

ORIGINAL RESEARCH

Impact of Antibiotic Choices Made in the Emergency Department on Appropriateness of Antibiotic Treatment of Urinary Tract Infections in Hospitalized Patients

Dmitry Kiyatkin, MD¹, Edward Bessman, MD², Robin McKenzie, MD^{3*}

¹Collaborative Inpatient Medical Service, Department of Medicine, Johns Hopkins Bayview Medical Center, Baltimore, Maryland; ²Department of Emergency Medicine, Johns Hopkins Bayview Medical Center, Baltimore, Maryland; ³Division of Infectious Diseases, Department of Medicine, Johns Hopkins Bayview Medical Center, Baltimore, Maryland.

BACKGROUND: Overuse of antibiotics to treat urinary tract infections (UTIs) is common in hospitalized patients and may begin in the emergency department (ED).

METHODS: For a 4-week period we reviewed medical records of all patients admitted to the hospital who initiated treatment for a UTI in the ED.

RESULTS: According to study criteria, initiation of antibiotics was inappropriate for 55 of 94 patients (59% [95% confi-

dence interval {CI}, 48%-69%]), and continuation after admission was inappropriate for 54 of 80 patients (68% [95% CI, 57%-78%]).

CONCLUSION: Failure to reevaluate the need for antibiotics initiated in the ED to treat UTIs may lead to overuse of antibiotics in hospitalized patients. *Journal of Hospital Medicine* 2016;11:181-184. © 2015 Society of Hospital Medicine

After pneumonia, urinary tract infection (UTI) is the second most commonly diagnosed infection leading to hospitalization.¹ However, a large proportion of those admitted with a diagnosis of UTI do not meet diagnostic criteria and receive inappropriate antibiotic therapy.^{2,3} Because antibiotic treatment often begins in the emergency department (ED), we conducted a study to determine the rate of initiation of inappropriate antibiotic treatment for UTIs in the ED and the rate of continuation of inappropriate antibiotics after admission to the hospital.

METHODS

We retrospectively identified all patients admitted from the ED of Johns Hopkins Bayview Medical Center, a tertiary, acute care hospital during 4 nonconsecutive weeks in the winter of 2012 to 2013. We reviewed ED and hospital records of all patients with positive urinalyses who initiated antibiotic treatment in the ED for a diagnosis of UTI. A positive urinalysis was defined as the presence of more than 5 leukocytes per high-power field, leukocyte esterase, or nitrites. In the ED, approximately two-thirds of urinalyses were ordered via order sets, and the majority of patients

were evaluated by nurse practitioners and physician assistants.

In the absence of specific guidelines for the treatment of UTIs in the ED, criteria for this study were based on the Centers for Disease Control and Prevention (CDC) surveillance definitions,⁴ the Infectious Diseases Society of America guidelines for asymptomatic bacteriuria,⁵ and the Society for Healthcare Epidemiology of America (SHEA) criteria for diagnosing and treating UTIs in long-term care facilities.^{6,7} We defined initiation of antibiotic treatment in the ED for a potential UTI as appropriate only if the patient had a positive urinalysis and 1 or more of the following: (1) fever (temperature >38°C), (2) a urinary symptom or sign (urgency, frequency, dysuria, suprapubic tenderness, or costovertebral angle pain or tenderness), (3) an indication for treating asymptomatic bacteriuria (pregnancy or a planned invasive urologic procedure), or (4) altered mental status in the presence of a chronic urinary catheter.^{6,7} Continuation of antibiotics was considered inappropriate if 1 or more doses were given after admission to patients who did not meet the above criteria for appropriate initiation of antibiotics (regardless of urine culture results). For patients who met the above criteria, continuation was considered inappropriate if the urine culture grew no organisms or only grew nonpathogenic urogenital flora and the patient received antibiotics for 3 or more days.

Urine culture results were reported as positive if >10⁴ organisms per milliliter grew on semiquantitative culture. The following were considered potential uropathogens: enteric gram-negative rods (GNRs), non-lactose fermenting GNRs, *Corynebacterium urealyticum*, yeast, group B streptococci, *Enterococcus*

*Address for correspondence and reprint requests: Robin McKenzie, MD, Division of Infectious Diseases, Johns Hopkins University, Johns Hopkins Bayview Medical Center, 5200 Eastern Ave., MFL Center Tower, 3rd Floor, Baltimore, MD 21224; Telephone: 410-614-6254; Fax: 410-550-1169; E-mail: rmckenz@jhmi.edu

Additional Supporting Information may be found in the online version of this article.

