Published in final edited form as:

Infect Control Hosp Epidemiol. 2013 November ; 34(11): 1204–1207. doi:10.1086/673449.

INAPPROPRIATE TESTING FOR URINARY TRACT INFECTION IN HOSPITALIZED PATIENTS: AN OPPORTUNITY FOR IMPROVEMENT

Sarah Hartley, MD¹, Staci Valley, MD¹, Latoya Kuhn, MPH³, Laraine L. Washer, MD^{1,4}, Tejal Gandhi, MD¹, Jennifer Meddings, MD, MS¹, Carol Chenoweth, MD¹, Anurag N. Malani, MD², Sanjay Saint, MD, MPH^{3,1}, Arjun Srinivasan, MD⁵, and Scott A. Flanders, MD¹

¹Department of Internal Medicine, University of Michigan

²St. Joseph Mercy Hospital, Ann Arbor, MI

³Patient Safety Enhancement Program (PSEP) and Hospital Outcomes Program of Excellence (HOPE) of the Ann Arbor Veterans Affairs Medical Center, Ann Arbor, MI 48109

⁴Department of Infection Control and Epidemiology, University of Michigan

⁵Healthcare Associated Infection Prevention Programs in the Division of Healthcare Quality Promotion at the Centers for Disease Control and Prevention

Abstract

Urine cultures are frequently obtained in hospitalized patients. We reviewed documented indications for culture and compared these to professional society guidelines. Lack of documentation and important clinical scenarios (prior to orthopedic procedures and altered mental status without a urinary catheter) are highlighted as areas of use outside of current guidelines.

Introduction

Infections of the urinary tract are common in hospitalized patients, accounting for approximately 35% of healthcare-associated infections, and are one of the most common indications for antimicrobial use.¹ However, many patients with asymptomatic bacteriuria are misdiagnosed with urinary tract infection (UTI) and receive antimicrobials, despite guidelines recommending against it. This practice contributes to adverse patient outcomes by exposing patients to unnecessary toxic effects, development of pathogenic organisms such as *Clostridium difficile*, and increasing rates of multi-drug resistant organisms.² Efforts to reduce antimicrobial overuse in hospitalized patients will need to target inappropriate treatment of asymptomatic bacteriuria. One important strategy to reduce treatment of asymptomatic bacteriuria is to reduce the unnecessary diagnostic testing that leads to its identification.

Guidelines and consensus statements have been issued for the management of positive urine cultures. These encompass asymptomatic bacteriuria, UTI (positive urine cultures in the setting of clinical manifestations supportive of the diagnosis), and catheter-associated UTI.^{2–7} The key differentiating factor in the evaluation of a patient with suspected UTI is

Address for correspondence: Sarah E. Hartley, MD, Clinical Instructor, University of Michigan Health System, 1500 E Medical Center Drive, SPC 5736, Ann Arbor, Michigan 48109, hartsara@med.umich.edu, Phone: (734) 647-1599, Fax: (734) 615-8401.

Potential conflicts of interest. SV and AS report no conflicts of interest.

initial assessment of clinical manifestations. In the absence of clinical manifestations of UTI, no diagnostic testing is indicated.

Past studies have targeted the overuse of urine cultures in the hospital as a potential area of cost reduction, but urine culture utilization is also a ripe target for reducing antimicrobial overuse. Clinician adherence to guideline recommendations for ordering urine cultures and factors associated with testing outside of those indications have not been well described. We reviewed medical records to evaluate the indication for urine cultures in a diverse group of hospitalized patients, and identify factors associated with testing outside professional guideline and consensus statement recommendations.

Methods

All inpatients 18 years of age or older who had a urine culture obtained between February 2008 and February 2009 at the University of Michigan Health System were eligible for inclusion. From this population a random sample of 275 patients was selected for medical record review who had a urine culture sent during hospital admission or while the patient was in the process of being admitted such that results returned while the patient was hospitalized. Patients with the following characteristics were excluded: prior renal transplant or urinary diversion surgery, urinary stents or nephrostomy tubes in place, admitted to the intensive care unit at the time of culture, pregnancy, treatment for UTI as an outpatient at the time of admission or receiving empiric treatment for UTI for greater than 48 hours prior to urine culture, discharged or died before the urine culture results were reported.

Criteria for testing according to published guidelines and consensus conferences were compiled.²⁻⁷ The final list of indications required consensus by the entire study team (Table 1). Inter-rater reliability was assessed using the kappa statistic.

