Does Nonpayment for Hospital-Acquired Catheter-Associated Urinary Tract Infections Lead to Overtesting and Increased Antimicrobial Prescribing?

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Background. On 1 October 2008, in an effort to stimulate efforts to prevent catheter-associated urinary tract infection (CAUTI), the Centers for Medicare & Medicaid Services (CMS) implemented a policy of not reimbursing hospitals for hospital-acquired CAUTI. Since any urinary tract infection present on admission would not fall under this initiative, concerns have been raised that the policy may encourage more testing for and treatment of asymptomatic bacteriuria.

Methods. We conducted a retrospective multicenter cohort study with time series analysis of all adults admitted to the hospital 16 months before and 16 months after policy implementation among participating Society for Healthcare Epidemiology of America Research Network hospitals. Our outcomes were frequency of urine culture on admission and antimicrobial use.

Results. A total of 39 hospitals from 22 states submitted data on 2,362,742 admissions. In 35 hospitals affected by the CMS policy, the median frequency of urine culture performance did not change after CMS policy implementation (19.2% during the prepolicy period vs 19.3% during the postpolicy period). The rate of change in urine culture performance increased minimally during the prepolicy period (0.5% per month) and decreased slightly during the postpolicy period (–0.25% per month; P < .001). In the subset of 10 hospitals providing antimicrobial use data, the median frequency of fluoroquinolone antimicrobial use did not change substantially (14.6% during the prepolicy period vs 14.0% during the postpolicy period). The rate of change in fluoroquinolone use increased during the prepolicy period (1.26% per month) and decreased during the postpolicy period (–0.60% per month; P < .001).

Conclusions. We found no evidence that CMS nonpayment policy resulted in overtesting to screen for and document a diagnosis of urinary tract infection as present on admission.
hospitals only receive reimbursement if a urinary tract infection was demonstrated to have been present at the time the patient was admitted to the hospital (rather than acquired during hospitalization) [2]. There is a debate over whether this policy will decrease the frequency of CAUTI or whether it may create perverse incentives for hospitals to document asymptomatic bacteriuria at the time of admission and inappropriately treat them as urinary tract infections, to avoid loss of payment if a CAUTI is diagnosed after admission. Although the policy explicitly applies to reimbursement for CAUTI, documentation of any urinary tract infection at admission would increase reimbursement. As described in a recent editorial, “if, as a result of the rule change, clinicians were pressured to test the urine of all patients on admission to the hospital, the risk of unnecessary treatment of asymptomatic bacteriuria or inflammation would be substantial” [3]. Past CMS policy designed to improve management of pneumonia has had the unintended consequence of antibiotic overuse [4].

Several groups of patients commonly have bacteria in their urine without any symptoms of infection (ie, asymptomatic bacteriuria) and do not benefit from antimicrobials [5]. For these patients, the possibility of overperformance of urine culture at admission as a screening tool to detect and document urinary tract infection as being present on admission, and thereby to avoid possible nonpayment, is real and concerning [6]. Urinary tract infection is a diagnosis based largely on clinical symptoms, with the support of nonspecific laboratory tests such as urinalysis and urine culture [6, 7]. Patients with urinary catheters are particularly prone to bacteriuria and pyuria, which would fulfill the criteria for CAUTI in the appropriate clinical setting of fever, pain, tenderness, or other nonspecific criteria [7]. Given that fever and abdominal pain are often caused by other conditions, culturing urine more frequently would be expected to yield an increased frequency of urinary tract infection diagnoses, even if symptoms in patients receiving the diagnosis were best explained by another clinical syndrome. This increase in false-positive diagnoses of urinary tract infection at admission would be expected to increase inappropriate use of antimicrobials for patients with a diagnosis of urinary tract infection, resulting in potential increases in bacterial resistance, Clostridium difficile infections, and adverse drug reactions over time. Our aim was to thus evaluate whether implementation of the CMS policy of nonreimbursement for hospital-acquired CAUTI was temporally associated with increased frequency of urine culture on hospital admission. As a secondary outcome, we examined whether implementation of the CMS policy was associated with increased use of antimicrobials commonly used for the treatment of urinary tract infection.

METHODS

This study was completed using the Society for Healthcare Epidemiology of America (SHEA) Research Network, a consortium of >200 hospitals that has successfully conducted multicenter research projects in healthcare epidemiology [8, 9]. An invitation to participate in the current study was sent to all SHEA Research Network members. This study received institutional review board (IRB) approval with a waiver of informed consent and a HIPAA waiver from the coordinating center, the University of Maryland School of Medicine, as well as from IRBs at all individual sites.

