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Diagnostic Stewardship

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Disclosures

- I have nothing to disclose

For more info….

- SHEA IDWeek training course on diagnostic stewardship
  - Saturday Oct 18th (pre-meeting)

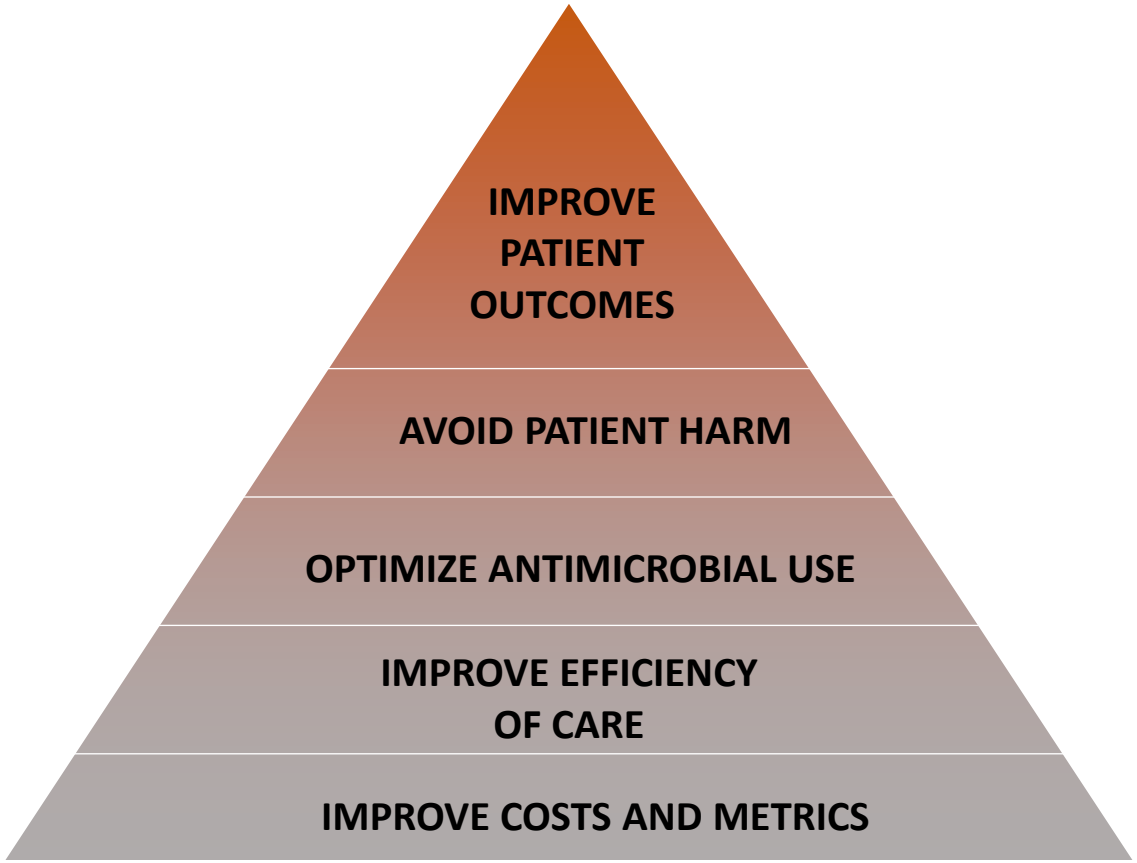
- SHEA Task Force papers

Overarching Threads for Diagnostic Stewardship

- Guided by conceptual Model of Diagnostic Stewardship
- Mostly about how we implement testing
- Optimizing diagnosis (mostly ↓ testing, sometimes more)
- Improving patient outcomes > costs etc.
- Doesn't oversimplify diagnosis, but discourages misuse of tests
- Clinician language of ordering, lab processing, reporting—laboratory language of pre-/post-/analytic

Fabre et al ICHE 2023; Morgan et al JAMA 2017

Objectives of Diagnostic Stewardship



Fabre V, et al. ICHE. 2023

INFECTION CONTROL & HOSPITAL EPIDEMIOLOGY FEBRUARY 2018, VOL. 39, NO. 2

COMMENTARY

Diagnostic Stewardship for Healthcare-Associated Infections: Opportunities and Challenges to Safely Reduce Test Use

Gregory R. Madden, MD;[1] Robert A. Weinstein, MD;[2] Costi D. Sifri, MD[1,3]

Brief Report

National Healthcare Safety Network laboratory-identified *Clostridium difficile* event reporting: A need for diagnostic stewardship

Clare Rock MD, MS [a,b,c,*], Zoi Pana MD, MS, PhD [a], Surbhi Leekha MBBS, MPH [d], Polly Trexler MS, CIC [c], Jennifer Andonian MPH [c], Avinash Gadala MS, BPharma [a], Karen C. Carroll MD [e], Lisa L. Maragakis MD, MPH [a,b,c] ; for the CDC Prevention Epicenters Program

Diagnostic Stewardship: Opportunity for a Laboratory–Infectious Diseases Partnership

Robin Patel[1] and Ferric C. Fang[2]

[1]Divisions of Clinical Microbiology and Infectious Diseases, Departments of Laboratory Medicine and Pathology and Medicine, Mayo Clinic, Rochester, Minnesota, and [2]Departments of Laboratory Medicine and Microbiology, University of Washington School of Medicine, Seattle.

Recent advances in microbial diagnostics are providing clinicians with information about microbes causing infections and their resistance to antimicrobial agents more rapidly than ever before. Diagnostic stewardship refers to the appropriate use of laboratory testing to guide patient management, including treatment, in order to optimize clinical outcomes and limit the spread of antimicrobial resistance. Fulfilling the promise of diagnostic stewardship requires a seamless partnership between clinical laboratories, pharmacists, and infectious diseases clinicians, so that appropriate tests are ordered and diagnostic information is translated into appropriate management in real time.

VIEWPOINT

Diagnostic Stewardship—Leveraging the Laboratory to Improve Antimicrobial Use

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Division of Infectious Diseases, Department of Internal Medicine, University of Michigan Health System, Ann Arbor; and Associate Editor, *JAMA*

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Division of Medical Microbiology, Department of Pathology, University of Iowa Carver College of Medicine, Iowa City

Antimicrobial stewardship programs have emerged as a means to address inappropriate antimicrobial use, manage costs, decrease drug resistance, and prevent medication-related adverse events. The traditional stewardship model relies on pharmacists, infectious disease physicians, or both, providing feedback to clinicians.

Culture-based and non-culture-based diagnostic tests help establish the presence or absence of infection. Although routine, the process of ordering and interpreting diagnostic tests is complex and frequently results in diagnostic error.[1] The decision to order a test should be guided by careful clinical evaluation, recognition of a clinical syndrome, and estimation of the pretest likelihood of the condition for which the test is obtained. Tests are ordered, specimens collected and processed, and results reported. Clinicians then interpret these results and decide whether to initiate or continue treatment.[1]

However, clinicians often order common tests for patients without symptoms specific for the disease process (ie, those with a very low pretest likelihood of infection), eg, *Clostridium difficile* stool testing among patients without diarrhea, or urine cultures among patients without symptoms referable to the urinary tract. When cascading fashion—for example, performing urinalysis but proceeding to urine culture only if pyuria is present.

Some hospitals have gone further, engaging in educational campaigns to teach clinicians appropriate indications and sampling for tests. One program reported a 46% reduction in blood cultures among critically ill children.[3] Diagnostic stewardship has been operationalized in the electronic health record through removal of specific tests, clinical decision support to guide appropriate testing, or allowing the option to order testing if results of initial tests are positive, eg, "urine culture if pyuria present," which reflexively orders a urine culture if pyuria is present on urinalysis. Some of the most common infectious disease tests and potential diagnostic stewardship interventions are described in the **Table**.

