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BRIEF REPORT

Reducing Antimicrobial Therapy for Asymptomatic Bacteriuria Among Noncatheterized Inpatients: A Proof-of-Concept Study

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This proof-of-concept study demonstrates that no longer routinely reporting urine culture results from noncatheterized medical and surgical inpatients can greatly reduce unnecessary antimicrobial therapy for asymptomatic bacteriuria without significant additional laboratory workload. Larger studies are needed to confirm the generalizability, safety, and sustainability of this model of care.

Keywords. asymptomatic bacteriuria; urine culture; antimicrobial stewardship.

Antimicrobial therapy for asymptomatic bacteriuria (ASB) is only indicated in pregnant patients and those undergoing genitourinary procedures in which mucosal bleeding is expected [1]. Outside these patient populations, treatment confers no benefit and causes adverse drug reactions, *Clostridium difficile* infection, and selection for infection with increasingly resistant bacteria [2–4]. Despite compelling evidence and clinical practice guidelines recommending against treatment for ASB in nonpregnant adults, studies in hospitalized patients and residents of long-term-care facilities have consistently found that up to two-thirds of patients with ASB still receive antimicrobial therapy [5–7].

Preventing ordering of urine cultures without clinical indication is a complex task, requiring modification of long-standing practices and beliefs among physicians and nurses [7, 8]. We considered a method of bypassing these difficult-to-change behaviors by intervening at the stage of laboratory reporting. In a recent prospective audit of medical and surgical inpatients, we noted that urine cultures submitted from noncatheterized patients were rarely associated with symptomatic urinary tract infection (UTI) [7]. Symptomatic patients were significantly more likely to receive empiric therapy at the time of test ordering than asymptomatic patients, with the latter almost always receiving antibiotics in response to positive culture results. We hypothesized that urine cultures from noncatheterized inpatients were being sent with a low pretest probability of UTI, with treatment being initiated in response to positive results without consideration of the clinical status of the patient. This pilot study was undertaken to evaluate the impact of no longer routinely reporting positive urine culture results from noncatheterized inpatients, but rather asking clinicians to call the microbiology laboratory for the results if UTI is suspected.

METHODS

We conducted a controlled before–after study of modified reporting of urine cultures from noncatheterized medical and surgical inpatients during January/June 2013 (Baseline periods) and February/July 2013 (Intervention periods). Mount Sinai Hospital is a 472-bed acute-care teaching hospital with an electronic patient record where urine cultures are ordered and labeled as noncatheter or catheter specimens and the ordering location is automatically recorded. Catheterized specimens were defined as those collected via intermittent urinary catheterization, a chronic indwelling urinary catheter, nephrostomy tube, or suprapubic catheter. Urine cultures ordered from 4 medical and 4 surgical wards were included; obstetric patients are admitted to separate maternity wards, which were excluded.

All urine cultures from noncatheterized inpatients from study wards were processed as usual in the microbiology laboratory [9]. However, positive results from noncatheterized specimens were no longer reported automatically. Instead, the following message was posted to the electronic medical record:

> The majority of positive urine cultures from inpatients without an indwelling urinary catheter represent asymptomatic bacteriuria. If you strongly suspect that your patient has developed a urinary tract infection, please call the microbiology laboratory.

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Results were immediately released to any clinician who telephoned. Results of catheterized urine culture specimen results continued to be routinely reported, and served as the control group.

Each patient with a positive urine culture was assessed by one of the study investigators (J. A. L., G. W. R., M. L.) within 24 hours of culture for the presence of UTI using Centers for Disease Control and Prevention (CDC) surveillance criteria [10]. Noncatheterized patients met clinical criteria if they had fever (>38°C) without another explanation, or at least 1 urinary symptom (dysuria, urgency, frequency, costovertebral angle tenderness, suprapubic pain or tenderness). Catheterized patients met clinical criteria if they had fever, suprapubic pain, or costovertebral angle tenderness. New antimicrobial prescriptions were documented for all patients within 24 hours of urine culture ordering (empiric therapy) and at 72 hours (in response to positive results).