Received: June 7, 2015; Revised: October 1, 2015; Accepted: October 6, 2015

2015 Society of Hospital Medicine DOI 10.1002/jhm.2508

Published online in Wiley Online Library (Wileyonlinelibrary.com).

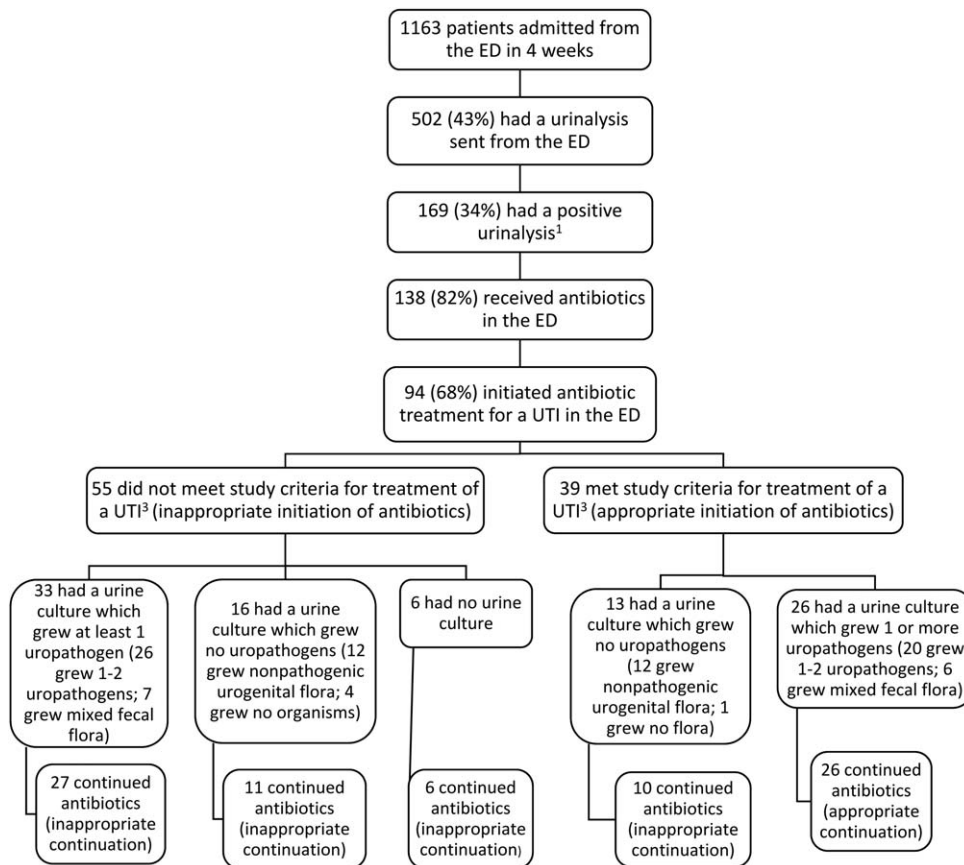


FIG. 1. Study design and major findings. Flowchart indicates procedure for identifying 94 patients who initiated antibiotic treatment for a UTI in the ED. Study criteria were used to designate inappropriate and appropriate initiation of antibiotic treatment of UTIs in the ED. Patients with antibiotic treatment initiated inappropriately in the ED who continued antibiotic treatment after admission were considered to be inappropriately continued on antibiotics regardless of the results of urine cultures. Also, those with an indication to start antibiotics in the ED who continued antibiotics for 3 days or more in spite of urine cultures that failed to grow a uropathogen were considered to be inappropriately continued on antibiotics. Abbreviations: ED, emergency department; UTI, urinary tract infection.

spp., *Staphylococcus aureus*, *Staphylococcus saprophyticus*, *Staphylococcus lugdunensis*, and *Aerococcus urinae*. More than 2 potential uropathogens were reported as mixed fecal flora. The following were considered to be nonpathogenic urogenital flora: coagulase-negative staphylococci not designated as potential uropathogens, *Lactobacillus* spp, urease-negative *Corynebacterium*, viridans group streptococci, and *Gardnerella vaginalis*. Specimens with mixed fecal flora and specimens with 1 to 2 uropathogens were grouped together as containing a potential uropathogen. Cultures that grew no organisms or only nonpathogenic urogenital flora were labeled as containing no uropathogen.

RESULTS

Of 1163 patients admitted to the hospital from the ED, 138 began antibiotic therapy for either a presumed UTI (94 patients) or another infection (44) (Figure 1). Non-UTI infections included pneumonia (23), skin and soft tissue infection (9), intra-abdominal infection (8), and other (4).

