HENRY FORD HEALTH

HENRY FORD HEALTH + MICHIGAN STATE UNIVERSITY Health Sciences

International Vaccine Institute

Diagnostic Stewardship

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CAPTURA
Capturing data on Antimicrobial resistance Patterns and Trends in Use in Regions of Asia

TACE ASIA
Technical Assistance for Clinical Engagement

MOTT MACDONALD

UKaid from the British people

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Table of Contents

What is Diagnostic Stewardship?

- Coordinated **guidance** and **interventions** to improve **appropriate** use of microbiological **diagnostics** to guide **therapeutic** decisions
- Should promote **appropriate**, **timely diagnostic** testing, including **specimen** collection and **pathogen** identification, and **accurate**, timely **reporting** of results to guide patient **treatment**
- The **appropriate** use of **laboratory** testing to guide patient **management** in order to optimize clinical **outcomes** and **limit** the spread of antimicrobial resistance
- Not to be confused with the cost-effective use of laboratory tests (which, although is part of diagnostic stewardship)

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Diagnostic stewardship involves overseeing and optimizing the use of diagnostic tests to improve patient outcomes.

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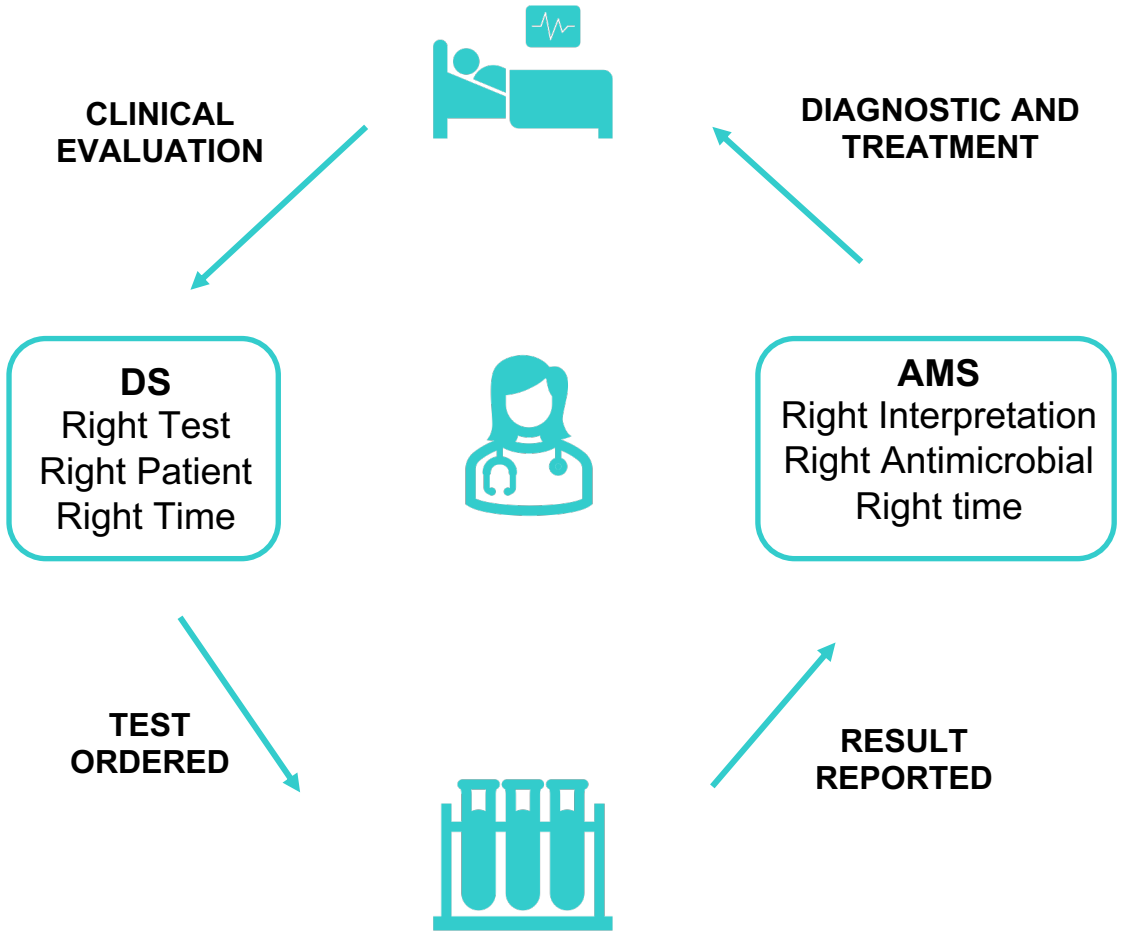
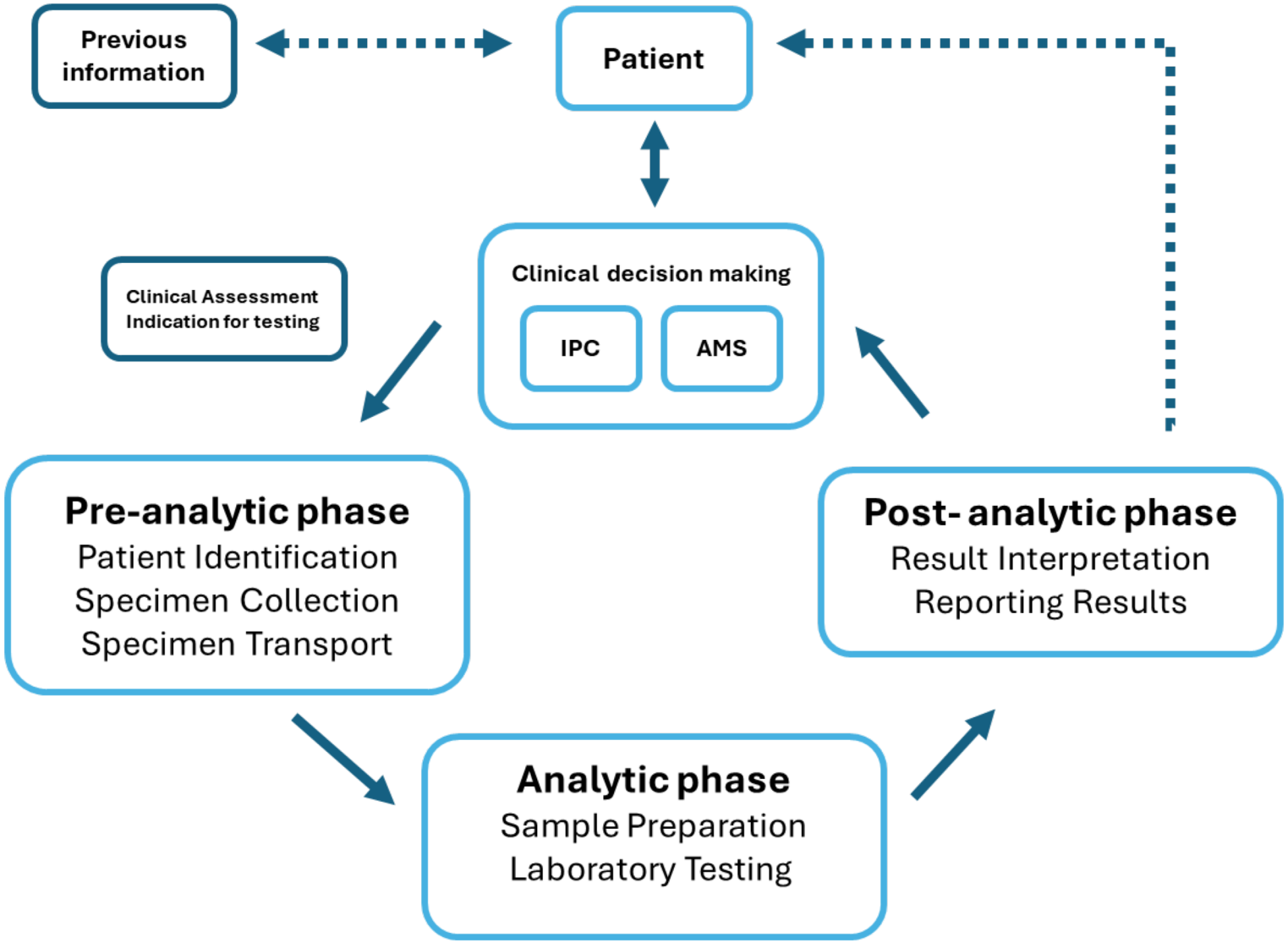
Antimicrobial Stewardship and Diagnostic Stewardship

