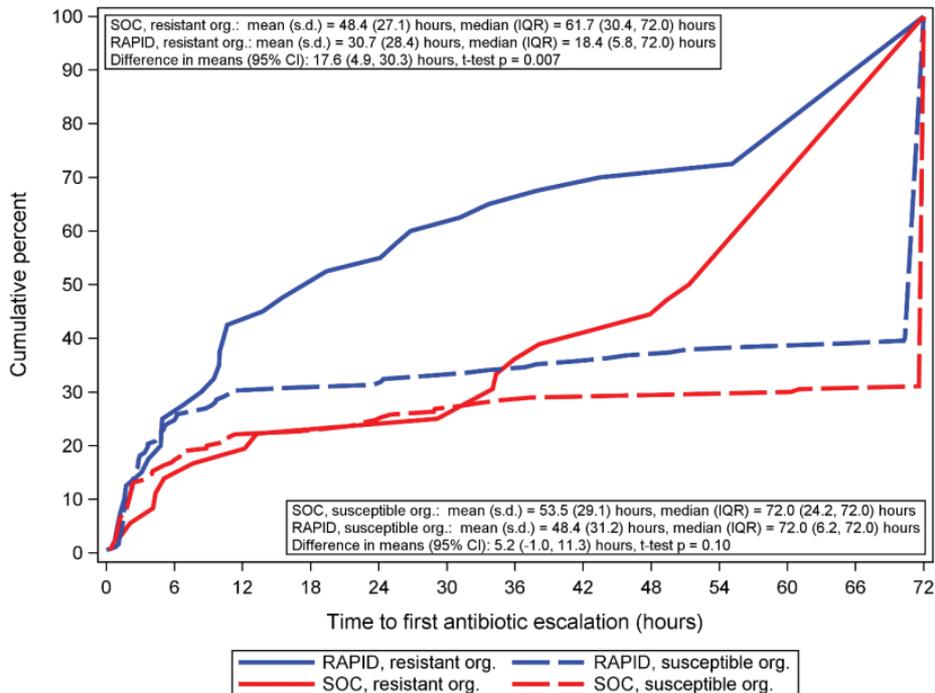
Timbrook, et al. Clin Infect Dis 2017;64:15-23.

Madden, et al. Infect Cont Hosp Epidem 2018;39:214.

Lydon, et al. Exp Rev Molec Diagn 2018;18:723.

