Appropriate use of diagnostic tests in medical practice

A review of five Choosing Wisely recommendations pertaining to infectious diseases diagnosis and management.

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ABSTRACT: Inappropriate use of diagnostic tests is common in medical practice. There is a tendency for clinicians to overinvestigate or order unnecessary tests that either do not impact medical care or potentially harm the patient. Excessive testing is common for several reasons, including fear of missing a diagnosis, limited time during patient visits, patient expectations, and institutional pressures. However, overtesting generates superfluous and misleading clinical data, leads us down the wrong path, causes unnecessary anxiety, and produces extra medical waste. I review my top five recommendations from Choosing Wisely relevant to both outpatient and inpatient management of infection.

Diagnostic stewardship is the process of optimizing the ordering, performance, and reporting of diagnostic tests to enhance the diagnosis and management of infections.[1] In other words, this process promotes prioritizing the right test for the right patient at the right time to elicit the right therapeutic action, with the goal of delivering the best evidence-based care, improving antibiotic use, reducing adverse effects, and decreasing unnecessary use of health care resources. Knowledge and understanding of pretest and posttest probabilities, false positives and false negatives, and test accuracy are key to implementing diagnostic stewardship strategies. Overtesting is the most common form of inappropriate testing, with 40% to 60% of tests deemed unnecessary, leading to overdiagnosis, overtreatment, and increased risk of patient harm.[1,2] In one study, half of test results did not prompt a change in management, and for those that did, not all changes were beneficial.[2] Overall, 72% of patients experienced no benefit or harm from testing.[2] The well-known Choosing Wisely campaign, launched in Canada in 2014 and around the globe in 2015, aims to reduce unnecessary tests, treatments, and procedures to ensure clinicians deliver high-quality care.[3] Less commonly, undertesting can result in missed diagnoses and inappropriate treatment.

The typical pathway of diagnostic testing is:

1. A clinician decides that a test is needed.
2. The test is ordered.
3. A specimen is collected and transported to the lab.
4. The specimen is processed by the lab.
5. The test result is reported.
6. The clinician interprets the result.[1]

Diagnostic stewardship efforts should target the clinician at steps 1, 2, 3, and 6 to be most effective at the individual level. Strategies such as education, decision support tools, best practice alerts, test restriction, order sets, and provider feedback can optimize test ordering.

Below are five Choosing Wisely recommendations that pertain to infection diagnosis and management.

Urine cultures

Collect urine cultures from adults only if they have symptoms localizing to the urinary tract or fever, are pregnant, or are undergoing genitourinary instrumentation where mucosal bleeding is expected.[4]

Urine cultures are commonly obtained in hospitalized patients, with over 80% receiving inappropriate antibiotic treatment for asymptomatic bacteriuria.[5] Many clinicians erroneously equate a positive urine culture with a diagnosis of a urinary tract infection (UTI) due to the misconception that the urine should be sterile.[6] In fact, the urinary system possesses its own unique microbiome that protects humans from true infections.[7] Therefore, unnecessary antibiotic exposure might *increase* the risk of developing a UTI. A common practice is to order a urine culture in patients with cloudy or foul-smelling urine or altered mental status, despite evidence arguing against this practice.[8,9] Elderly patients are frequently subjected to unnecessary urine tests and overtreatment with antibiotics, because asymptomatic bacteriuria is present in up to 40% to 50% of this population.[10] In those with indwelling Foley catheters, the bacterial colonization rate is near 100% after 2 weeks of catheterization.[10] Antibiotic treatment in patients with delirium and

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bacteriuria without UTI symptoms does not improve mental status or functional outcomes.[11] Education about true UTI symptoms (e.g., dysuria, urinary frequency, hematuria, absence of vaginal discharge, irritation, flank pain, suprapubic pain) might limit inappropriate urine testing.[12] For patients with chronic indwelling Foley catheters, urine culture should be obtained only if fever, new costovertebral tenderness, rigors, or new-onset delirium without another obvious cause is present.[13] Possible systemic solutions to combat overtesting of urine include a requirement to document UTI symptoms to obtain a urine culture, removal of urine culture from standard order sets, and processing of urine cultures only if specific criteria are met on urinalysis (e.g., pyuria).[14]