The primary clinical outcome was the rate of treatment of ASB in noncatheterized inpatients during the intervention periods compared with catheterized controls. Process measures included the number of urine culture results reported to clinicians and the proportion of catheter urine cultures that were accurately labeled based on bedside audits of urinary catheter presence by study investigators. Catheterized specimens that were mislabeled as noncatheterized were included in the catheter control group. We also tracked the number of calls to the laboratory, occurrence of untreated UTIs (either no antimicrobial prescribed or discordant empiric antimicrobial therapy based on culture and susceptibility results), and sepsis among untreated patients at 72 hours. The significance of differences in proportions was assessed using Fisher exact test. All analyses were performed using Excel software, version 11.0 and GraphPad software.

This pilot quality improvement project was designed to reduce unnecessary antimicrobial use for ASB. Results remained available to clinicians by telephone 24 hours per day, and all patients were prospectively assessed to document safety of this change in urine culture reporting. The study was approved by the Research Ethics Board of Mount Sinai Hospital, Toronto, Ontario, Canada.

RESULTS

During the 16-week study, 415 urine specimens from noncatheterized inpatients and 231 specimens from catheterized inpatients were submitted for culture from medical and surgical wards, of which 151 (23%) were positive (74 specimens from noncatheterized patients and 77 from catheterized patients). UTI was present among 10 of 415 (2%) noncatheterized patients and 7 of 231 (3%) catheterized patients; the remaining 134 (89%) of positive urine cultures did not meet CDC criteria for UTI and represented ASB. Patient characteristics are summarized in Table 1. At the time of urine culture ordering, 5% (7/134) of patients not meeting criteria for UTI were started on empiric antimicrobial therapy compared with 65% (11/17) of patients who met criteria for UTI ($P < .0001$).

The rate of antimicrobial therapy for ASB during the baseline periods was 48% (95% confidence interval [CI], 32%–65%; 15 of 31 patients) among noncatheterized inpatients and 42% (95%

Table 1. Baseline Characteristics of Medical and Surgical Inpatients With Positive Urine Cultures Collected From Inpatient Wards

	Baseline, No. (%)		Intervention, No. (%)	
Characteristic	Noncatheterized (n = 37)	Catheterized (n = 28)	Noncatheterized (n = 37)	Catheterized (n = 49)
Urinary tract infection[a]	6 (16)	2 (7)	4 (11)	5 (10)
Asymptomatic bacteriuria	31 (84)	26 (93)	33 (89)	44 (90)
Demographics				
Age, y, median	73	85	79	78
Female sex	22 (59)	22 (79)	28 (76)	32 (65)
Medical ward	21 (57)	14 (50)	21 (57)	26 (53)
Surgical ward	16 (43)	14 (50)	16 (43)	23 (47)
Reason for admission				
Functional decline or fall	4 (11)	2 (7)	6 (16)	4 (8)
Acute neurologic event	2 (6)	3 (11)	6 (16)	2 (4)
Abdominal surgery	12 (32)	7 (25)	11 (30)	15 (31)
Respiratory/cardiac	9 (24)	4 (14)	6 (16)	13 (27)
Orthopedic surgery	2 (5)	7 (25)	4 (11)	7 (14)
Other	8 (22)	5 (18)	4 (11)	8 (16)

[a] Based on prospectively applied surveillance criteria from the Centers for Disease Control and Prevention [10].

Table 2. Outcomes Before and After Implementation of Modified Urine Culture Reporting of Noncatheterized Medical and Surgical Inpatients

	Baseline		Intervention	
Outcome	Noncatheterized	Catheterized	Noncatheterized	Catheterized
Outcome measure				
ASB treatment rate	15/31 (48)	11/26 (42)	4/33 (12)	18/44 (41)
Process measures				
Total cultures reported	37/37 (100)	28/28 (100)	5/37 (14)	49/49 (100)
Labeling accuracy	35/37 (95)	25/28 (89)	37/37 (100)	41/49 (84)
Unintended consequences				
Calls to laboratory	0 (0)	0 (0)	5/37 (14)	1/49 (2)
Untreated UTI	1/37 (3)	1/28 (4)	0 (0)	0 (0)
Sepsis	0 (0)	1/28 (4)	0 (0)	1/49 (2)

Data are presented as No. (%).