Potential Benefits

Diagnostic stewardship emerged from the desire to improve clinical care, with fewer false-positive test results and less overdiagnosis while identifying true-positive cases. Accurate diagnosis is also closely associated with more appropriate antibiotic use, resulting in fewer adverse effects and shorter hospital stays. Decreasing false-positive test results can also improve patient care by allowing clinicians to avoid a prolonged workup of false-

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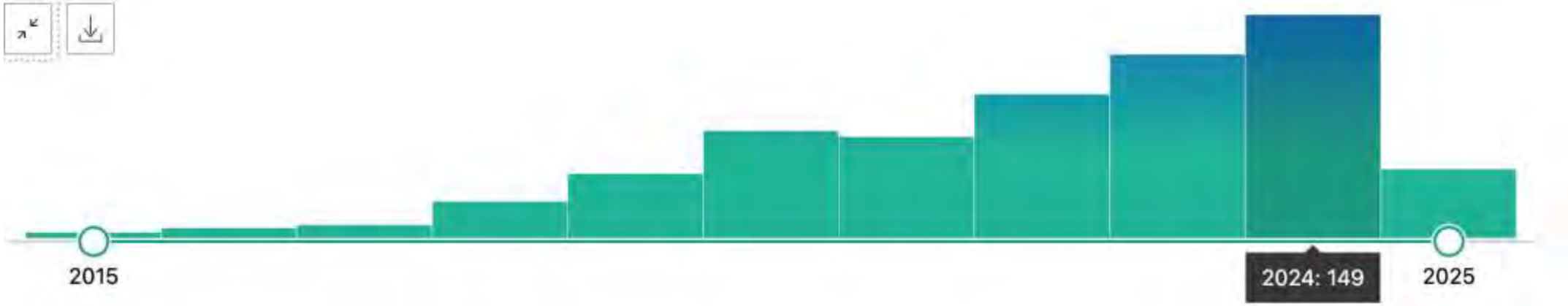
Implementation of Rapid Molecular Infectious Disease Diagnostics: the Role of Diagnostic and Antimicrobial Stewardship

Kevin Messacar,[a,b] Sarah K. Parker,[b] James K. Todd,[b] Samuel R. Dominguez[b]

Section of Hospital Medicine[a] and Section of Infectious Diseases,[b] Department of Pediatrics, Children's Hospital Colorado, University of Colorado School of Medicine, Aurora, Colorado, USA

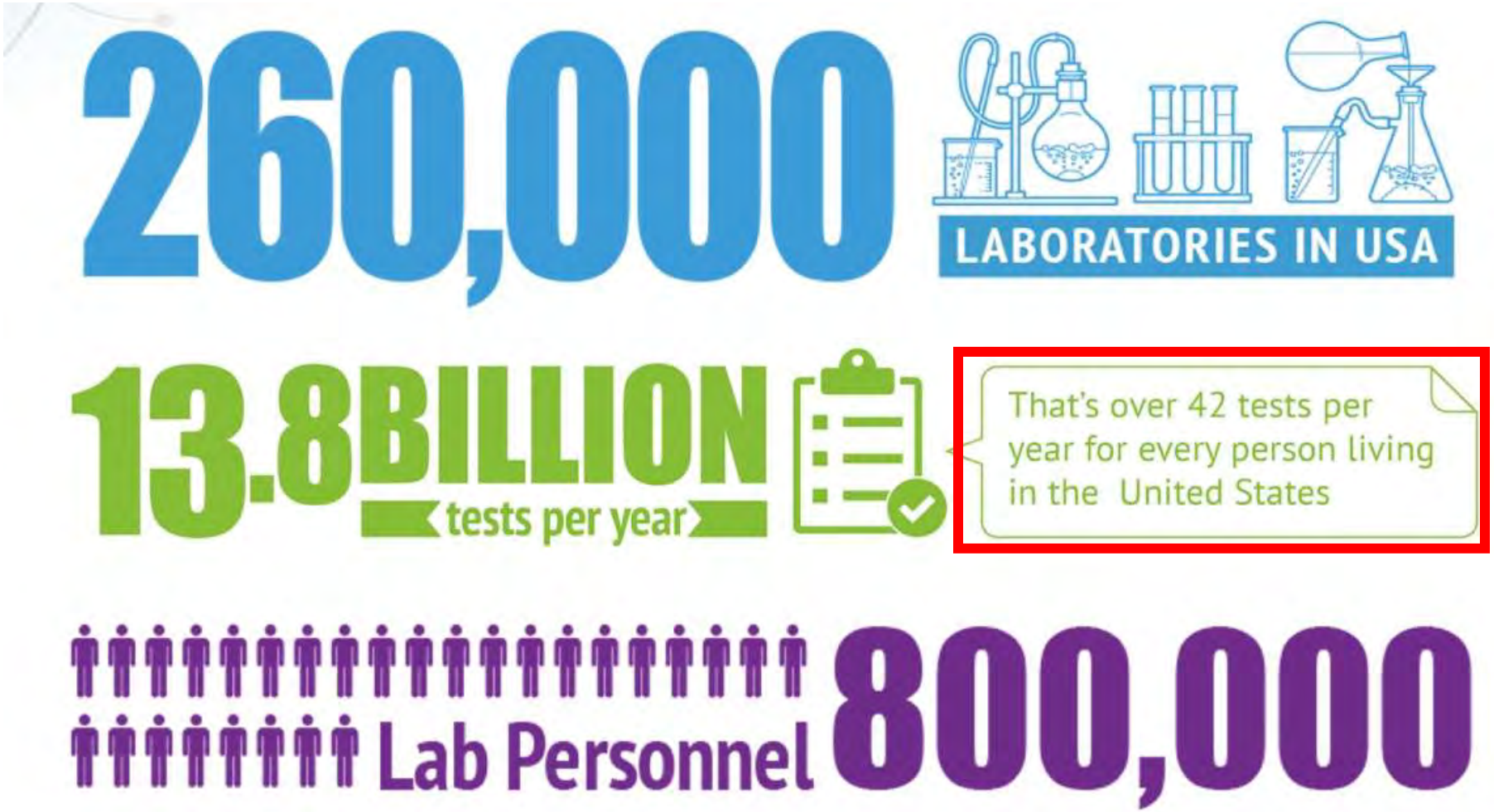
History of Diagnostic Stewardship

- Testing is a relatively new phenomenon in medicine
- 2015 NAM Improving Diagnosis—diagnostic error & Dx excellence
- ~2017 Diagnostic stewardship became the term for work in ID to improve implementation of tests
- 2023 SHEA Task Force Dx St—4 documents
- 2024 CDC Core Elements Dx Ex—combining excellence, stewardship, and overdiagnosis



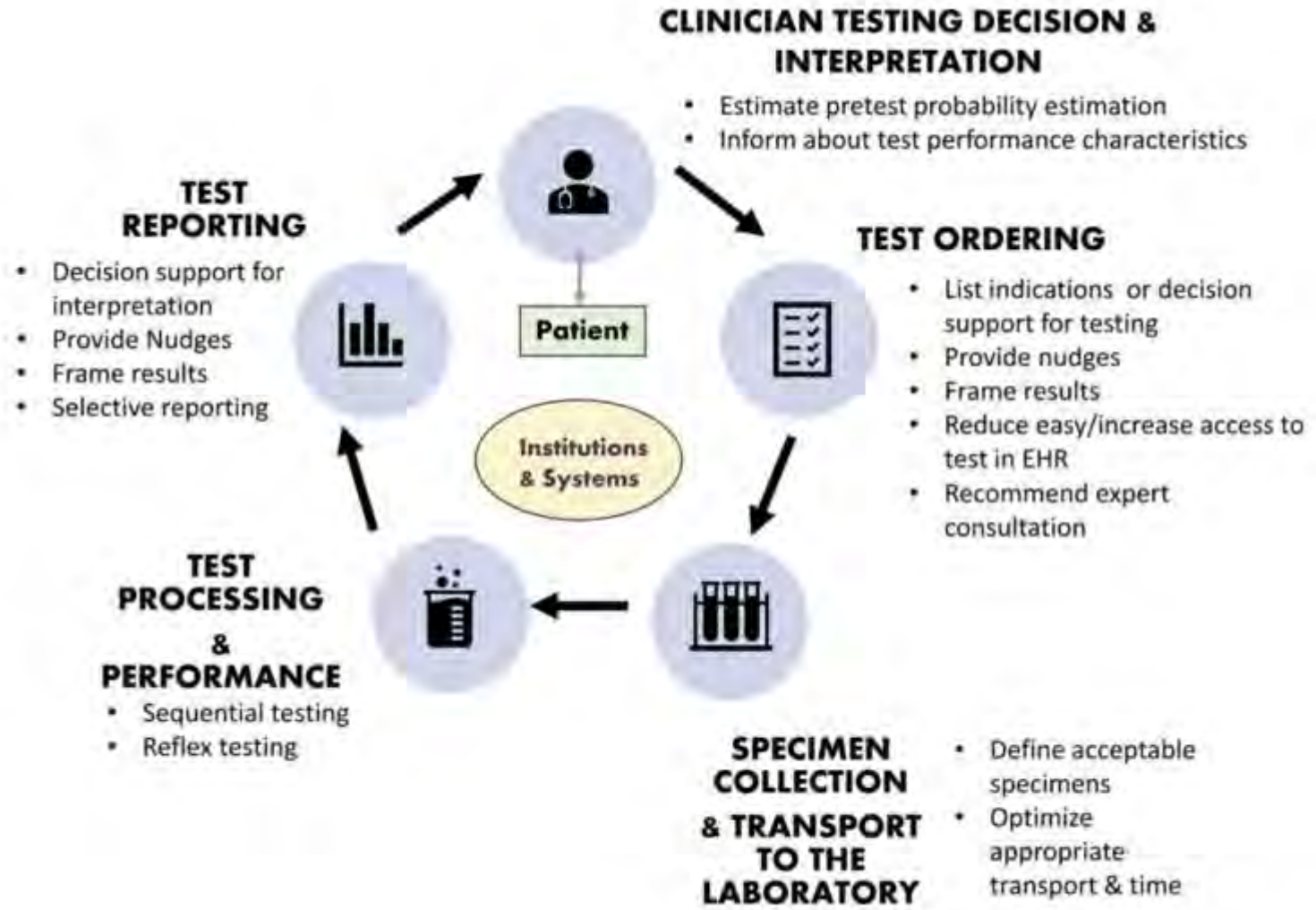
Morgan et al. JAMA 2017; Messacar et al. JCM 2016, Dik et al. JCM 2017

We do a lot of tests!