Diagnostic Stewardship (DS) is an auxiliary to AMS and comprises obtain the :

RIGHT TESTS in the RIGHT PATIENT in order to use the RIGHT DRUG at the RIGHT TIME at the RIGHT DOSE for the RIGHT DURATION.



Diagnostic Pathway



Importance of appropriate use of diagnostic tests

- **Enhances Clinical Decision-Making:** Provides critical information for accurate diagnoses and effective treatment plans.

- **Prevents Patient Harm:** Reduces risks associated with unnecessary procedures and false positives.

- **Reduces Healthcare Costs:** Avoids expenses from unnecessary tests and treatments.

- **Mitigates Diagnostic Errors**: Improves accuracy by ensuring tests are relevant and evidence-based.

- **Combats Overdiagnosis and Overtreatment**: Prevents unnecessary interventions by avoiding detection of clinically insignificant conditions.

- **Supports Diagnostic Excellence:** Aligns testing with clinical needs, enhancing patient care quality.

Importance of appropriate use of diagnostic tests

- Specimen collection should take place **before** initiating any empiric treatment
- In the case of a serious or life-threatening infection, microbiological sampling should be done **before** initiating treatment whenever possible
- Treatment should not be **delayed** while waiting for the diagnostic procedure to be performed or for the laboratory results
- Surveillance data will be **key** in guiding the empiric treatment and successful patient outcome

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The main goal of diagnostic stewardship is to increase the number of diagnostic tests ordered

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Importance of appropriate use of diagnostic tests

Pre-analytical phase

History and clinical exam
Determine optimal sample source
Determine pre-test probability
Choose adequate test

Recommend diagnostic tests
Counsel on novel diagnostics
Assess sample appropriateness

Ensure adequate sampling
Ensure proper sample labeling and transportation
Report additional clinical data

Importance of appropriate use of diagnostic tests

Table: Summary of key aspects of clinical specimen management for bacterial culture

When should a specimen be collected for bacterial culture?	✓ Case definition fulfilled ✓ Prior to antimicrobial therapy whenever possible
What kind of specimen should be selected for bacterial culture?	✓ Appropriate specimen from suspected site of infection according to case definition
How should a specimen be collected for bacterial culture?	✓ By trained staff ✓ With strict adherence to precautions ✓ Using appropriate technique ✓ Using correct material and container ✓ Ensuring adequate amount of specimen ✓ Using appropriate transport medium ✓ Ensuring correct labelling
How should a specimen be transported to laboratory?	✓ In the correct package for safe transport ✓ Within 2 hours after collection, at room temperature (around 20 to 25°C) ✓ In correct storage at the health-care facility if necessary ✓ Accompanied by a request form with complete clinical, demographic and epidemiological information

WHO. Diagnostic stewardship , 2016

Importance of appropriate use of diagnostic tests

Best practices for sample collection, preparation and transportation during the pre-analytical phase [2].

General considerations	- Sampling by well trained professionals - Sampling prior to antimicrobial initiation - Proper labeling with a unique patient identifier, name, date of birth, specimen type, date of collection, hospital, or community origin - Transportation with clinical information - Encourage judicious use of novel diagnostics
Urine cultures	- Patient education on reducing contamination (clean catch) - Prompt transportation or refrigeration to reduce proliferation of contaminants
Blood cultures	- Encourage peripheral venipuncture sampling over central line sampling - Attempt to obtain two samples with adequate blood volume
Respiratory cultures	- Swab both nostrils and pharynx to increase the yield of nasopharyngeal sampling - Provide patients with proper instructions on providing expectoration for sputum culture - Consider distal sampling (like bronchoalveolar lavage [BAL], mini-BAL, bronchial washing), if possible, to increase diagnostic yield
Throat cultures	- Avoid throat cultures when clinical history is inconsistent with bacterial infection (acute viral infection)
Stool culture and *Clostridioides difficile* toxin and polymerase chain reaction	- Collect in a clean container - Keep at room temperature and transport within 2 hours of sampling
Genital swabs for sexually transmitted diseases culture and polymerase chain reaction	- For cultures, inoculate into growth medium on the bedside to improve the detection of *Neisseria gonorrhea* - Transport quickly
Wound swab	- Ensure deep wound culturing whenever possible - Favor needle aspiration from wound borders or tissue cultures from surgical debridement to avoid contamination and improve diagnostic yield