Data

The CMS nonpayment policy took effect on 1 October 2008. Data were obtained for all adult hospital admissions during a prepolicy period, from 1 June 2007 to 30 September 2008, and a postpolicy period, from 1 October 2008 to 28 February 2010. All hospitals provided daily retrospective data for the study period. To assess the primary outcome (ie, frequency of urine culture on admission after implementation of the CMS policy), variables collected included the daily number of admissions and the number of urine cultures performed in the first 48 hours after the date of admission (including 10 hours prior to admission, to capture urine cultures performed for patients in the emergency department). Urine cultures were assessed within the first 48 hours for 2 reasons: (1) samples requested from admission orders for urine culture may not be collected until up to 48 hours later, and (2) the Centers for Disease Control and Prevention (CDC) considers conditions diagnosed >48 hours after admission to be hospital-acquired conditions [10]. Data on the number of wound cultures performed in the first 48 hours after admission were also requested and reported. Wound cultures were chosen as a nonequivalent, dependent variable to identify changes in culturing practice not related to the CMS policy [11].

To evaluate the secondary outcome of antimicrobial use, we obtained retrospective data from a convenience subsample of hospitals with access to automated pharmacy data to obtain the number of patients who were prescribed antimicrobials that are often (although not exclusively) used for the treatment of urinary tract infection. Antimicrobials included fluoroquinolones, trimethoprim-sulfamethoxazole, cephalaxin, amoxicillin-clavulanate, and nitrofurantoin. Fluoroquinolone antimicrobials included ciprofloxacin, levofloxacin, moxifloxacin, and gatifloxacin. Other broad-spectrum antibiotics were not included, as these are more commonly used for other infections. We collected data on antimicrobial use in the first 72 hours after admission and, to better measure how often antimicrobials were being used for suspected urinary tract infection, determined the number of patients who had urine cultures.
performed in the first 48 hours after admission and were prescribed an antimicrobial in the first 72 hours after admission.

Validation
To validate computer-obtained data on submission of urine specimens for microbiologic culture, we asked participating sites to perform manual validation. Sites were instructed to validate the first 4 patient records for each month by looking up each patient’s medical record, checking to see whether they had a urine culture within 48 hours of the date of admission. This was done to evaluate the accuracy of documentation of urine culture submission and the presence or absence of corresponding microbiology results in the clinical record. A total of 13 of 35 sites completed full manual validation. Validation data showed 14 incorrect entries out of 1486 validation admissions reviewed (error rate, 0.9%).

Statistics
Thirty-five hospitals with an average of 30 000 admissions in both the prepolicy and postpolicy periods and an average urine culture frequency of 20% (200 cultures per 1000 admissions) provided >99% power to detect an absolute difference in urine culture frequency of 5% (50 cultures per 1000 admissions), using a 2-sided test with a type I error of 5% and assuming a within-hospital correlation of 5%. Under similar assumptions, 10 hospitals with an average of 7000 admissions with urine cultures in both periods and an average fluoroquinolone prescription frequency of 27% (270 prescriptions per 1000 admissions) provided >85% power to detect an absolute difference in frequencies of 5% in fluoroquinolone use.

Data were analyzed as a before/after quasi-experimental study. Culture frequencies during the prepolicy and postpolicy periods were compared using Poisson mixed-effects models to account for within-hospital correlation. Models were created for overall urine culture frequencies (as the primary outcome, dependent variable) in the prepolicy and postpolicy periods, for overall urine culture frequencies (as the primary outcome, control variable, wound culture performance, also decreased with the prepolicy period (0.60% per month; P < .001). Overall prescription frequencies and trends are presented in Table 1 and Figure 2. The only antimicrobial use decreased during the postpolicy period (P < .001). The rate of change in urine culture performance in the 35 hospitals subject to the CMS rule during the prepolicy and postpolicy periods was 0.5% per month during the prepolicy period and –0.25% per month during the postpolicy period (P < .001; Figure 1 and Table 1). The rate of change in the control variable, wound culture performance, also decreased during the postpolicy period (–0.83% per month), compared with the prepolicy period (0.60% per month; P < .001).

In the 4 control hospitals not subject to the CMS rule, the median percentage of admissions during which urine culture was performed ≤48 hours after admission was 23.4% during the prepolicy period and 24.8% during the postpolicy period. The rate of change in urine culture frequency in these 4 hospitals decreased during the postpolicy period (–0.60% per month), compared with the prepolicy period (1.26% per month; P < .001).