Cornish, CDC
ECCMID 2019

Conceptual Model of Diagnostic Stewardship



Fabre et al. ICHE 2023

SHEA Task Force Papers—ICHE 2023/24

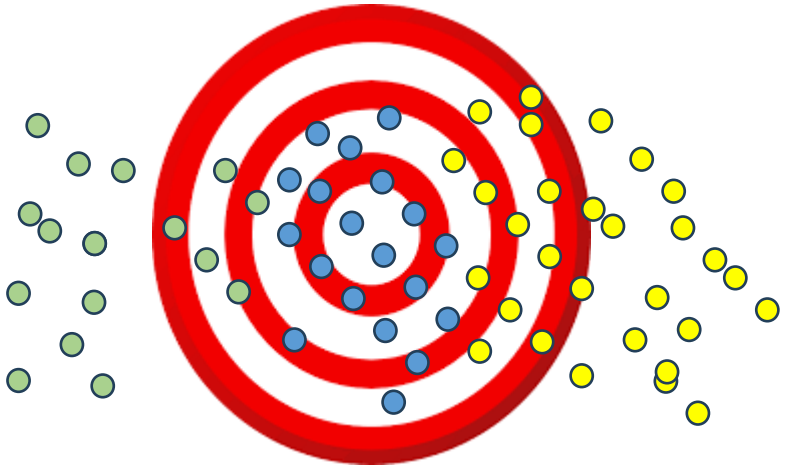
- Principles of diagnostic stewardship: A practical guide
  - *Fabre et al.*
- The relationship between diagnostic stewardship and antimicrobial stewardship
  - *Ku et al.*
- Diagnostic stewardship to improve patient outcomes and healthcare-associated infection (HAI) metrics
  - *Singh et al.*
- Diagnostic stewardship and the COVID-19 pandemic
  - *Epstein et al.*

Diagnostic Stewardship mostly about implementing testing

- The steps of testing based on the conceptual model
- Optimize one or more steps in the model
- “Diagnostic stewardship” is sometimes used broadly, e.g. clinicians deciding to test or not
- Broader medical-decision making around diagnosis, to test or not and how to interpret a test best = Diagnostic excellence

Goal of Dx Stewardship is **Optimizing** testing

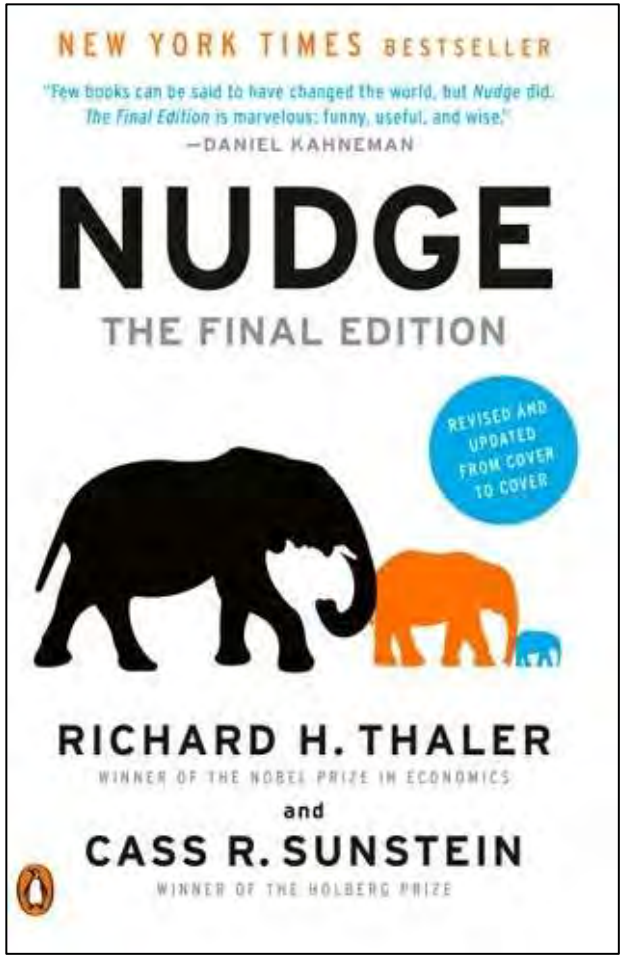
- **Mostly decrease overuse**—e.g. wrong ordering of urine cultures
- Sometimes **assuring a test is used** when needed (more testing)—rapid blood cultures ID
- Sometimes **using a new or more expensive test**—multiplex panel
- Goal is better patient outcomes
- Smarter testing



Diagnostic stewardship does NOT oversimplify medicine

- Endless variability in medicine
- We can’t define best testing for all situations
- But diagnostic stewardship greatly improves wrong practices
- Don’t force decisions—but encourage best care
- Behavioral economics
  - Framing
  - Nudges
- Allow variation/requests