Blood cultures

Blood cultures should not be routinely obtained in low-yield situations when patients are not systemically septic, have a clear source of infection, and have a direct specimen for culture (e.g., urine, wound swab, sputum, cerebrospinal fluid, joint aspirate).[15]

Up to 40% of blood cultures are ordered unnecessarily, and up to half of all positive blood cultures represent contamination.[1,2,16,17] Blood culture contamination is associated with significant increases in health care costs, longer hospital stays, and adverse effects, including unnecessary antibiotics and additional testing for patients.[16,17] Over 90% of blood cultures do not grow any organisms, indicating that most blood cultures are likely not required, and only 5% identify a true pathogen.[16,18] Infections with a low risk of bacteremia, such as cellulitis, pneumonia, and cystitis, do not routinely require blood culture testing.[17] For high-risk conditions, including endovascular infections and sepsis/septic shock, the diagnostic value of blood cultures is higher.[16] Blood cultures are commonly ordered to evaluate fever and leukocytosis, both of which correlate poorly with bacteremia.[16] The presence of shaking chills is a more specific sign of bacteremia.[19] Follow-up blood cultures are recommended only for bacteremia caused by *Staphylococcus aureus*, *S. lugdunensis*, fungi, and any organism implicated in endovascular infections.[16] Routine follow-up blood cultures for uncomplicated bacteremia caused by Gram-negative pathogens such as *Escherichia coli* or *Klebsiella pneumoniae* are generally not useful, as they are infrequently positive and do not alter clinical management.[20] Blood cultures should be repeated only if clinical status deteriorates, suggesting a new infection or a nonresponse to antibiotic therapy after 72 hours since the last blood culture.[20] Implementing prediction models and artificial intelligence into electronic medical records to identify patients at high risk of bacteremia who would benefit from blood culture testing can promote laboratory stewardship.[17]

It is not a sufficient justification to order a test solely to satisfy one's curiosity or to alleviate anxiety if the evidence does not support its use.

Cultures from swabs

Cultures from swabs of superficial ulcers are prone to both false positive and false negative results regarding the cause of the infection and should be obtained by proper technique only when there are clinical signs of a wound infection.[4]

Diagnosing a wound infection can be challenging. Wounds are normally colonized with bacteria, and sometimes with fungi.[21] Wound swabs often provide misleading, distracting, and unhelpful microbiological information. Clinicians commonly equate a positive wound culture with an infection, even though the diagnosis of a wound infection is based on clinical assessment. Chronic wounds harbor a plethora of bacterial species, and their presence can reflect any combination of colonization, biofilm formation, and infection.[21,22] Therefore, wound cultures should be obtained only if there is clinical suspicion of infection. Otherwise, culturing wounds without signs of infection does not predict clinical outcomes.[23] Tissue biopsy, needle aspiration of wound borders, and deep cultures provide the most useful diagnostic information, but they are difficult to obtain and impractical for the average clinician.[21,24] As a result, obtaining a wound culture with a swab, preferably using the Levine method (rotate the tip of the swab over a clean 1 cm^2 non-necrotic area of the wound bed for 5 seconds, using firm but gentle pressure to extract fluid from the wound tissue), ideally after the wound has been cleansed with normal saline or sterile water to avoid contamination with skin flora, is usually recommended instead.[22] Depending on the quality of the specimen and how it was collected, the real pathogen(s) implicated in the infection might not grow in culture, and other times, nonpathogenic microbes grow out instead.[21] Educating clinicians on the appropriate indication for collecting wound cultures (i.e., only when a wound infection is suspected) and on proper test interpretation can minimize patient harm and unnecessary resource use.