RAPIDS-GN Randomized controlled trial

Faster escalation & de-escalation with rapid ID/AST

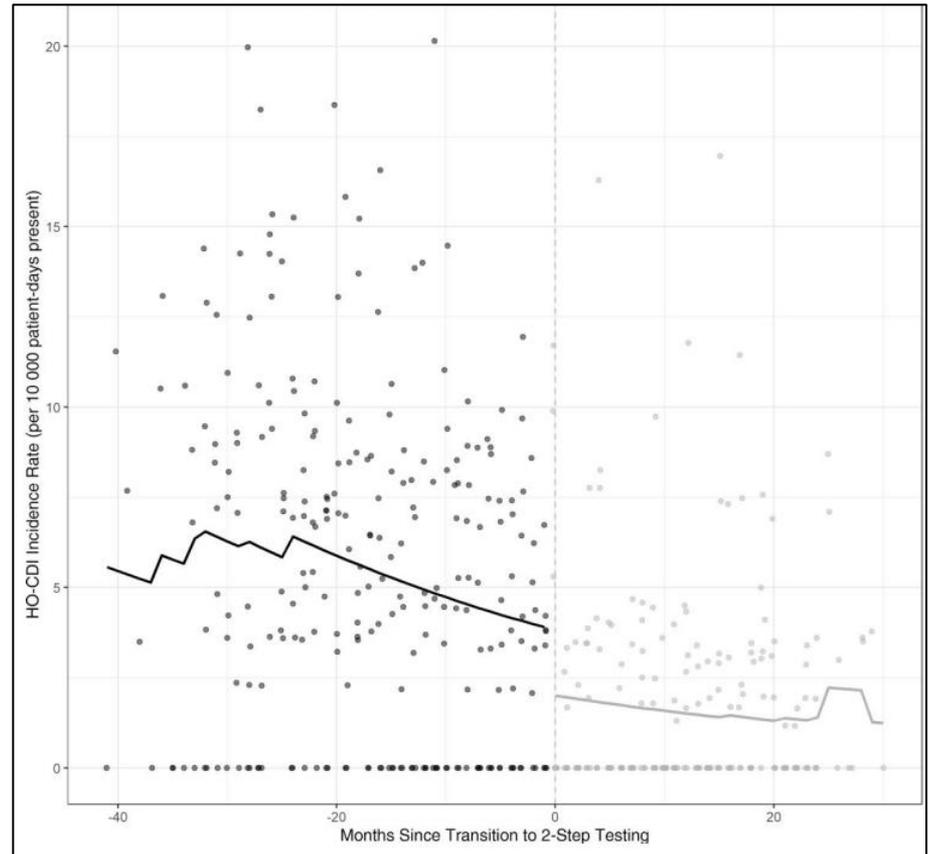


Impact of adopting reflex toxin EIA testing on vancomycin/fidaxomicin use & colectomy rates

8 hospitals in NC and VA

- NAAT → EIA two step testing
- HO-CDI SIR ↓ by 47%
- Vanc/Fidaxo use ↓ by 37%
- No change in colectomy rate

Turner, et al. Clin Infect Dis 2023.
[doi: 10.1093/cid/ciad334](https://doi.org/10.1093/cid/ciad334)



Post-analytic: Interpretation and reporting

- Selective reporting or cascading of results
 - Guide clinician to optimal or preferred therapy
- Clear explanations to reduce inappropriate tx
 - “Likely contaminant”
 - *C difficile* PCR + but toxin negative, possible colonization
- Link to active antibiotic stewardship program
 - Blood culture RDT result paged directly to ASP team

Original Article

Nudging In MicroBiology Laboratory Evaluation (NIMBLE): A scoping review

Bradley J. Langford PharmD, BCPS^{1,2}, Elizabeth Leung PharmD, MScI, BCPS AQ-ID^{1,3}, Reem Haj PharmD^{1,3}, Mark McIntyre PharmD⁴, Linda R. Taggart MD, MPH^{1,3}, Kevin A. Brown PhD^{2,3}, Mark Downing MD¹ and Larissa M. Matukas MD^{1,3}

¹Unity Health Toronto, Toronto, Ontario, Canada, ²Public Health Ontario, Toronto, Ontario, Canada, ³University of Toronto, Toronto, Ontario, Canada and ⁴Sinai Health System, Toronto, Ontario, Canada