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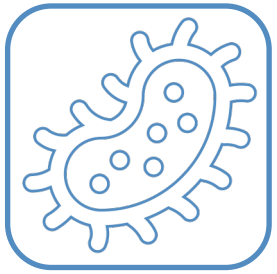
Importance of appropriate use of diagnostic tests

Analytical phase

Determine sample adequacy for testing

Recommend alternative/additional diagnostic tools

Reject damaged/unsealed samples



Ensure proper processing and preservation of samples

Avoid contamination of samples

Provide real-time clinical feedback to guide sample processing and testing

Establish institutional criteria for sample appropriateness

Importance of appropriate use of diagnostic tests

- **Microbiological Cultures**: Identify pathogens from clinical samples to guide targeted antimicrobial therapy.
- **Antimicrobial Susceptibility Testing (AST)**: Determine pathogen resistance profiles to select effective treatments.
- **Polymerase Chain Reaction (PCR)**: Rapidly detect specific genetic material of pathogens for quick identification.
- **Serological Tests**: Detect antibodies or antigens indicating exposure or active infection.
- **Imaging Studies**: Visualize internal structures to identify infection sites, such as abscesses or pneumonias.
- **Rapid Diagnostic Tests (RDTs)**: Provide immediate results for point-of-care decision-making.
- **Multiplex Diagnostic Panels**: Simultaneously detect multiple pathogens in a single sample

Importance of appropriate use of diagnostic tests

- Rapid initiation of appropriate antimicrobial therapy is mainly hindered by the long **turnaround time** of standard culturing techniques, **identification** and **susceptibility** testing

- Point-of-care (POC) tests and new techniques, such as molecular tests, reduce time to identification and may even detect markers of resistance to commonly used antimicrobials

Importance of appropriate use of diagnostic tests

Novel diagnostic tools for the identification of organisms causing bloodstream infection.

Assay	Detected pathogens	Resistance markers	Turnaround time*
PNA-FISH	**Gram positive** *Staphylococcus aureus* and coagulase-negative staphylococci *Enterococcus faecalis* and other enterococci **Gram negative** *Escherichia coli* *Klebsiella pneumoniae* *Pseudomonas aeruginosa*	No	1.5-3 h
QuickFISH	**Gram positive** *Staphylococcus aureus* and coagulase-negative staphylococci *Enterococcus faecalis* and other enterococci **Gram negative** *Escherichia coli* *Klebsiella pneumoniae* *Pseudomonas aeruginosa*	No	<30 min
Gene Xpert MRSA	*Staphylococcus aureus*	*mecA*	< 1 h
Verigene Gram-positive	*Staphylococcus aureus* and coagulase-negative staphylococci *Streptococcus* spp. *E. faecalis and E. faecium* *Listeria* spp.	*mecA, vanA, vanB*	2.5 h
Verigene Gram-negative	*E. coli* *Shigella* spp. *K. pneumoniae and K. oxytoca* *P. aeruginosa* *Serratia marcescens* *Acinetobacter* spp. *Proteus* spp. *Citrobacter* spp. *Enterobacter* spp.	KPC, NDM, CTX-M, VIM, IMP, OXA	2 h

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Importance of appropriate use of diagnostic tests

MALDI-TOF	Gram-positive and Gram-negative bacteria, mycobacteria	Multiple	10–30 min
FilmArray (BCID)	**Gram positive**	*mecA*, *vanA*, *vanB*	1 h
	S. aureus and other staphylococci		
	Streptococcus spp.		
	Enterococcus spp.		
	Listeria monocytogenes	IMP, KPC, NDM, VIM, OXA-48-like,	
	Gram negative	*mcr-1*, CTX-M,	
	Hemophilus influenza		
	Neisseria meningitides		
	Enterobacter cloacae complex		
	E. coli		
	K. pneumoniae and *K. oxytoca*		
	P. aeruginosa		
	Serratia marcescens		
	Acinetobacter baumanii		
	Proteus spp.		