Diagnostic stewardship is based on lab science & psychology of decision-making

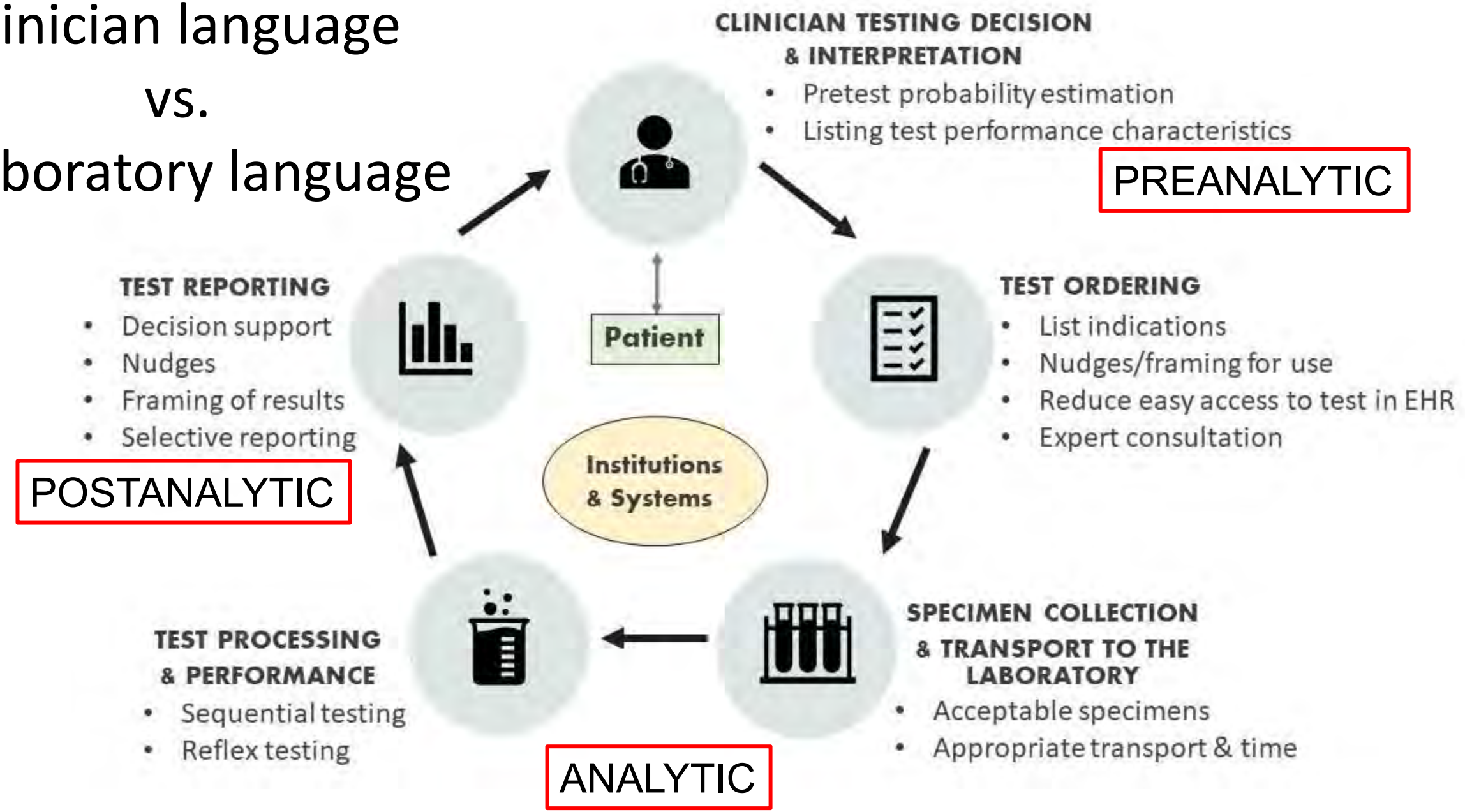


Compared to clinical microbiology

- Diagnostic stewardship differs from clinical microbiology by:
  - Clinician oriented
  - Focused on practices / patient outcomes
  - Clinical performance of tests (not “analytical”)
    - How well identify disease/not disease
- But needs strong understanding / collaboration with micro
  - How tests are performed
  - How to change lab processes
  - How reporting can be changed
- Similar relationship for the general lab and radiology

(Micro and ID have closer relationship in Canada, Australia, Europe etc.—Med micro training)

Clinician language vs. Laboratory language



Fabre et al. ICHE 2023

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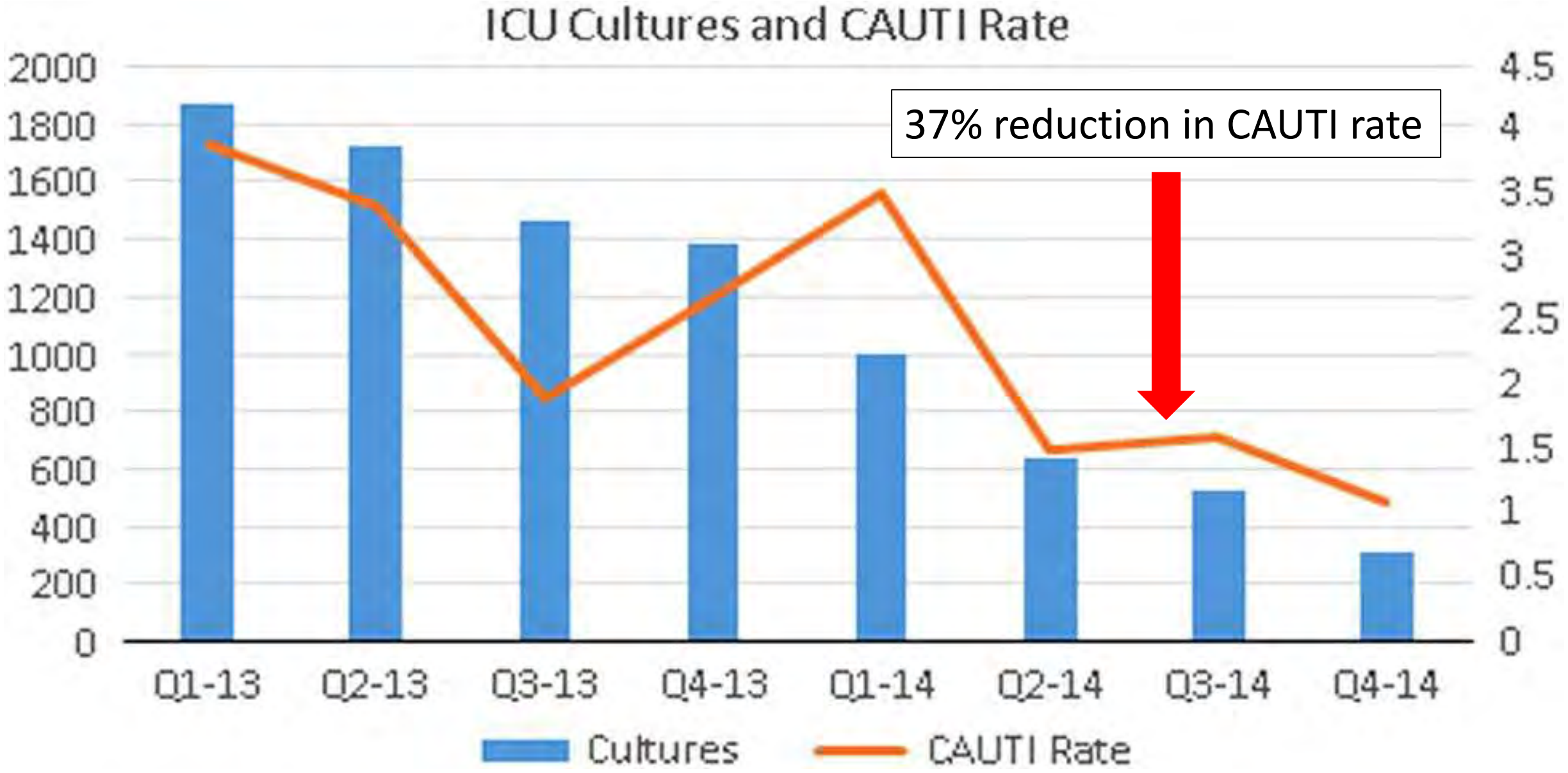
Examples of diagnostic stewardship

Reducing CAUTI by Reducing Urine Culturing

- Multidisciplinary effort to reduce CAUTI
- 2013 focus on catheter insertion & maintenance
- 2014 focus on culturing practices:
  - Published recommendations on evaluation of fever in critically ill patient, urine culture only for:
    - Kidney transplant, neutropenic, post GU-surgery
    - Evidence for obstructive process