For the 94 patients treated for a UTI in the ED, the mean age was 67 years, and 77% were women. Ten had a chronic urinary catheter, and 13 came from a

long-term care facility. Eighty of these patients continued antibiotics after admission.

According to study criteria, 55 of the 94 patients (59%) who initiated treatment for a UTI in the ED had no indication to do so. These 55 patients had a variety of admitting diagnoses other than UTI (Table 1); 25% were admitted with altered mental status. Forty-four of these 55 (80%) continued antibiotics (inappropriately) after admission, including 11 patients whose urine cultures grew no uropathogens.

Of the 39 patients with an indication to initiate treatment for a possible UTI, 13 had urine cultures (taken before antibiotics were administered) that grew no uropathogens, yet 10 of these patients continued antibiotics inappropriately after admission (Figure 1).

In summary, initiation of antibiotics in the ED was inappropriate for 55 of 94 patients (59% [95% confidence interval {CI}, 48%-69%]), and continuation after admission was inappropriate for 54 of 80 patients (68% [95% CI, 57%-78%]).

DISCUSSION

According to study criteria, the majority of patients treated for a UTI in the ED before admission initiated antibiotic treatment inappropriately in the ED and

TABLE 1. Admission Diagnoses in 55 Patients With Positive Urinalyses but No Indication for Treating a Urinary Tract Infection Who Received Antibiotic Treatment for a Diagnosis of Urinary Tract Infection in the Emergency Department

Admission Diagnosis	No. of Patients With Diagnosis (%)	Mean Age, y	No. of Women (%)	No. of Patients Continuing Antibiotics After Admission (%)
Altered mental status*	14 (25)	76	11 (79)	14 (100)
Syncope or near syncope	7 (13)	72	6 (86)	5 (71)
Other neurologic conditions [†]	6 (11)	64	5 (83)	6 (100)
Mechanical falls	6 (11)	85	5 (83)	4 (67)
Gastrointestinal conditions [‡]	8 (15)	53	6 (75)	3 (38)
Psychiatric conditions	3 (5)	32	4 (100)	4 (100)
Other [§]	11 (20)	72	9 (79)	9 (79)
All patients	55 (100)	69	46 (84)	45 (82)

NOTE: *Altered mental status (11), delirium (1), hepatic encephalopathy (1), hypoglycemia (1). [†]Possible stroke (3), seizure (1), headache (1), newly diagnosed brain tumor (1). [‡]Nausea and vomiting or abdominal pain (4), gastroenteritis (1), gastrointestinal bleeding (1), cholecystitis (1), pancreatitis (1). [§]Chest pain (3), epigastric pain (1), shortness of breath, (1) cough (1), atrial fibrillation (1), weakness (1), chronic pain (1), acute renal failure (1), alcohol withdrawal (1).

continued antibiotics inappropriately after admission. Our findings suggest several points where intervention could interrupt this chain of events.

Reducing the number of urinalyses ordered in the ED could reduce inappropriate treatment.⁸ In this study, 43% of patients admitted from the ED had urinalyses, many obtained via order sets before evaluation by a clinician. Although triage order sets improve ED throughput,⁹ they also produce extraneous results that may lead to unnecessary interventions. We suggest removing urinalyses from order sets for conditions for which a UTI is unlikely to contribute.

In this study altered mental status was a common diagnosis among patients categorized as receiving inappropriate antibiotics in the ED. All patients with altered mental status continued antibiotic treatment after admission. According to the study definition (and CDC and SHEA criteria^{4,6,7}), bacteriuria and altered mental status without additional criteria (urinary symptoms or signs, fever, or an indwelling urinary catheter) are insufficient for the diagnosis of a symptomatic UTI. Since the study was conducted, the CDC surveillance definition for UTIs in long-term care has been updated and now includes the new onset of confusion in catheterized individuals only if leukocytosis is also present.¹⁰ Because patients at the greatest risk of developing altered mental status—the frail elderly—also have high rates of asymptomatic bacteriuria (up to 40%–50% in nursing home residents⁵), the 2 conditions co-occur frequently by chance alone. Although it is common to attribute altered mental status in a patient with pyuria or bacteriuria to a UTI, there are no convincing data to support a causal relationship for patients who are otherwise asymptomatic.¹¹ An alternative approach for stable patients is careful observation while withholding antibiotics and looking for other causes of altered mental status.¹¹

Inappropriate treatment may also stem from misunderstanding the significance of asymptomatic pyuria and bacteriuria, common findings in certain popula-

tions. The only evidence-based indications for treatment of asymptomatic bacteriuria are pregnancy and planned invasive urinary tract procedures.⁵ For several other populations, strong randomized trials show no benefit.⁵

Obtaining a good specimen for urinalysis and culture is often problematic. In this study, 37 of 88 cultures (42%) grew mixed fecal or nonpathogenic urogenital flora and appeared to be contaminated. Reporting techniques can be influential.¹² Microbiology reports could state that mixed urogenital flora and mixed fecal flora often represent contamination.

