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Optimizing Inpatient Urine Culture Ordering Practices Using the Electronic Medical Record: A Pilot Study

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Abstract

A prospective quasi-experimental before-and-after study of an electronic medical record–anchored intervention of embedded education on appropriate urine culture indications and indication selection reduced the number of urine cultures ordered for catheterized patients at an academic medical center. This intervention could be a component of CAUTI-reduction bundles.

Catheter-associated urinary tract infections (CAUTIs) are increasingly common[1] and are a significant cause of increased morbidity, increased length of stay,[2] and increased healthcare cost,[3] including potential financial penalties for poorly performing centers.[4] Generally, 2 fundamental strategies are used to reduce these infections: (1) to use indwelling urinary catheters appropriately and (2) to optimize the ordering of urine cultures (UCs) according to clinical indications. Further studies aimed at promoting appropriate UC ordering are needed.[5] Asymptomatic bacteriuria is common in the setting of urinary catheters and is often treated unnecessarily, potentially leading to increased bacterial resistance or risk for *C. difficile* colitis.[6] An emerging body of research describes procedures for using the electronic medical record (EMR) to modify practitioner behavior and practices.[7] We undertook a quasi-experimental before-and-after study using an EMR-anchored intervention to reduce unnecessary UCs, and we examined its impact on UC ordering practices at an academic medical center.

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SUPPLEMENTARY MATERIAL

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METHODS

The study was conducted in the 2 critical care units in which UCs were most frequently ordered at UW Health-University Hospital, a 592-bed academic medical center. Prior to this pilot study, several interventions were implemented at our institution to reduce inappropriate indwelling urinary catheter use (Online Supplementary Appendix 1). In a series of multi-disciplinary meetings, we created an institutional guideline regarding UC indications, focusing on those pertinent to patients with urinary catheters (Table 1).[5,8] Indications were embedded in the EMR UC order to be visible to all providers (Online Supplementary Appendix 2). If a patient was in a pilot unit, was ≥18 years of age, and had a urinary catheter, indication selection was mandatory. The EMR order change went into effect on June 9, 2015.

The following data were collected 2 months after the order change: patient days, number of UAs, and number of UCs for all patients in pilot units during the 2-month intervention period (June 9, 2015–August 7, 2015, named "postintervention period 1") and 2 months prior (April 10, 2015–June 8, 2015, named the "preintervention period"). Review of these data revealed that providers chose "Miscellaneous, see progress note" frequently without documenting indications in the note. Therefore, the drop-down menu of indications was changed to a full-view menu of radio buttons, and "Miscellaneous, see progress note" was eliminated on October 9, 2015. Data were subsequently collected for postintervention period 2 (October 9, 2015 through December 7, 2015). The UC indication was recorded for all periods. Data were also collected for nonpilot units. A chart review was conducted of those patients with a catheter for whom a UC was ordered to determine whether the clinical picture and documentation matched the selected indication.

The number of UAs and UCs ordered were compared using OpenEpi software (Dean AG, et al, OpenEpi: Open Source Epidemiologic Statistics for Public Health, www.OpenEpi.com) to perform χ^2 or Fisher's exact tests where applicable. STATA: Release 14 software (StataCorp, College Station, TX) was used for segmented regression analysis of interrupted time series for UAs and UCs in pilot units. A P value ≤ .05 was considered statistically significant. We conducted descriptive statistics analyses to evaluate indications for UCs.

RESULTS

In the pilot intervention units, compared to the preintervention period, there was a non-significant decrease in UCs ordered during postintervention period 1, and 34% fewer UCs were ordered for catheterized patients during postintervention period 2 (P = .049) (Table 2). The total numbers of UCs ordered were similar for the preintervention period and post-intervention period 1, but these totals were significantly lower for postintervention period 2 (P = .02). Significantly fewer UAs were ordered for patients with urinary catheters during post-intervention period 1 than during the preintervention period (P = .03). The total numbers of UAs ordered were not significantly different among the 3 periods.

In our time series analysis (Online Supplementary Appendix 3), the decrease in UC ordering noted between the periods did not show a significant downward slope within either

postintervention period. Notably, however, when viewing the start of the preintervention period through the end of the second intervention period as 1 continuous period, a significant downward trend was observed in UCs ordered for catheterized patients (1.3 orders per 1,000 catheter days; $P = .031$).