Mullin KM et al. ICHE 2017



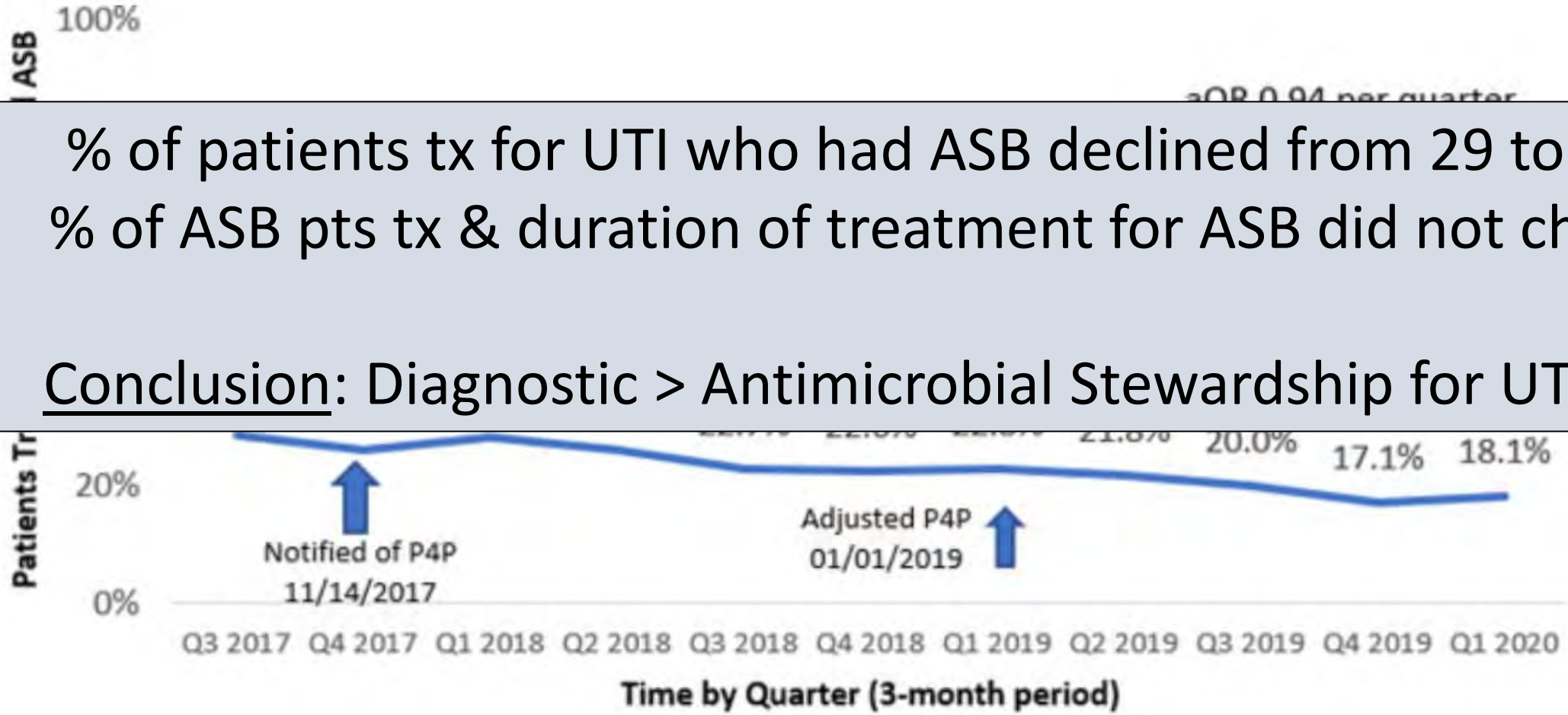
Mullin KM et al. ICHE 2017

Reducing antibiotic treatment of asymptomatic bacteriuria in 46 Michigan hospitals

- Interventions: benchmarking performance, sharing best practices, pay for performance
- Outcome: % hospitalized patients treated for UTI who had asymptomatic bacteriuria (ASB)
- Estimate relative impact of antibiotic vs diagnostic stewardship in treatment of ASB

Vaughn et al. JAMA IM 2023

Michigan Hospital Medicine Safety Consortium: Reducing Tx of ASB



% of patients tx for UTI who had ASB declined from 29 to 17%

% of ASB pts tx & duration of treatment for ASB did not change

<u>Conclusion</u>: Diagnostic > Antimicrobial Stewardship for UTI/ASB

Vaughn et al. JAMA IM 2023

Urine Cx diagnostic stewardship

- Improve ordering—indications to order
- Only culture with pyuria (“reflex” or “conditional” culturing)
  - Caution around naming “urine culture” may be best
  - Pyuria cutoffs >10, >25?
- Better report urine culture results
  - Call lab for results?
  - Cascade antibiotic susceptibilities

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. Cosgrove[1]; 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

Rock et al. Clin Infect Dis 2022

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

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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

Rock et al. Clin Infect Dis 2022

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

Woods-Hill et al. JAMA Pediatrics 2022

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 outc					
Blood cultur					<.001
Secondary o					
Central line-infection[c]					<.001
Clostridioide					.80
Broad-spectr					<.001
New initiatio antibiotics[f,e]					<.001
Secondary o					
Mortality[g,h]					.25
PICU length of stay, d					.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 harm seen in balancing measures

Woods-Hill et al. JAMA Pediatrics 2022

Impact of diagnostic stewardship

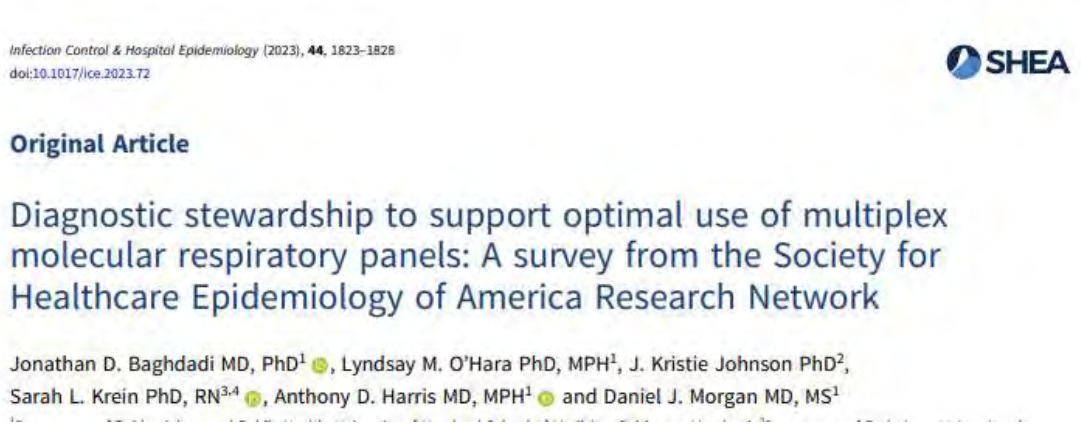
Infection	NHSN-reportable HAIs	Antibiotic use
CAUTI		
C difficile		
CLABSI		

Woods-Hill et al. JAMA Pediatrics 2022; Mullin KM et al. ICHE 2017
Trautner B et al. JAMA Intern Med 2015; Rock et al. Clin Infect Dis 2022
Vaughn et al. JAMA Intern Med 2023; Morgan et al. JAMA 2023

Molecular tests

- Multiplex panels
- Karius and other “agnostic” testing

- Cost a bigger driver
- Many results of uncertain or harmful significance



Infection Control & Hospital Epidemiology (2023), **44**, 1823–1828
doi:10.1017/ice.2023.72

SHEA

Original Article

Diagnostic stewardship to support optimal use of multiplex molecular respiratory panels: A survey from the Society for Healthcare Epidemiology of America Research Network

Jonathan D. Baghdadi MD, PhD[1], Lyndsay M. O'Hara PhD, MPH[1], J. Kristie Johnson PhD[2], Sarah L. Krein PhD, RN[3,4], Anthony D. Harris MD, MPH[1] and Daniel J. Morgan MD, MS[1]

GI Multiplex panels

- Greatly improve access to testing (which was rare before)
- High analytic accuracy
- Clinically less clear impact
- Often used inappropriately—Dx St guides better use
  - No laxatives, true diarrhea, not >3 days in hospital etc.
- Some hospitals suppress *C. difficile* results (often colonized)

Baghdadi et al CIDR 2020
Saif et al. ASHE 2024

Antimicrobial Stewardship & Healthcare Epidemiology (2024), **4**, e22, 1–6
doi:10.1017/ash.2024.15

SHEA

Original Article

Clinical decision support for gastrointestinal panel testing

Nadia T. Saif MD, MPH[1], Cara Dooley MD, MPH[1], Jonathan D. Baghdadi MD, PhD[1], Daniel J. Morgan MD, MS[1,2] and KC Coffey MD, MPH[1,2]

[1]Department of Epidemiology and Public Health, University of Maryland School of Medicine, Baltimore, MD, USA and [2]Department of Medicine, Veteran's Affairs (VA) Maryland Healthcare System, Baltimore, MD, USA

CSF multiplex testing Meningitis/Encephalitis

- Multiplex PCR to detect 14 pathogens
  - Limited ordering
  - Stewardship / ID Team communicated results
  - Faster time to optimal Abx/ less IV ABX

