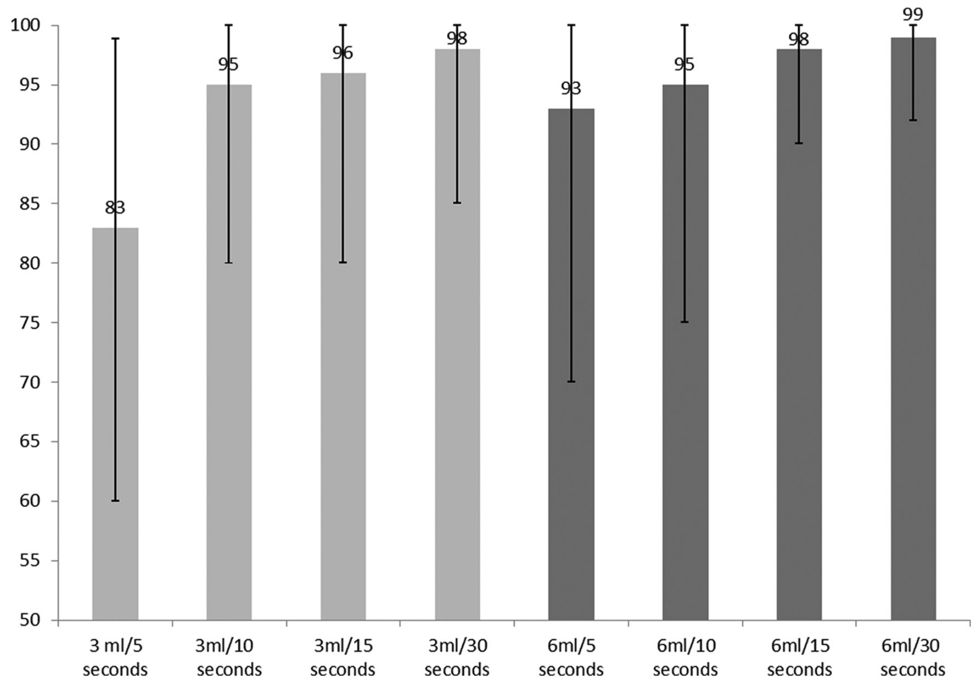

Fig. 1. Mean skin coverage in % and range of distribution with different volume/time combinations using fluorescent marker in alcoholic hand disinfectant.

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The varying specificity of urine cultures in different populations

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To the Editor—Diagnostic testing is essential in distinguishing patients who have a disease from those who do not. The accuracy of a test is described by sensitivity and specificity. Sensitivity reflects how many patients *with* disease have a positive test, and specificity reflects how many patients *without* disease have a negative test. When a test is applied to different populations, pretest probability changes, but not sensitivity or specificity because these are inherent characteristics of the test.[1] However, clinical experience suggest that urine cultures and other tests do not have fixed testing characteristics and that specificity can and does vary by population. We sought to explore the rule that sensitivity and specificity are fixed using a commonly ordered test—the urine culture.

Laboratory values reflect underlying microbiology, physiology, or biochemistry and must be accurate and consistent, but to be clinically useful a diagnostic test must distinguish patients with and without clinical disease. Urinary tract infection (UTI) requires symptoms in addition to the presence of a microorganism. For microbiology tests, positive results indicating the presence of a potentially pathogenic organism in the absence of symptomatic disease are common and are known as asymptomatic colonization or asymptomatic bacteriuria (ASB). Treatment of ASB is a leading cause of antibiotic overuse.[2] Urine cultures are among the most commonly ordered tests but are often misinterpreted, especially in older, sicker populations.

We searched the English-language medical literature using the terms urine culture, urinary tract infection, and sensitivity or specificity. This search was supplemented by a manual review of the bibliographies of all identified articles. One author (K.C.T) initially screened the titles and abstracts of the search results. Two authors (K.C.T and D.J.M.) then independently reviewed and abstracted data from the articles identified as relevant.

We identified 1,075 articles, of which 18 satisfied the criteria of reporting sensitivity or specificity of urine cultures.[2–7] Of these, 13 were summarized in 1 guideline.[2] Articles were analyzed for sensitivity and specificity using 10^5 colony-forming units per milliliter as the criteria for comparison (Table 1). For multiple studies of the same population, a weighted average for sensitivity and specificity was calculated.

Urine cultures had a sensitivity of ~90% for UTI in healthy outpatient women (Table 1). We found no studies of the sensitivity of urine cultures for other populations. We found highly variable specificity for urine culture to identify UTI, from 80%–90% in healthy outpatients down to nearly 0% in patients with chronic indwelling catheters.