In the 10 hospitals that submitted data on antibiotic use, a median of 14.6% of patients were treated with a fluoroquinolone antimicrobial during the prepolicy period; this decreased to a median of 14.0% during the postpolicy period. Among patients with urine cultures performed ≤2 days after admission, a median of 29.2% were prescribed a fluoroquinolone antimicrobial during the prepolicy period, and a median of 28.2% were prescribed a fluoroquinolone antimicrobial during the postpolicy period. The rate of change in fluoroquinolone antimicrobial use decreased during the postpolicy period (–1.24% per month), compared with the prepolicy period (0.30% per month; P < .001). The rate of change in fluoroquinolone antimicrobial use for patients who had urine culture performed decreased during the postpolicy period (–0.74% per month), compared with the prepolicy period (1.28% per month; P < .001). Overall prescription frequencies and trends are presented in Table 1 and Figure 2. The only

RESULTS
A total of 39 SHEA Research Network hospitals (cited in the Acknowledgments) participated. These hospitals included 15 community hospitals and 22 tertiary care hospitals, with sizes varying from 120 to 1000 beds. Sites represented 22 different states in all geographic areas of the continental United States, accounting for a total of 2 362 742 admissions. Of the 39 hospitals, 4 were not subject to CMS rules (3 are in Maryland, and 1 is a cancer hospital). No hospitals that were part of the Department of Veterans Affairs (VA) participated. All 35 hospitals subject to CMS rules provided urine culture data, and 28 provided control wound culture data. For the secondary outcome, 10 hospitals provided requested antimicrobial prescribing data.

The median percentage of admissions during which urine culture was performed ≤48 hours after admission was 19.2% during the prepolicy period and 19.3% during the postpolicy period. The rate of change in urine culture performance in the 35 hospitals subject to the CMS rule during the prepolicy and postpolicy periods was 0.5% per month during the prepolicy period and –0.25% per month during the postpolicy period (P < .001; Figure 1 and Table 1). The rate of change in the control variable, wound culture performance, also decreased during the postpolicy period (–0.83% per month), compared with the prepolicy period (0.60% per month; P < .001).

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antimicrobials used in >5% of admissions were fluoroquinolones. Other antimicrobials were used much less frequently than fluoroquinolones (data not shown; these included trimethoprim-sulfamethoxazole, cephalaxin, amoxicillin-clavulanate, and nitrofurantoin).

**DISCUSSION**

In a national sample of 39 hospitals, we found no evidence that the CMS policy resulted in overtesting for urinary tract infections on admission. Furthermore, the secondary outcome of antimicrobial prescribing was also not found to increase following implementation of the CMS policy.

CMS nonpayment for hospital-acquired conditions reflects a fundamental and controversial change in hospital payment structure. The potential for unintended consequences of nonpayment for hospital-acquired CAUTI, including adverse outcomes associated with excessive use of antimicrobials, such as selection pressure promoting the emergence of multidrug-resistant organisms and increased risks for C.

**Table 1. Frequency of Urine Cultures and Fluoroquinolone Use Before and After the Centers for Medicare & Medicaid Services Stopped Reimbursing Hospitals for Treatment of Hospital-Acquired Catheter-Associated Urinary Tract Infection**

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<tbody>
<tr>
<td></td>
<td>Median Frequency(^a) (95% CI)</td>
<td>Relative Change,(^b) % (95% CI)</td>
<td>Median Frequency(^a) (95% CI)</td>
</tr>
<tr>
<td>Urine cultures (n=35)</td>
<td>180 (150–216)</td>
<td>0.50 (0.40–0.59)</td>
<td>185 (154–222)</td>
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<tr>
<td>Wound cultures (control variable; n = 28)</td>
<td>27.0 (20.9–34.9)</td>
<td>0.60 (0.32–0.88)</td>
<td>26.2 (20.3–33.9)</td>
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<td>FQ use in all admissions (n = 10)</td>
<td>128 (92–177)</td>
<td>0.30 (0.10–0.50)</td>
<td>123 (89–171)</td>
</tr>
<tr>
<td>FQ use in patients with a urine culture at time of admission (n = 10)</td>
<td>272 (158–468)</td>
<td>1.28 (0.98–1.58)</td>
<td>267 (155–458)</td>
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Abbreviations: CI, confidence interval; FQ, fluoroquinolone.

\(^a\) Defined as the No. of cultures or No. of FQ prescriptions per 1000 admissions, from Poisson mixed-effects regression.

\(^b\) Defined as the slope, expressed as a relative change in frequency of cultures or FQ prescriptions since the previous month, from Poisson mixed-effects segmented regression.

\(^c\) For comparison of the relative change in frequency (ie, slopes) during the prepolicy and postpolicy periods.
 difficile infection, were a concern for many [3, 12, 13]. Importantly, our study did not identify adverse consequences associated with the CMS policy on hospital-acquired CAUTI. However, our data reflect only the first 16 months after the CMS policy. The long-term impact of public reporting of CAUTI and the 1% decrease in all diagnosis-related group payments in 2015 for hospitals in the worst quartile for rates of hospital-acquired conditions may have unintended consequences and must be carefully assessed as they are implemented [14].