Procalcitonin

Procalcitonin (PCT) should be used only with guidance from an evidence-based protocol.[25]

PCT is a frequently ordered laboratory test to diagnose infections and monitor response to treatment. However, experts have recently questioned the utility of PCT.[26] PCT suffers from mediocre sensitivity and specificity and is unable to reliably detect an infectious process because it may be falsely low in localized infections such as cellulitis, abscess, and empyema, and falsely elevated in noninfectious conditions, including severe trauma, major burns, and chronic renal failure.[26] While PCT has been shown to reduce antibiotic consumption in patients with pneumonia and sepsis in earlier randomized controlled trials, recent data show that it performs no better than usual care and might inadvertently prolong

treatment or lead to inappropriate antibiotic initiation due to misinterpretation of results.[27-30] In the real world, implementing and strictly adhering to a PCT algorithm is challenging and does not mimic the tightly controlled nature of a clinical trial.[30] In my clinical experience reviewing cases in Fraser Health, only in a minority of situations where PCT testing is done is it clinically useful when considering the indication for testing and the impact on antibiotic management. Furthermore, in my experience, clinicians tend to err on the side of prescribing antibiotics, even when PCT testing does not support it. This biomarker often provides redundant information when other symptoms and signs suggest a bacterial infection. A laboratory test is useful only if the result can meaningfully influence decision making. Using PCT in ways unsupported by evidence can lead to confusion, unnecessary tests, prolonged antibiotic courses, and inappropriate specialist consultations.[30] If PCT is used, it should be reserved for inpatients with pneumonia or sepsis guided by evidence-based algorithms.[31]

Routine CD4 monitoring

Routine CD4 monitoring in patients with HIV infection with viral suppression of more than 2 years and CD4 counts higher than 500/μL is not necessary unless virologic failure occurs or intercurrent opportunistic infection develops.[32]

CD4 lymphocyte monitoring has been the standard practice in HIV management for decades. Recent guidelines recommend against routine surveillance of CD4 counts when the viral load has been suppressed for at least 2 years and the CD4 count is above 500/μL, because it provides limited information and results rarely alter clinical management.[33] Choosing Wisely Canada also supports this recommendation, adding that CD4 levels should be rechecked if the viral load becomes detectable or an opportunistic infection is diagnosed.[32] In HIV patients with a CD4 count above 350/μL, it is very unlikely for CD4 levels to drop below 200/μL during a period of continuous viral suppression.[34] A more reliable marker of immune status is the CD4 percentage, which is less prone to wide fluctuations. Frequent measurements of CD4 levels might cause undue anxiety due to the normal variation of white blood cell counts, which can be influenced by stress, acute illness, or medications.[35] Yet the British Columbia Centre for Excellence in HIV/AIDS therapeutic guidelines (last revised March 2023) recommend annual CD4 monitoring for patients with a suppressed viral load and a CD4 count above 500/μL.[36] Patients with well-controlled HIV often have their CD4 levels measured when admitted to hospital for an acute illness unrelated to HIV. Testing during this time is not helpful, because CD4 levels might decline transiently and may not accurately reflect the patient's true immune status.[37] Substantial cost savings can be realized by curbing CD4 testing in stable HIV patients (i.e., suppressed viral load with CD4 greater than 500/μL).[37]

Conclusions

Overtesting, which leads to overtreating, is far too common in infectious diseases practice. The patient is harmed by the physical discomfort of diagnostic investigations, the inconvenience of repeated testing, and anxiety over abnormal results that are clinically irrelevant. The health care system and environment are also impacted by increased demand on limited resources, prolonged wait times for patients who need the test, and excess medical waste. It is not a sufficient justification to order a test solely to satisfy one's curiosity or to alleviate anxiety if the evidence does not support its use. Following Choosing Wisely guidelines can enhance awareness of diagnostic stewardship and its benefits for patients and the health care system. Sometimes less is more. ■

Competing interests

None declared.

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