CSF Molecular Panel Testing Orderset

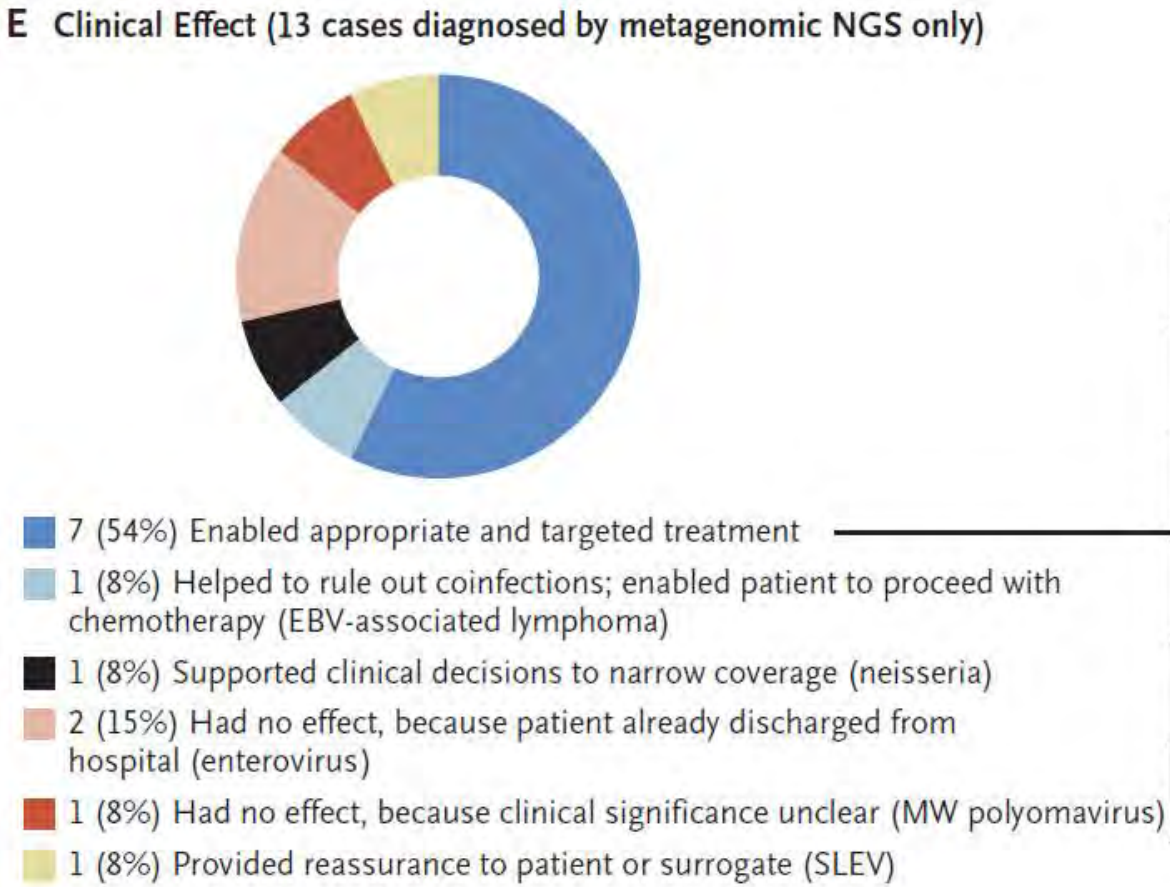
Check one of the approved indications for testing (REQUIRED):

- ☐ Febrile Infant <2 months
- ☐ Encephalitis
- ☐ CNS infection in immunocompromised patient
- ☐ Meningitis (will be run only if ≥5 WBCs in CSF)

Messacar et al. Pediatrics 2022 (Thanks Kevin Messacar)

Metagenomic Next Generation Sequencing

- Diagnostic Stewardship Strategies:
  - "Tumor-Board" of Experts to Review + Interpret
  - Test Restriction/Prior Approval
    - ID Consult/ Micro Lab Director
  - "Test of Last Resort" Approach, Turnaround Time has Limited Impact



Wilson et al. NEJM. 2019

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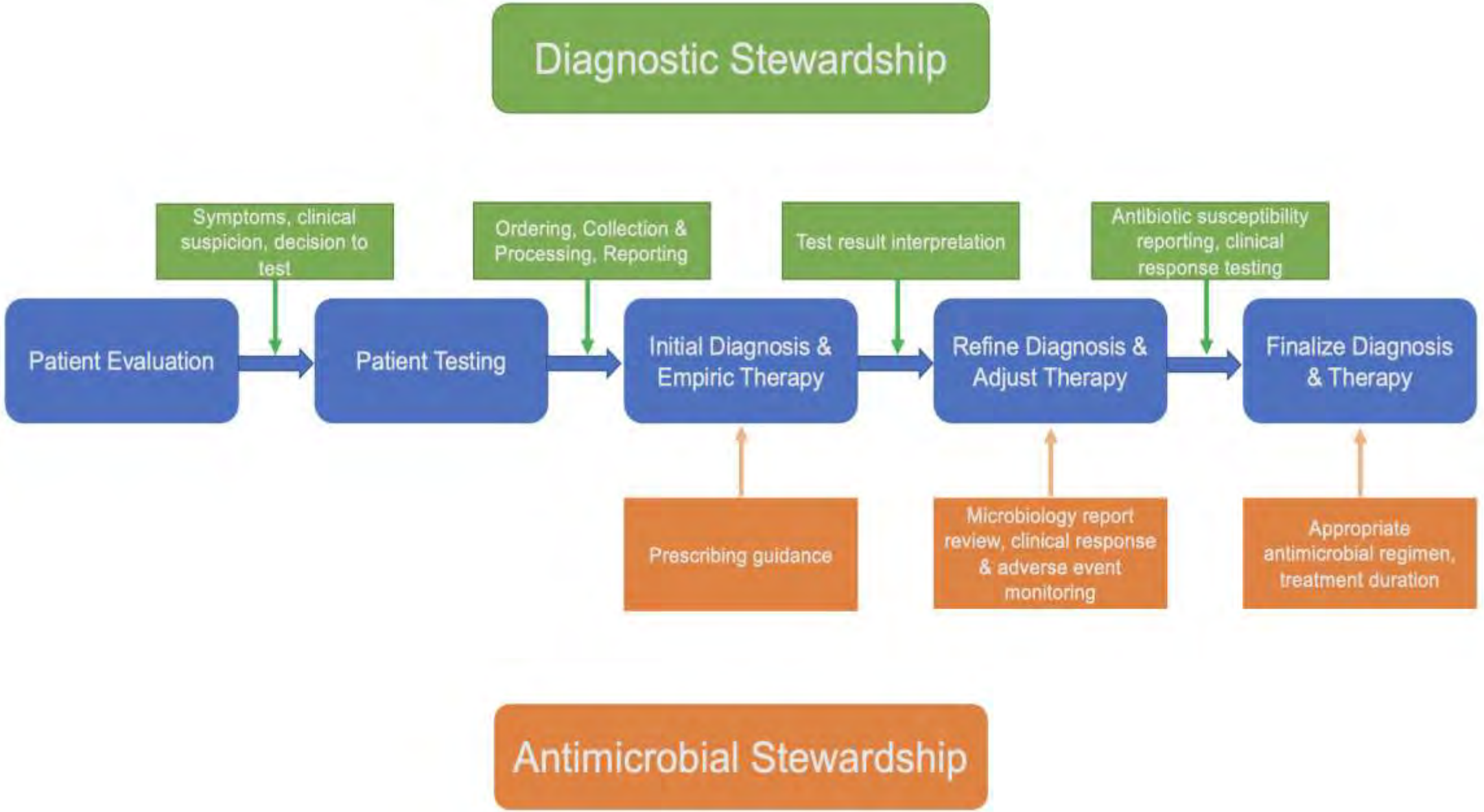
Diagnostic vs. antimicrobial stewardship



Ku et al. ICHE 2024

Non-infectious diagnostic stewardship

Disease/ indication	Diagnostic stewardship procedures	Impact on diagnostic error and patient care
Daily laboratory monitoring	Training on ordering EHR ordering restrictions	Reduced daily labs Decreased misdiagnosis of electrolyte disorders Less anemia
Pulmonary embolism	PERC and D-dimer testing	Decreased CT chest testing Decreased misdiagnosis of subsegmental pulmonary embolism and incidentalomas Decreased ED times and hospital admissions

Morgan et al. JAMA 2023

Stewardship of other tests

The NEW ENGLAND JOURNAL of MEDICINE

Perspective FREE PREVIEW

Medical-Imaging Stewardship in the Accountable Care Era

Daniel J. Durand, M.D., Jonathan S. Lewin, M.D., and Scott A. Berkowitz, M.D., M.B.A.

Though often essential for diagnosis and management, medical imaging is known for low-value uses and as the single largest source of per-capita radiation exposure. The framework used to reduce overuse of antimicrobial agents can help inform imaging-stewardship efforts.