Previous CMS policies intended to improve hospital treatment of infections have had unintended negative consequences. For example, the CMS policy relating to pneumonia prevention has been associated with inappropriate use of antimicrobials [4]. The CMS process-of-care measure for pneumonia care initially included a measure requiring that patients with pneumonia receive an antimicrobial ≤ 4 hours after emergency department arrival. Emergency medicine physicians found this time frame to be narrow and, in response to pressure to improve the measure, began prescribing antimicrobials to most patients with pulmonary syndromes [4]. Subsequently, the window for receiving antimicrobials was widened to 6 hours, which helped decrease overprescribing [15].

Instead of an increase in testing for urinary tract infections on admission, we found a slight decrease in testing after implementation of the CMS policy. The clinical relevance of this finding is unclear. With >2 million hospital admissions, our study was powered to detect very small differences. Our

**Figure 2.** Frequency of fluoroquinolone use among all admissions (A) and among patients suspected of having urinary tract infection (B) before and after the Centers for Medicare & Medicaid Services stopped reimbursing hospitals for treatment of hospital-acquired catheter-associated urinary tract infection. Data points represent daily median frequencies, and dashed lines represent 95% confidence intervals. Abbreviation: FQ, fluoroquinolone.
finding that wound culture frequencies also decreased during this period suggests that there may be secular trends independent of the CMS policy that have resulted in less microbiologic culturing for a range of specimen types. Although the secondary outcome of antimicrobial prescribing was only measured in 10 hospitals, this outcome still had significant power to detect a small difference. A small decrease in fluoroquinolone antimicrobial prescribing, from 14.6% during the prepolicy period to 14.0% during the postpolicy period, was observed. This finding could be related to improved antimicrobial stewardship for fluoroquinolone antimicrobials or to a shift away from fluoroquinolone antimicrobials to broader-spectrum antimicrobials in response to increasing rates of infection due to multidrug-resistant organisms [9, 10].

Whether the CMS policy has had a beneficial effect on patient care has yet to be fully determined. Krein et al recently reported the results of a large national study of VA hospitals (which are not subject to the CMS rule changes) and non-VA hospitals in which surveys were conducted in 2005 and 2009 to assess the use of practices to prevent central line–associated bloodstream infection (CLABSI), ventilator-associated pneumonia (VAP), and CAUTI after the CMS policy was implemented [15]. These investigators found that the use of key practices to prevent CLABSI, VAP, and CAUTI increased in both VA and nonfederal hospitals, suggesting that, despite its perceived importance, the CMS policy may not be the primary driver of practice change [15]. Additionally, while approximately two-thirds of nonfederal hospitals reported a moderate or large increase in preventing CAUTI as a facility priority, use of practices to prevent CAUTI remains low, compared with use of practices to prevent CLABSI and VAP [15].

CAUTI is the most common hospital-associated infection, with significant costs and morbidity [1]. However, hospital coding that is used for reimbursement only detects a small fraction of CAUTIs, and the CMS policy is not expected to have an appreciable effect on reimbursement [13]. A more reliable method of CAUTI detection would improve policies designed to encourage prevention. Methods of detection will need to be objective to decrease variability in how frequencies are reported and to avoid penalizing hospitals that make more rigorous efforts to identify CAUTI.

Strengths of our study include its use of data from a nationally representative group of community and tertiary care hospitals in 22 states. This was achievable through the SHEA Research Network. Second, hospitals submitted validated primary data in a standardized manner. Finally, a proportion of hospitals were able to collect the secondary outcome of antimicrobial use to better measure potential unintended consequences of the policy.

Our findings should be interpreted in the context of the following important limitations. First, this study was based on retrospective, clinically collected data. Second, we did not examine use of urinalysis, which may have been performed to justify a diagnosis of urinary tract infection. Third, fluoroquinolone antibiotics are used for diagnoses other than urinary tract infection. Fourth, the CMS policy was publicized 2 years before the date it started, and hospital practices may have changed before 1 October 2008. Last, this study did not examine whether CMS nonpayment policy resulted in a decrease in CAUTI.

In a large, nationally representative set of hospitals, we did not identify overtesting for urinary tract infection to document the infection as present on admission and avoid nonreimbursement for CAUTI. Robust consortia of hospitals such as the SHEA Research Network are necessary to examine the positive and negative effects of policy changes [16]. The CMS policy did not promote overtesting for or unnecessary treatment of urinary tract infection.

**Notes**

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