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Importance of appropriate use of diagnostic tests

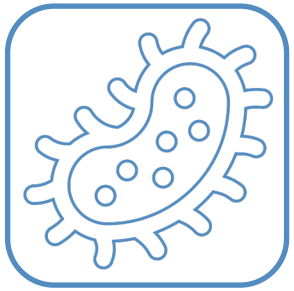
Pos - analytical phase

Modify reporting to indicate colonization

Selectively report susceptibility results

Properly analyze results and correlate to pretest probability and clinical input

Recommend additional testing/novel diagnostics if possible



Timely reporting of results

Integrating EMR into result reporting

Collaborate with microbiologists to ensure proper analysis of results

Correlate results to clinical data to ensure a proper diagnosis

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What do you think is the biggest barrier to implementing Diagnostic Stewardship?

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Interpreting results from targeted therapy

Reasons why healthcare providers disregard DS principles in daily practice:

- Absence of good clinical microbiological diagnostics
- Lack ok knowledge of guidelines
- Misleading reporting of results
- Disease severity
- Lack o personnel training

Interpreting results from targeted therapy

Understanding Antimicrobial Susceptibility Test (AST) Results:

- **Susceptible (S):** Indicates that the pathogen is likely to be inhibited by the standard dosage of the antimicrobial agent.
- **Intermediate (I):** Implies that the pathogen may be inhibited if the drug is concentrated at the infection site or if a higher dosage is used.
- **Resistant (R):** Suggests that the pathogen is not inhibited by the antimicrobial agent at standard dosages.

Interpreting results from targeted therapy

Minimum Inhibitory Concentration (MIC):

- The MIC is the lowest concentration of an antimicrobial that prevents visible growth of a microorganism.
- Comparing the MIC to established breakpoints helps determine susceptibility:
  - **MIC ≤ Susceptible breakpoint:** Pathogen is susceptible.
  - **MIC > Resistant breakpoint:** Pathogen is resistant

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Diagnostic stewardship is not relevant to antimicrobial resistance (AMR) prevention efforts

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Interpreting results from targeted therapy

Interventions that have shown effectiveness at promoting DS.

Author	Intervention	Outcome	Recommendation
VAP			
Hellyer et al. [104]	Using levels of IL-1β and IL-8 to discontinue therapy	No effect on AMS due to the reluctance of physicians to discontinue therapy	Conventional and novel biomarkers can be helpful when deciding on the duration of treatment Risks vs. benefits should be weighed in deciding which sampling technique to use as non-invasive sampling may be sufficient in most cases Modified reporting is essential for AMS efforts and unnecessary treatment reduction Gram-stain on respiratory cultures may substantially reduce unnecessary therapy, and is a widely available and inexpensive means to promote DS, particularly in LMICs
Berton et al. [105]	Invasive sampling (BAL, mini-BAL, bronchial washing) vs. non-invasive sampling (ETA)	No difference in mortality, ICU LOS, days on MV, or changes of antimicrobials	
Musgrove et al. [106]	Reporting sputum cultures as "no MRSA and no *Pseudomonas* spp." vs. "polymicrobial respiratory flora"	De-escalation increased from 39% to 73% ($P<0.001$) Median duration of anti-pseudomonal antimicrobials decreased from 7 to 5 days ($P<0.001$) Significant decrease of MDR isolation from respiratory cultures from 8% to 1%	
Yoshimura et al. [107]	Gram-stain guided vs. standard empirical therapy (covering MRSA and *Pseudomonas* spp.)	Decreased use of anti-pseudomonal and anti-MRSA drugs No significant difference in coverage rates (92% in interventional arm vs. 95% in control)	
BSI			

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Interpreting results from targeted therapy