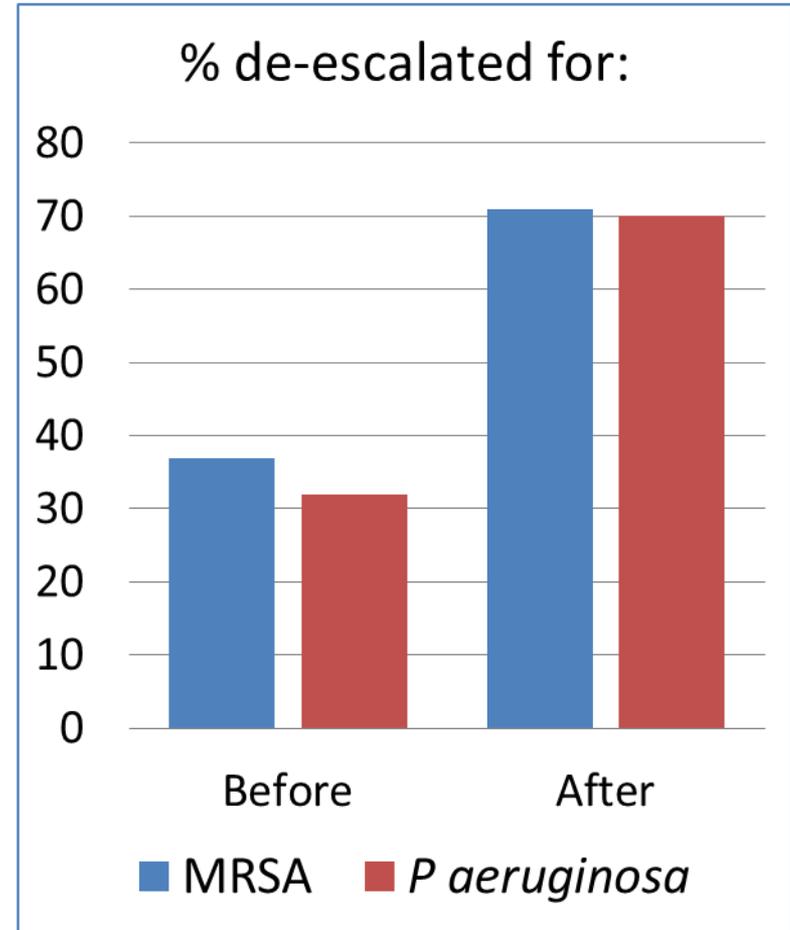
- 15 studies, most were pre-post design (1 RCT)
- 12 report change in at least one antibiotic use outcome
- Selective or cascade reporting most common
- Other interesting approaches: concealment or “framing”
- Major gaps, opportunities for further research

One recent example of a lab “nudge”

- Simple before-after study in 4 hospitals
- Added “No *S. aureus*/MRSA or *P. aeruginosa*” comment to “Commensal respiratory flora”
- ASP created handout and in-person education to ICU prescribers and pharmacists
- Encouraged de-escalation approach

Results

- 150 pts each pre & post
 - Adults on empiric RTI tx
 - Mixed oral flora on culture
- Duration anti-MRSA/PSA treatment ↓ from 7 to 5 d
- 50% ↓ in AKI, SOI adjusted
- ↑ in de-escalation rates



Modified Reporting of Positive Urine Cultures to Reduce Inappropriate Treatment of Asymptomatic Bacteriuria Among Nonpregnant, Noncatheterized Inpatients: A Randomized Controlled Trial

“This POSITIVE urine culture may represent asymptomatic bacteriuria or urinary tract infection. If urinary tract infection is suspected clinically, please call the microbiology laboratory....for identification and susceptibility results.”

Appropriate therapy 80% in treatment arm vs. 53% in control arm

	Antimicrobial Stewardship	Diagnostic Stewardship
Goals	Improve antibiotic use Reduce AMR, reduce AEs	Improve diagnostic(s) use Reduce diagnostic error
Team	ID physician, ID PharmD, Microbiologist/Lab, Infection Preventionist, IT	
Value	Improve antibiotic use Improve patient outcomes	Improve lab utilization Improve patient outcomes
Targets	Antibiotic selection, dose, duration and route of admin	Test selection, collection, transport, processing, reporting, interpretation
Interventions	Audit and feedback Prior authorization Antibiotic time-out Antibiotic de-escalation IV to oral transitions Guidelines and order sets	Nudges and order set hygiene Testing criteria Optimizing test collection Specimen rejection criteria Result report content & formatting Testing algorithms

Ideal diagnostic stewardship interventions:

- Built into ordering-testing-reporting workflow
- Minimally disruptive, but cannot be bypassed
- Educate clinicians while improving selection and interpretation of tests

“Better methods are needed for clinicians to accurately estimate pretest probability of disease and then adjust those probabilities for test results”

Diagnostic stewardship: Future directions

- Improve education in diagnostic reasoning
- Create & support diagnostic stewardship teams
- Expand beyond CAUTI and *C difficile*
 - Blood cultures, molecular testing, radiology, others
 - Use balancing metrics to identify/limit harms
 - Leverage EMR, AI, risk calculators for CDS
- Increased funding for research & innovation

Thank you!