Results

A total of 208 patients were included (Table 2); 120 (57.7%) patients did not meet guideline-based criteria for a urine culture. Of these, 75 patients (62.5%) had a reason documented that was inconsistent with current guidelines, including screening for bacteriuria before an orthopedic procedure (n= 24, 20.0%) and altered mental status without a urinary catheter present (n= 16, 13.3%). There was no documented reason for ordering the culture in 45 patients (37.5%). Among patients meeting guideline-based criteria (n= 88, 42.3%), fever was the most common sign (n= 65, 73.9%) while clinical manifestations more specific to the urinary tract were present in only 21 patients (23.9%).

One hundred seventy-six (84.6%) urine cultures had no growth, and this rate was similar regardless of the presence or absence of guideline-based criteria (84.1% vs. 85.0%). Approximately one-third of patients (n=67, 32.2%) received antimicrobials within 48 hours prior to urine culture. The kappa statistic for agreement on indications for culture was 0.89, indicating excellent agreement.

Discussion

Our findings highlight areas of tension between clinical practice and guideline-based recommendations, including obtaining urine culture prior to orthopedic procedures and in patients with altered mental status without a urinary catheter. Prosthetic joint infections with organisms originating in the urinary tract have been described, but are rare. Recent retrospective evaluation of the treatment of asymptomatic bacteriuria prior to orthopedic procedures showed higher rates of skin and soft tissue infections and postoperative UTI in those treated for bacteriuria preoperatively.⁸ There are no current UTI guideline or

consensus statement recommendations specific to this population. Altered mental status in patients without a urinary catheter, while a common reason for ordering urine cultures, is not a guideline-supported indication. The geriatric literature, however, supports the idea that the delirious elder may not be able to verbalize complaints specific to the urinary tract and endorses evaluation for occult infection with urinalysis.⁹

Importantly, lack of documentation of the indication for urine culture was common. While not necessarily reflecting inappropriate testing, results of urine culture can be difficult to interpret if documentation is lacking. Poor communication, including poor documentation, between providers has been highlighted as the root cause of sentinel events reported to The Joint Commission and is an area of continued work for quality improvement in health care.

In patients who met guideline-based clinical criteria for ordering cultures, fever was the sole indication in nearly three-quarters. Fever is common in hospitalized patients, not specific for UTI, and often represents another source of infection or an underlying inflammatory state. This coupled with prevalent empiric antimicrobial use in our study population likely contributed to low rates of culture positivity, further complicates the evaluation and management of UTI, and may contribute to overuse of antimicrobials.

Our study has important limitations. The retrospective design relies on determination of clinical manifestations of UTI based on clinician documentation at the time of care and results from a single center may affect generalizability. Prior findings of poor performance in the diagnosis and treatment of UTI, however, suggest that the problems we identified may be widespread.¹⁰ Further, our low rates of culture positivity preclude evaluation of the management of asymptomatic bacteriuria, and thus any direct link between testing and inappropriate antimicrobial use. These limitations should be assessed along with the strengths of our evaluation, which include a rigorous method for medical record abstraction, the consolidation of multiple national guidelines and consensus statements to a single list of criteria, and excellent inter-rater agreement.

Previous efforts to reduce urine culture utilization have included requiring use of a screening urinalysis and if positive, subsequent urine culture. However, this approach fails to align the clinical indications emphasized in current guidelines with the diagnosis of UTI. Targeted educational efforts and perhaps guideline modifications addressing problematic clinical scenarios we identified, such as elective orthopedic surgery and delirium, may be more effective. Additionally, symptoms specific to the urinary tract which are highly associated with UTI are emphasized in current guidelines, yet we found that hospitalized patients more often have non-specific clinical manifestations including fever and altered mental status. Ideally, future research might identify biomarkers offering more precise diagnostic guidance, thus aiding in the management of patients without specific urinary symptoms or who are on antimicrobials at the time of urine culture. Finally, the indications for ordering urine cultures are often not documented in the medical record. Requiring an indication be documented at the time of ordering might mitigate this problem. Efforts targeting use of urine cultures in hospitalized patients will play an important role in improving antimicrobial stewardship.

Acknowledgments

Potential conflicts of interest. LK, LW, TG, AM, SF reported that money has been paid to their institution as a grant from the CDC Foundation.

Potential conflicts of interest. SH reported money had been paid to her for consultancy from Society of Hospital Medicine.

Potential conflicts of interest. LW reported money had been paid to her institution for grants/grants pending from the National Institutes of Health (NIH)/ National Institute of Allergy and Infectious Diseases (NIAD).