In patients with urinary catheters on nonpilot units, no significant difference in the number of UAs or UCs ordered was observed (Online Supplementary Appendix 4). Similar total numbers of UAs were ordered during the preintervention period and postintervention period 1, but significantly more UAs were ordered during postintervention period 2 ($P < .001$). Fewer total UCs were ordered during postintervention period 2 than during the preintervention period ($P = .002$), but no difference was observed between the preintervention period and postintervention period 1.

During postintervention period 1, for all patients in the pilot units (including those with no catheter for whom selection was not mandatory), an indication was not recorded in 78 cases and “Miscellaneous; see progress note” was selected 13 times. Among the indications, fever with a positive UA was selected most frequently (n = 8). Inherent to the order change, there were no “Miscellaneous, see progress note” entries during postintervention period 2. However, 47 of 84 of orders remained with no indication selected during postintervention period 2. The most commonly selected indication was fever (n = 17) followed by “anticipated urologic procedure” (n = 6) and “suprapubic pain or tenderness” (n = 4). The most commonly selected indication for patients with urinary catheters was fever (n = 7 in post-intervention period 1 and n = 12 in post-intervention period 2) followed by anticipated urologic surgery, and suprapubic pain or tenderness (Online Supplementary Appendix 5). Of the 27 orders issued during postintervention period 2 with an indication, 7 selected indications matched the clinical picture documented in the notes. For 3 patients for whom UCs were ordered, criteria were met but the clinical signs could have been explained by a different syndrome. Another 9 of these 27 orders did not match the clinical picture, and 8 orders for UC were never executed because each was part of a reflex UA to UC order where the UA was negative.

DISCUSSION

The incorporation of standardized indications in the EMR for ordering a UC and requiring the selection of an indication for patients with indwelling urinary catheters was associated with a decrease in the rate of UC ordering in the intervention units. The mismatch in selected and actual indications, along with the predominance of nonspecific indications selected, suggest that further provider education is needed.

Possibly, the decrease in UC ordering in nonpilot units was a result of contamination of the intervention because UC indications embedded in the EMR were seen by ordering providers throughout the hospital. Other studies have also shown that education targeting appropriate UC ordering can be effective,[5,9] and our results highlight the importance of provider education to order UCs only if UTI is suspected. In general, many patients with catheters have pyuria and bacteriuria; therefore, reflex cultures for a positive UA are likely of little

benefit for these patients.[10] In addition, our findings support the use of the EMR as a potential tool for infection prevention.

Our study had limitations in study design that did not permit the assessment of causality. Furthermore, this study was a quality improvement project with short study periods, and we did not assess other potential consequences of the intervention. Future studies should investigate the impact of such an intervention on antimicrobial use.

In conclusion, providing approved indications in the EMR order and requiring an indication for UC for patients with urinary catheters were associated with a decrease in UCs ordered and may be important components of a CAUTI-prevention program in conjunction with interventions to promote appropriate catheter use.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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TABLE 1.

Appropriate and Inappropriate Urine Culture Indications in Catheterized Patients

Indications for Urine Culture in Catheterized Patients	Inappropriate Indications for Urine Culture
• Suprapubic pain/tenderness • Acute gross hematuria • Costovertebral angle tenderness • New fever/rigors with clinical assessment negative for more likely etiology • Acute alteration of mental status with clinical assessment negative for more likely etiology • Alteration in medical condition with clinical assessment negative for more likely etiology in patient whom fever may not be a reliable sign • Increased spasticity or autonomic dysreflexia in patients with altered neurologic sensation	• Abnormal urine quality • Routine component of “pan-culture” in fever evaluation until other etiologies have been excluded • Asymptomatic pyuria • Asymptomatic elderly, diabetic or institutionalized patient • Routine documentation of bacteriuria clearance

TABLE 2.

Catheterized and Total Patient Urine Culture Orders and Rates in Pilot Units

Characteristic	Preintervention	Postintervention 1	*P* Value[a]	Postintervention 2	*P* Value[b]
Catheter days	1,115	1,088	…	1,113	…
Catheter UAs, No.	125	90	.03	106	.24
Rate per 1,000 catheter days	112	83	…	95	…
Catheter UCs, No.	62	48	.27	41	.049
Rate per 1,000 catheter days	56	44	…	37	…
Total patient days	2,141	2,140	…	2,177	…
Total UAs	310	274	.13	285	.21
Rate per 1,000 patient days	146	128	…	131	…
Total UCs	146	132	.44	110	.02
Rate per 1,000 patient days	68	62	…	51	…

NOTE. UA, urinalysis; UC, urine culture.

[a]Between the preintervention period and postintervention period 1.

[b]Between the preintervention period and postintervention period 2.

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