Abbreviations: ASB, asymptomatic bacteriuria; UTI, urinary tract infection.

CI, 26%–61%; 11 of 26 patients) among catheterized inpatients. Following introduction of modified reporting, treatment of ASB among noncatheterized inpatients decreased to 12% (95% CI, 5%–27%) for an absolute risk reduction of 36% (95% CI, 15%–57%; $P = .002$), and a number needed to treat of 3 (95% CI, 2–7). The treatment rates among catheterized controls remained 41% (95% CI, 31%–69%) during the intervention period, significantly above those of noncatheterized inpatients ($P = .01$; Table 2).

Clinicians called the laboratory to obtain culture and susceptibility results for 5 of the 37 modified reports (14%; 95% CI, 6%–28%): once for a patient with UTI and 4 times for patients with ASB. Four UTIs occurred among noncatheterized inpatients; in all cases, clinicians had initiated appropriate empiric antimicrobial treatment when urine cultures were ordered. At 72 hours after urine specimen collection, there were no clinical signs of UTI or sepsis among untreated noncatheterized inpatients.

DISCUSSION

Treatment of ASB remains a major source of unnecessary antimicrobial use among hospitalized patients [5–7]. Our proof-of-concept study of no longer reporting positive noncatheterized urine culture results unless a telephone call request was made greatly decreased antimicrobial therapy for ASB. Our audits to ensure safety of this change in reporting are unlikely to explain this rapid change in prescribing behavior, as prescription rates for catheterized patients during the same periods remained unchanged.

Ideally, an intervention to decrease ordering of urine cultures without indication would prevent detection and subsequent treatment of ASB. Unfortunately, these tests are often submitted by multiple care providers for a wide range of indications [5, 7, 8]. A cluster-randomized trial of a diagnostic and therapeutic algorithm for suspected UTI failed to have any impact on the number of urine cultures ordered [11]. Providing education to clinicians, in the form of treatment algorithms or audit and feedback, is modestly effective but resource intensive [11–13]. These studies suggest that once urine culture results are reported, they are difficult to ignore and reflexively result in the prescription of antimicrobial therapy, even for patients with a low suspicion of UTI. By no longer routinely reporting these results among low-risk inpatients, our intervention reduced the tendency to react to positive urine culture results while continuing to encourage clinicians to pursue results if they had a high suspicion of UTI. This approach appeared to be highly effective and did not require any training or education of care providers.

This study has several limitations. First, it was undertaken as a proof-of-concept study at one institution; larger studies are needed to confirm the safety outcomes of this intervention prior to broad implementation. Second, the use of standardized surveillance definitions for UTI may have overestimated the proportion of patients with ASB, especially among patients who could not reliably communicate their symptoms. However, only a minority of patients who did not meet these criteria at the time of test ordering received empiric therapy, suggesting that clinicians agreed there was a low pretest probability of UTI in these patients. In our practice environment, all patients admitted to medical inpatient units and patients with surgical emergencies are admitted via the emergency department, permitting easy distinction between cultures sent upon admission and those sent after admission. This may not be true in all institutions. Finally, this study was undertaken among general medical and surgical inpatients and should not be generalized to other patient populations without further study.

This proof-of-concept study demonstrates that no longer routinely reporting urine culture results from noncatheterized medical and surgical inpatients can greatly reduce unnecessary antimicrobial therapy for ASB without significant additional workload for the laboratory. Larger studies are needed to confirm the generalizability, safety, and sustainability of this model of care.

Notes

Author contributions. All authors had access to the data and contributed to the preparation of this manuscript.

Potential conflicts of interest. All authors: No reported conflicts.

All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

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