The specificity of urine cultures varies greatly by population, from 0% to 90%, which contradicts the rule that the specificity of a diagnostic test does not change by population. This finding has broad implications for urine testing and treatment in different patient groups. Biologically, this variability in specificity results from different populations having factors that lead to chronic bacterial colonization, leading to false-positive results in patients without symptoms of UTI. Although urine cultures are accurate for presence of bacteria, they are nonspecific for the presence of clinical UTI. Other examples of widely used tests in which sensitivity or specificity vary by population are *Clostridium difficile*[8] and B-type natriuretic peptide (BNP).[9]

Correct application of diagnostic testing is complex. Appreciating potential variation in specificity by population tested is important for patient care. With urine cultures, treatment of false-positive urine cultures, or ASB, risks antibiotic exposure without clinical benefit. Varying specificity for this test across populations emphasizes the need to identify sensitivity and specificity within similar populations to the ones that the test will be applied to, and potentially determine, sensitivity and specificity for multiple populations. In an age of electronic records, the reporting of urine cultures and the predictive value of the results could easily be tailored to the type of patient tested. Additionally, the varied specificity of urine cultures means we need different diagnostic stewardship for urine cultures in long-term care, inpatient care, and outpatient care settings.[10] By appreciating the nuances of diagnostic testing for UTI and other diseases, we can leverage currently available technology to provide better diagnoses and patient care.

Table 1. Sensitivity, Specificity and Clinical Usefulness of Urine Culture for Diagnosis of Urinary Tract Infection (UTI) in Different Patient Populations

Patient Population	Sensitivity, %	Specificity, %	Clinical Use
Healthy outpatient women[2–7]	90	86	Can confirm diagnosis of UTI in patient with symptoms
Elderly outpatients (age ≥70 ys)[2]	[a]	90	Can confirm diagnosis of UTI in patient with symptoms
Elderly in long-term care facility (age ≥70 y)[2]	[a]	70	Small impact on diagnosis, helps for antibiotic selection
Chronically ill (diabetes; kidney transplant)[2]	[a]	76–95	Small impact on diagnosis, helps for antibiotic selection
Spinal cord injury with intermittent catheter use[2]	[a]	54	Only useful for antibiotic selection
Spinal cord injury with sphincterotomy/ condom catheter[2]	[a]	43	Only useful for antibiotic selection
Acute indwelling catheter use[2]	[a]	Decreases 3%–5% per catheter day[b]	Varies by duration of catheter use
Chronic indwelling catheter use[2]	[a]	2	Only useful for antibiotic selection

Note. For brevity, studies of specificity are summarized in the Infectious Disease Society of America guidelines for management of asymptomatic bacteriuria (ASB).[2] These guidelines report false-positive rate or ASB, which is 1-specificity. When rates of ASB are described, this is the false positive rate of urine culture testing, which was calculated as 1-specificity of the test.
[a]No studies identified reported sensitivity of urine cultures in these populations.
[b]The prevalence of asymptomatic bacteriuria or a positive urine culture without UTI increases 3%–5% per day of catheterization, therefore the specificity decreases by 3%–5% per day.

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The Hawthorne effect in observational studies:Threat or opportunity?

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To the Editor—In the December 2019 issue of *Infection Control and Hospital Epidemiology*, Mills et al[1] described factors that influence hand hygiene compliance in nursing facilities. Direct observation is used for data collection in this study. One of the problems in observational studies is the Hawthorne effect. However, insufficient control for the Hawthorne effect is a major problem in observational studies.

Hand hygiene (HH) is a simple way to prevent healthcare-associated infections (HAIs). Several methods can be used to measure HH, such as direct observation and measuring the amount of solutions used for hand hygiene (soap and alcoholic ingredients), but direct observation is a key standard method recommended by the World Health Organization.[2] In this method, the observer reviews the behavior of individuals in terms of performance. The first problem occurs because people often change their behavior when they know they are being observed. In fact, change in behavior and performance in the presence of an observer, termed reactivity, can influence the HH compliance rate and may not be an accurate representation of that behavior. Therefore, it is necessary to control reactivity in observational studies.[3]

The control of reactivity in research can be achieved using several methods. First, behavior can be measured when people do not know they are being assessed. In other words, observation is unobtrusive (nonreactive).[3] This approach can be applied in various ways, including hiding the observer or using hidden mechanical recording devices. Adaptation of participants to the presence of an observer through habituation or desensitization is another way to inhibit reactivity. In the habituation approach, the observer explains the process of the project to the participant engaged in clinical activities, and the observer is present on different occasions until the participant no longer reacts to being observed. Limiting the reactivity response through desensitization is similar to the desensitization process used in the behavioral treatment of phobias. This approach is often used by ethologists to adapt animal subjects to the presence of an observer.[3]

Reactivity is major problem that can increase error in measurements in observational studies. Attention to this problem from researchers who perform observational studies is an important first step. To control for reactivity in observational studies, it may be necessary to introduce oneself in different clinical settings.

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