Special Communication | Less Is More

December 2017

Evidence-Based Guidelines to Eliminate Repetitive Laboratory Testing

Kevin P. Eaton, MD[1]; Kathryn Levy, MD[2]; Christine Soong, MD[3,4]; Amit K. Pahwa, MD[5]; Christopher Petrilli, MD[2,6]; Justin B. Ziemba, MD[7]; Hyung J. Cho, MD[8]; Rodrigo Alban, MD[9]; Jaime F. Blanck, MLIS, MPA, AHIP[10]; Andrew S. Parsons, MD, MPH[11]

Author Affiliations

JAMA Intern Med. 2017;177(12):1833-1839. doi:10.1001/jamainternmed.2017.5152

HEALTH AFFAIRS FOREFRONT INNOVATIONS IN CARE DELIVERY

RELATED TOPICS:
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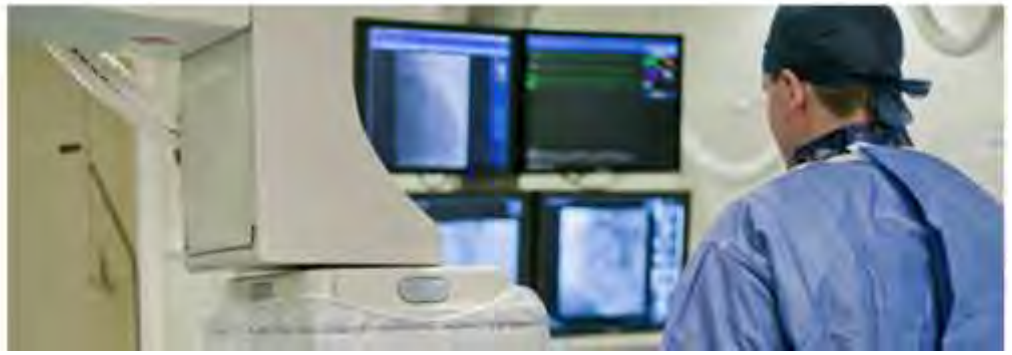
Clinician-Led Stewardship To Curb Medical Excess

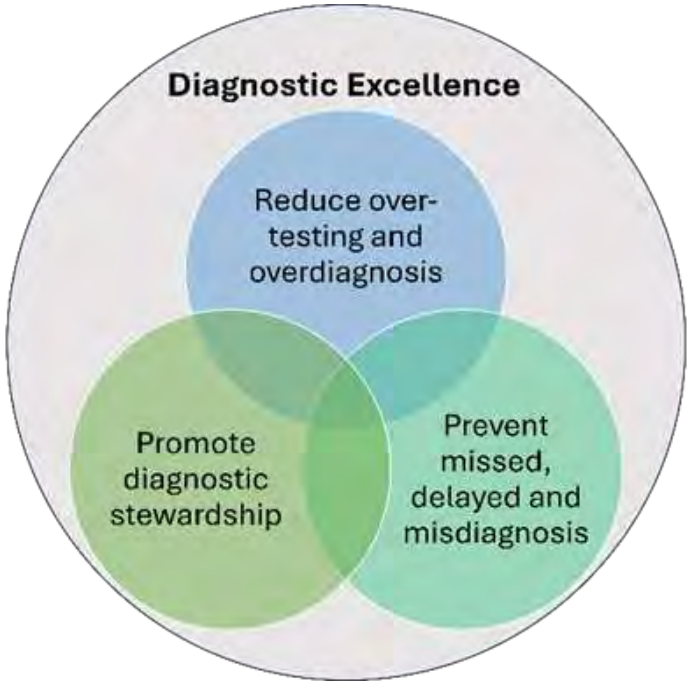
Dan Morgan

NOVEMBER 30, 2015 10.1377/forefront.20151130.052000



Diagnostic Excellence

- Broad focus on improving diagnosis and clinical reasoning
- SIDM/CIDM and National Academy of Medicine led
- **CDC combined many efforts on diagnosis into a Core Elements of DxEx**
- Released September 17, 2024
- Support individuals in hospitals, doing diagnostic stewardship & other actions



Morgan et al. Diagnosis 2024

https://www.cdc.gov/patient-safety/hcp/hospital-dx-excellence/index.html

Diagnostic Excellence

"Making a
correct and **timely** diagnosis
using the **fewest resources** while
maximizing **patient experience** and
managing uncertainty"

Singh et al. BMJ 2022

Clinical Reasoning

- Cognitive process
  - identifying and prioritizing clinical information
  - formulate diagnoses and make other clinical decisions
- Appropriately weighing information
- Changes in probability of diagnosis—initial (pretest) and updated for new information
- Sensitivity & specificity (or LR) of information (tests)
- Clinicians generally not good at probability / changing probability

Singh et al. BMJ 2022; Morgan et al. JAMA IM 2021; CDC Core Elements

Diagnostic Error

- **Delayed, missed** or **mis-diagnosis**
- NOT overdiagnosis

SOCIETY to IMPROVE DIAGNOSIS in MEDICINE

Patient Stories Programs Get Involved Coalition Resources Conferences About

Did you know?

1 in 3

One-third of malpractice cases that result in death or permanent disability stem from an inaccurate or delayed diagnosis, making it the number one cause of serious harms among medical errors.

*Research published in Diagnosis

12,000,000

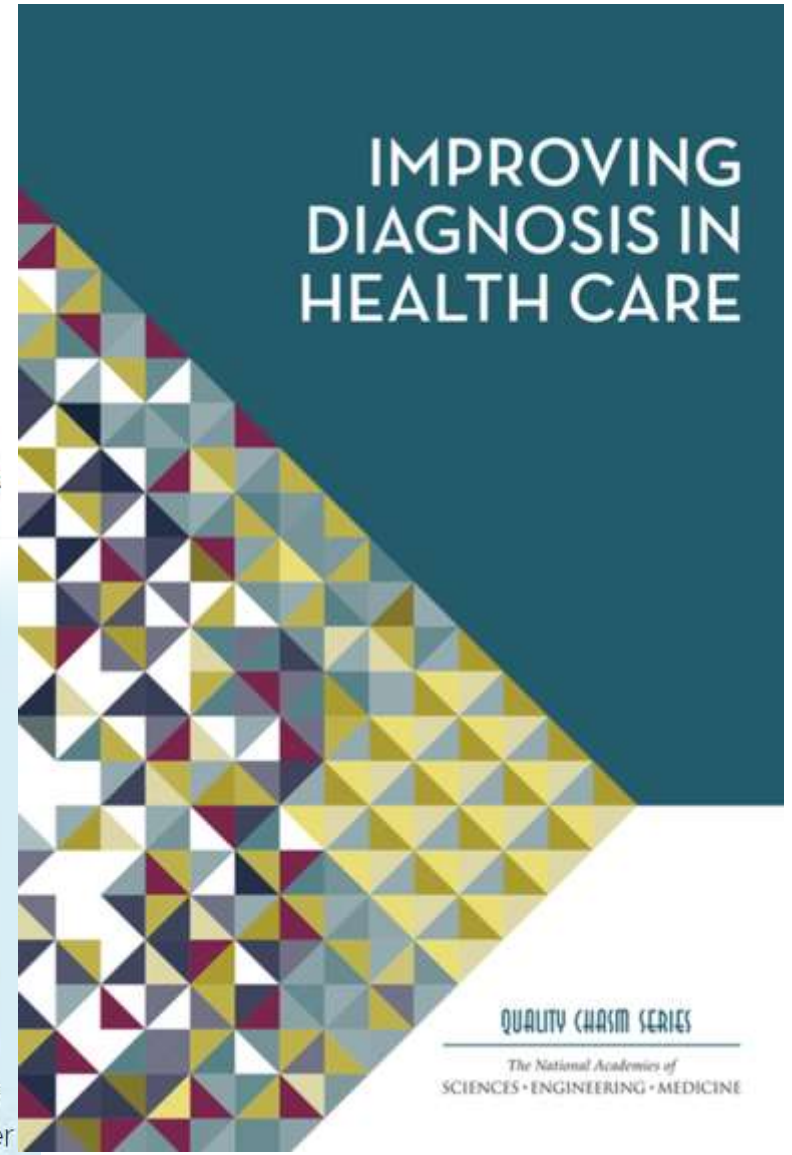
Diagnostic errors affect an estimated 12 million Americans each year, and likely cause more harm to patients than all other medical errors combined.

*Research published in BMJ Quality & Safety

80,000

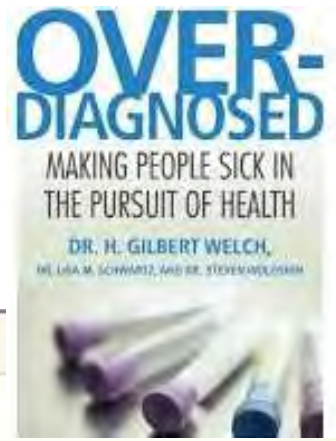
Roughly 80,000 deaths in U.S. hospitals each year can be attributed to diagnostic error. It's about the same number of people who die annually from breast cancer or diabetes.