Potential conflicts of interest. JM reported money had been paid to her institution for grants from AHRQ and NIH-LRP and grants/grants pending from Agency for Healthcare Research and Quality (AHRQ); money paid to her for employment at The University of Michigan Health System; payment for lectures including service on speakers bureaus for various professional and non-profit organizations (eg, Society for Healthcare Epidemiology of America (SHEA), and the Central Society for Clinical Research/CSCR, Wound Ostomy & Continence Nurses Society/WOCN); payment for manuscript preparation from RAND/AHRQ honorarium for preparation of AHRQ Chapter update on prevention of catheter-associated UTI; payment for development of educational presentations from SHEA; money paid to her institutions for grants/grants pending from AHRQ; travel/accommodations/meeting expenses unrelated to activities listed from AHRQ and Blue Cross Blue Shield of Michigan Foundation.

Potential conflicts of interest. CC reported money had been paid to her for employment at Infection Control and Epidemiology; travel/accommodations/meeting expenses unrelated to activities listed from SHEA

Potential conflicts of interest. SF reported that money has been paid to him for consultancy for the Institute for Healthcare Improvement and Society of Hospital Medicine; employment at the University of Michigan; expert testimony one expert review per year; payment for lectures including service on speakers bureaus for honorarium for various talks at hospitals as a visiting professor; royalties from Wiley Publishing; payment to his institution for grants/grants pending from CDC Foundation, Blue Cross Blue Shield of Michigan, Michigan Hospital Association

Potential conflicts of interest. SS reported that money has been paid to the University of Michigan as grants/grants pending from the NIH, Veteran's Administration, and AHRQ, Blue Cross Blue Shield of Michigan Foundation; and to him for employment at the University of Michigan and Ann Arbor VA Medical Center; expert testimony on legal cases focusing on medical malpractice; payment for lectures including service on speakers bureaus for Honoraria for talks at academic meetings, group-purchasing organizations (eg, VHA, Premier), state hospital associations (eg, Michigan Health and Hospital Association), visiting professorships, non-profit foundations (eg, IHI); no speakers bureau work; royalties from Lippincott Williams and Wilkins; McGraw-Hill; Wiley-Blackwell - all for books he has authored or edited; stock/stock options from Doximity.

Role of Funding Source: CDC Foundation

References

1. Griebing TL. Urologic diseases in America project: trends in resource use for urinary tract infections in med. J Urol. 2005; 173(4):1288–1294. [PubMed: 15758784]
2. Nicolle LE, Bradley S, Colgan R, Rice JC, Schaeffer A, Hooten TM. Infectious Diseases Society of America guidelines for the diagnosis and treatment of asymptomatic bacteriuria in adults. Clin Infect Dis. 2005; 40(5):643–654. [PubMed: 15714408]
3. Gupta K, Hooten TM, Naber KG, et al. International clinical practice guidelines for the treatment of acute uncomplicated cystitis and pyelonephritis in women: A 2010 update by the Infectious Diseases Society of America and the European Society for Microbiology and Infectious Diseases. Clin Infect Dis. 2011; 52(5):e103–e120. [PubMed: 21292654]
4. Hooten TM, Bradley SF, Cardenas DD, et al. Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in adults: 2009 International Clinical Practice Guidelines from the Infectious Diseases Society of America. Clin Infect Dis. 2010; 50(5):625–663. [PubMed: 20175247]
5. The prevention and management of urinary tract infections among patients with spinal cord injuries. National Institute on Disability and Rehabilitation Research Consensus Statement. J Am Paraplegia Society. 1992; 15(3):194–204.
6. Loeb M, Bentley D, Bradley S, et al. Development of minimum criteria for the initiation of antibiotics in residents of long-term-care facilities: results of a consensus conference. Infect Control Hosp Epidemiol. 2001; 22(2):120–124. [PubMed: 11232875]
7. The National Healthcare Safety Network (NHSN) Manual. Atlanta, GA: CDC Division of Healthcare Quality Promotion; 2009. Chapter 7. Catheter-Associated Urinary Tract Infection (CAUTI) Event. Available from: http://www.cdc.gov/nhsn/PDFs/pscManual/pscManual_current.pdf
8. Drekonja DM, Zarmbinski B, Johnson JR. Preoperative urine cultures at a Veterans Affairs Medical Center. Arch Intern Med. 2012;1–2. [PubMed: 22710831]