Human factors may also contribute to the inappropriate continuation of antibiotic therapy started in the ED. Hospital providers may not question a diagnosis made by another provider, especially if no alternative diagnosis emerges. Coincidental improvement with antimicrobial treatment may be mistaken as evidence of efficacy. Clinicians may be reluctant to tell a patient or family that the initial diagnosis and treatment plan were incorrect.

This study has several limitations. First, this review was retrospective. Omission of undocumented symptoms could lead to an overestimation of inappropriate antibiotic treatment. Alternatively, several factors could lead to an underestimation: patients treated for a UTI in the ED were identified only among those with positive urinalyses; cultures with mixed fecal flora were accepted as containing a potential uropathogen in spite of the high likelihood of contamination. Also, the study definition of appropriate antibiotic treatment was less stringent than guidelines on which it was based. The generalizability is limited by the single-center design, and results may not apply to centers with different staffing in their EDs or less utilization of order sets. Finally, the study definition was derived from guidelines that were not developed specifically for use in the ED.

In conclusion, we found a high rate of inappropriate antibiotic administration for UTIs that began in the ED and continued after admission. Overall,

providers in the ED should aim not to detect or treat asymptomatic pyuria, and clinicians in the hospital should reevaluate the need for antibiotic treatment started in the ED. Specific guidelines should be developed and validated to direct diagnosis and treatment of UTIs in the ED and hospital.

Disclosures: The information in this article was presented in part at the Society of Hospital Medicine annual meeting on March 24–27, 2014. No financial support was provided, and no conflicts of interest exist for any author.

References

1. Christensen KL, Holman RC, Steiner CA, Sejvar JJ, Stoll BJ, Schonberger LB. Infectious disease hospitalizations in the United States. *Clin Infect Dis*. 2009;49:1025–1035.
2. Gross P, Patel B. Reducing antibiotic overuse: a call for a national performance measure for not treating asymptomatic bacteriuria. *Clin Infect Dis*. 2007;45:1335–1337.
3. Gandhi T, Flanders SA, Markovitz E, Saint S, Kaul DR. Importance of urinary tract infection to antibiotic use among hospitalized patients. *Infect Control Hosp Epidemiol*. 2009;30:193–195.
4. Centers for Disease Control and Prevention. CDC/NHSN surveillance definition of healthcare-associated infection and criteria for specific types of infections in the acute care setting. 2013. Available at: http://www.cdc.gov/nhsn/pdfs/pscmanual/17pscnosinfdef_current.pdf. Accessed August 2014.
5. Nicolle LE, Bradley S, Colgan R, et al. Infectious Diseases Society of America guidelines for the diagnosis and treatment of asymptomatic bacteriuria in adults. *Clin Infect Dis*. 2005;40(5):643–654.
6. Loeb M, Bentley DW, 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;22:120–124.
7. Loeb M, Brazil K, Lohfeld L, et al. Effect of a multifaceted intervention on number of antimicrobial prescriptions for suspected urinary tract infections in residents of nursing homes: cluster randomised controlled trial. *BMJ*. 2005;331(7518):669.
8. Yin P, Kiss A, Leis JA. Urinalysis orders among patients admitted to the general medicine service. *JAMA Intern Med*. 2015;175(10):1711–1713.
9. Retezar R, Bessman E, Ding R, Zeger SL, McCarthy ML. The effect of triage diagnostic standing orders on emergency department treatment time. *Ann Emerg Med*. 2011;57:89–99.
10. Centers for Disease Control and Prevention. Urinary tract infection (UTI) event for long-term care facilities. Available at: http://www.cdc.gov/nhsn/PDFs/LTC/LTCF-UTI-protocol_FINAL_8-24-2012.pdf. Accessed September 2015.
11. McKenzie R, Stewart MT, Bellantoni MF, Finucane TE. Bacteriuria in patients who become delirious. *Am J Med*. 2014;127:255–257.
12. Leis JA, Rebick GW, Daneman N, et al. Reducing antimicrobial therapy for asymptomatic bacteriuria among noncatheterized inpatients: a proof-of-concept study. *Clin Infect Dis*. 2014;58:980–983.