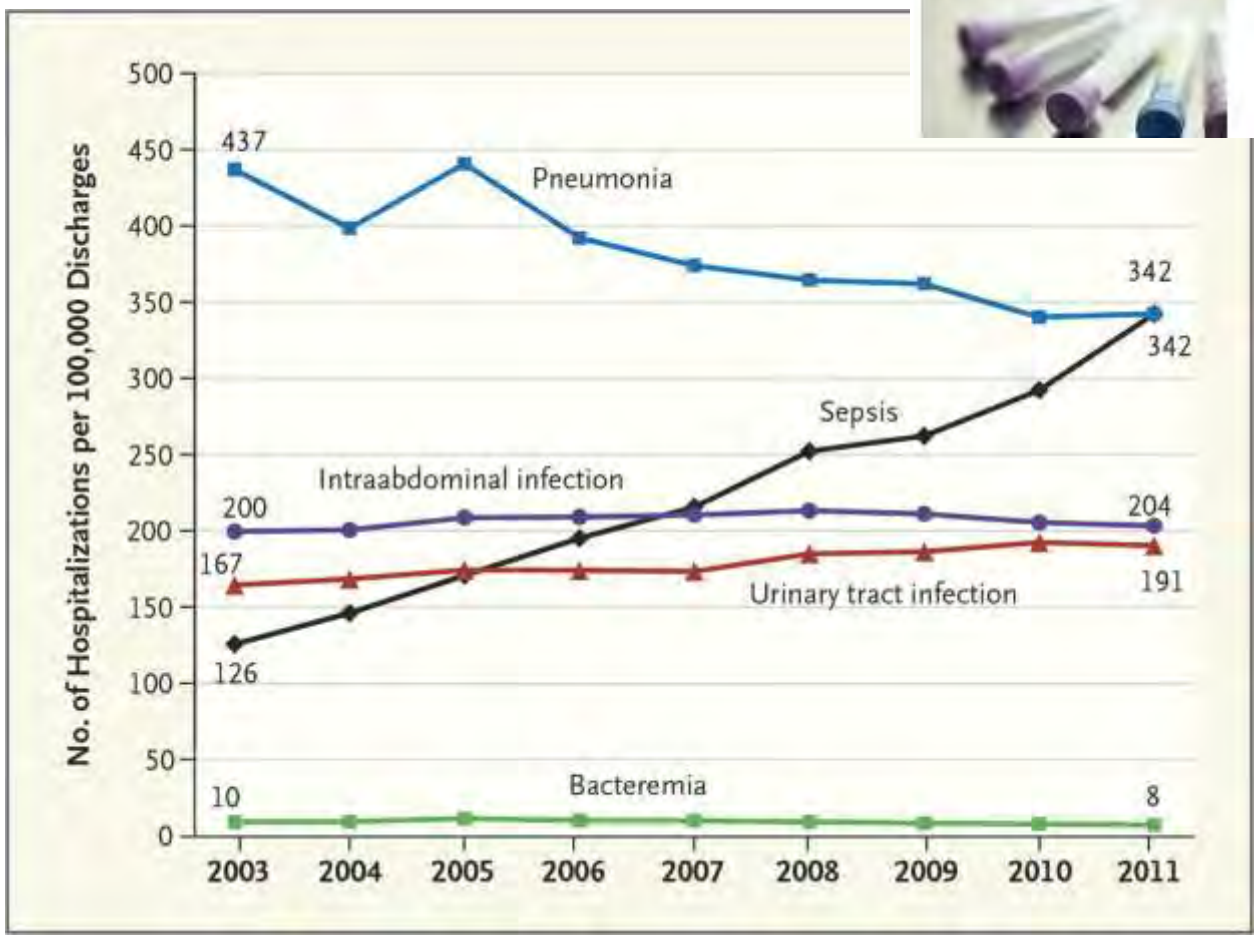
*From Improving Diagnosis in Health Care



Overdiagnosis

- Diagnosis of disease that will never cause symptoms or problems
- Can't identify in individual patients
- Breast, prostate, thyroid CA etc.
- Sepsis
- *C. difficile*
- UTI etc.





Esserman et al. JAMA 2013
Rhee et al. NEJM 2014
Polage et al. JAMA IM 2015

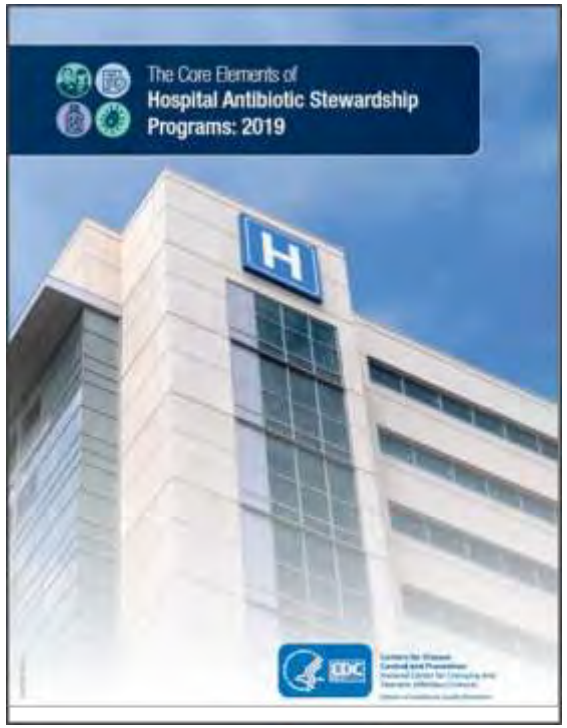
Improving **overdiagnosis in ID**?

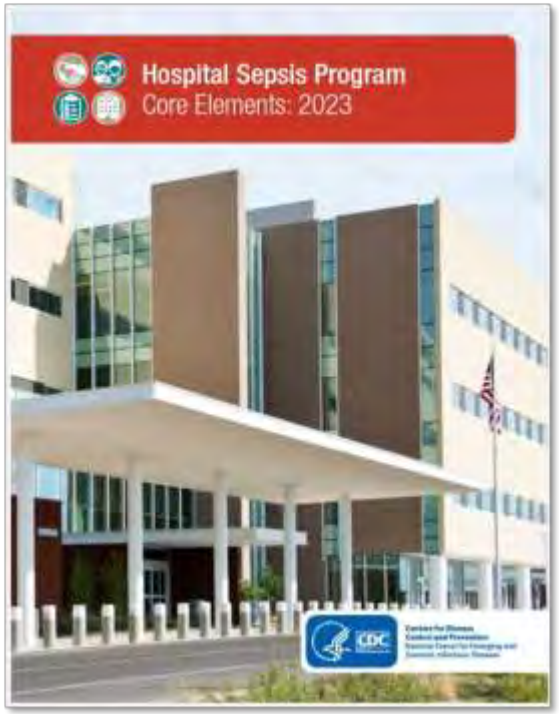
- ↓ testing when risk is low (higher testing thresholds)
- Consider what will you do with test result before ordering
- Address colonization—
  - Asymptomatic bacteriuria (ASB) (old asymptomatic UTI)
  - *C. difficile*
    - Limiting testing w/ laxatives
    - Toxin testing

Vaughn et al. JAMA IM 2023; Rock et al. BMJ Qual Saf 2022; Morgan et al. JAMA 2023

What do Antibiotic Use, Sepsis Management and Diagnostics Have in Common?

Core Elements!





Morgan et al. Diagnosis 2024

CDC Core Elements

Components	Antibiotic Stewardship	Sepsis	Diagnostic Excellence
Hospital Leadership Commitment	✓	✓	✓
Accountability	✓	✓	
Multi-Professional Expertise	✓	✓	✓
Action	✓	✓	✓
Tracking	✓	✓	✓
Reporting	✓	✓	✓
Education	✓	✓	✓
Patient, Family, and Caregivers Engagement			✓

What Will Diagnostic Excellence Programs Look Like?

- Will vary greatly depending on the hospital size and the types of testing it does, as well as on the available expertise
- Leadership might come from people who already have expertise in hospital quality and safety
- A program should provide dedicated time for:
  - Physician co-lead
  - Laboratory or radiology expert co-lead

How Can “Core Elements” Help?

- Provides a clear indication from CDC (CMS) that the topic is important enough that it merits focus from a dedicated program.
  - This has been helpful in some places to advocate for resources.
- Emphasizes the need for support and commitment from the hospital leadership.
- Provides some recommendations based on data and expert input on how to structure a program and what types of things that program could focus on.

Necessary elements to implement DS

- Define a clear goal
- Ensure relevant stakeholders are involved
  - Microbiology, ASP, IPC, IT, end users
- Ensure unit & hospital leadership support
- Define measures to assess impact (pos/neg)
- Review and refine intervention over time

Morgan et al. Diagnosis 2024; Fabre et al. ICHE 2023

Conclusions

- Diagnostic stewardship is about:
  - **Mostly implementing tests** better
  - **Optimizing** testing (not just less)
  - Improving **patient outcomes**
  - **Not oversimplifying** diagnosis
  - **Including clinician & lab** perspectives
  - For infectious disease, general medicine, radiology etc.
- Diagnostic excellence includes Dx Stewardship, overdiagnosis and improving diagnostic errors (safety events)
- CDC Core Elements of Diagnostic Excellence promotes development of hospital programs