9. Inouye SK. The dilemma of delirium: clinical and research controversies regarding diagnosis and evaluation of delirium in hospitalized elderly medical patients. *Am J Med.* 1994; 97(3):278–288. [PubMed: 8092177]
10. Lin E, Bhusal Y, Horwitz D, Shelburne SA 3rd, Trautner BW. Overtreatment of enterococcal bacteriuria. *Arch Intern Med.* 2012; 172(1):33–38. [PubMed: 22232145]

Table 1

Appropriateness Criteria for Sending a Urine Culture Based on National and Professional Society Guidelines and Consensus Statements²⁻⁷

Urinary Catheter Present (Indwelling catheter, condom catheter, or intermittent straight catheterization) [*] , ⁺⁺
<ul style="list-style-type: none"> • New onset of fever (>38 degrees Celsius) or provider report of fever^{4,5,6,7} • Rigors^{4,6} • Altered mental status without an alternative cause^{4,6} • Suprapubic pain or tenderness^{4,5,7} • Acute hematuria⁴ • Costovertebral pain or tenderness^{4,5,6,7} • Increased spasticity or autonomic dysreflexia (In patients with spinal cord injury)^{4,5}
Urinary Catheter Removed <48 hours prior [*] , ⁺⁺
<ul style="list-style-type: none"> • Any of the above criteria or • Urgency^{4,7} • Frequency^{4,7} • Dysuria^{4,7}
No history of urinary catheter or removal >48 hours prior to development of symptoms ⁺⁺
<ul style="list-style-type: none"> • Fever >38 C^{6,7} • Urgency^{6,7} • Frequency^{6,7} • Dysuria⁷ • Costovertebral pain or tenderness^{6,7} • Suprapubic pain^{6,7} • Acute hematuria⁶ • New or worsening incontinence⁶

^{*} Criteria presented by Hooten is Level A-III consistent with good evidence to support a recommendation for or against and represents evidence of opinions of respected authorities based on clinical expertise, descriptive studies, or reports of expert committees.⁴

⁺⁺ Additional guidelines and the consensus statement did not state a level of evidence and therefore, are assumed to reflect expert opinion.^{2,3,5-7}

Table 2

Patient Characteristics

Characteristic	Total n=208	Met guideline based criteria for ordering urine culture n=88	Did not meet guideline based criteria for ordering urine culture n=120	p-value
Age, mean (range)	59 (18–95)	55	61	0.01
Gender, n (%)				0.34
Female	105 (50.5%)	41 (46.6%)	64 (53.3%)	
Male	103 (49.5%)	47 (53.4%)	56 (46.7%)	
Race, n (%)				
Caucasian	167 (80.3%)	69 (78.4%)	98 (81.7%)	0.56
African American	24 (11.5%)	11 (12.5%)	13 (10.8%)	0.71
Unknown/Other	17 (8.2%)	8 (9.1%)	9 (7.5%)	0.68
Admitting Source, n (%)				
Emergency department	107 (51.4%)	54 (61.4%)	53 (44.2%)	0.01
From outpatient procedure/day of procedure	45 (21.6%)	10 (11.4%)	35 (29.2%)	<0.01
Direct admission (clinic, home, or observation unit)	35 (16.8%)	16 (18.2%)	19 (15.8%)	0.66
Transfer from another acute-care hospital	10 (4.8%)	2 (2.3%)	8 (6.7%)	0.20 *
Other/Unknown [†]	11 (5.3%)	6 (6.8%)	5 (4.2%)	0.53 *
Length of Stay, days				
Mean	11.9	11.2	12.4	0.63
Median	6	6	6	
Range	2–126	2–126	2–120	
Catheter present at time of urine culture or 48 hours prior to collection of urine culture, n (%)	63 (30.3%)	20 (22.7%)	43 (35.8%)	0.04
On antimicrobials at the time of urine culture or 48 hours prior to collection of urine culture, n (%)	67 (32.2%)	34 (38.6%)	33 (27.5%)	0.09
Service when urine culture was ordered, n (%)				
Internal Medicine	91 (43.8%)	42 (47.7%)	49 (40.8%)	0.32
Surgery	66 (31.7%)	19 (21.6%)	47 (39.2%)	<0.01
Emergency Department	38 (18.3%)	22 (25.0%)	16 (13.3%)	0.03
Other ^{††}	13 (6.2%)	5 (5.7%)	8 (6.7%)	0.77

* P values were determined from the Fisher's exact test

[†] Includes Transfer from other facility, Distinct Part Unit (rehabilitation/psychiatric unit) (separate admission), and unknown/missing

^{††} Includes Family Medicine, Psychiatry, Neurology, Physical Medicine and Rehabilitation, and Cannot Determine