BSI			
Copeland-Harpelin et al. [108]	Using a clinical decision tool using 3 criteria Post-operative BCs for post-operative BSIs (hypotension, fever, >2 days post-operatively)	85% reduction of BC orders while maintaining the same diagnostic yield	In the absence of hypotension and fever before 2 post-operative days, BCs are likely unnecessary Institutional guidance and training should be provided to HCWs to reduce excessive testing that may lead to unnecessary treatment Follow-up BCs may not be useful in patients who are responding well to treatment, except in cases of *S. aureus*, endovascular infection, *S. lugdunensis*, and persistence of signs of infection after 72 h of therapy
Fabre et al. [109]	Quality intervention study providing education and algorithms that help guide ordering new or repeat BCs	Significant reduction in BC orders BC positivity rate increased from 8.1% to 11.5% ($P<0.001$) in the ICU No effect on mortality and readmission rates	
Scheer et al. [110]	BCs after initiation of antimicrobials	BC positivity rate was reduced by 20% when obtained during antimicrobial therapy	
UTI			
Lee et al. [111]	Two-step algorithm sending urine samples to culture only if urinalysis shows pyuria	Significant reduction of antimicrobial use without affecting mortality Improved clinicians' confidence when withholding antimicrobials	Urine samples from asymptomatic patients with no pyuria on urinalysis should not be cultured to reduce the risk of treating asymptomatic bacteriuria Modified reporting of urine samples suggestive of ASB improves the appropriateness of antimicrobial therapy Two-step algorithm may also be used for CAUTI in critically ill patients where MDR burden is higher
Daley et al. [13]	Reporting urine samples as "possibility of being asymptomatic bacteriuria" vs. standard reporting Clinicians needed to call the microbiology lab to obtain identification and AST results	Higher rates of appropriate antimicrobial therapy were achieved in the intervention arm (80% vs. 52.7%, $P=0.002$)	

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Interpreting results from targeted therapy

Author	Intervention	Outcome	Recommendation
Epstein et al. [112]	Reflex urine protocol in patients suspected to have CAUTI	Reduced the rates of culturing and CAUTIs without affecting patient outcomes in critically ill patients	
CNS infections			
Broadhurst et al. [113]	Restricting CSF microarray testing to samples showing pleocytosis in immunocompetent adults	Significant increase of microarray testing yield from 11.5% to 18.6% 75% of false-positive results were avoided without any additional false-negative results Excluding immunocompromised patients, normal CSF WBC count was found to have a very high overall negative predictive value of 98-100% for nonviral agents	Restricting microarray testing to immunocompetent adult patients with CSF anomalies reduces unnecessary testing and improves diagnostic yield
CDI			
White et al. [10]	Reminder to check for laxative use when ordering stool testing	Reduction of inappropriate testing	Avoid testing for CDI in patients who are on laxatives or patients with low clinical suspicion of CDI Use the EMR to implement soft (review prior to ordering) or hard (block ordering) stops that promote DS The microbiology lab should not test non-loose stools or samples obtained from patients with low-pretest probability of CDI
Quan et al. [114]	Real-time checking of clinical criteria suggestive of CDI when ordering stool testing	Improved testing appropriateness Reduced hospital-onset CDI	
Quan et al. [114]	Blocking stool test order when clinical criteria are absent	56% reduction was observed for CDI testing and 54% reduction for HO-CDI laboratory-identified events	
Christensen et al. [115]	Implementation of a clinical review and pre-authorization protocol for CDI testing	Reductions in HO-CDI and oral vancomycin prescription	
Brecher et al. [116]	Allowing labs to refuse non-loose stools for stool testing	43% decrease in CDI testing was noted along with a 60% decrease in CDI events	
Truong et al. [117]	Microbiology labs were allowed to cancel CDI testing orders in the absence of clinical criteria (such as ≥3 loose stools in the past 24 h in the absence of laxative use in the past 48 h)	32% decrease in CDI testing and did not have any significant increases in ICU admission or 30-day all-cause mortality	

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Diagnostic stewardship can help reduce unnecessary testing and antimicrobial use.

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Q&A

Thank you!

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