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Brief Report

Urine test stewardship for catheterized patients in the critical care setting: Provider perceptions and impact of electronic order set interventions

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Electronic medical record support tool
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We implemented an electronic medical record (EMR) decision support tool for ordering urine cultures per evidence-based guidelines. Following the EMR change, we found a significant increase in proportion of cultures ordered for catheterized intensive care unit (ICU) patients meeting guidelines. We surveyed providers and found poor understanding of urine culture guidelines for catheterized ICU patients. EMR-based interventions and educational opportunities have potential to improve urine culture guideline adherence and reduce unnecessary testing and antibiotic use.

Catheter-associated urinary tract infections (CAUTIs) are one of the most common health care–associated infections,[1] often associated with increased expenditures[1,2] and prolonged hospital stays.[3] Most research on reducing CAUTIs emphasizes standard infection prevention. More recent literature focuses on diagnostic test stewardship to improve quality of care while safely reducing unnecessary tests and associated costs.[4] The American College of Critical Care Medicine (ACCCM) and Infectious Diseases Society of America's (IDSA's) latest available 2008 guidelines for evaluating new fever in critically ill adult patients stipulate that providers should only obtain urine cultures for populations at high risk for invasive infection, including: patients with (1) kidney transplantation, (2) recent genitourinary surgery, (3) neutropenia, or (4) evidence of urinary obstruction.[5] Because urinary catheter bacteriuria often represents catheter colonization rather than true infection, obtaining urine cultures in the absence of guideline indications may lead to false positives. Providers may subsequently misdiagnose colonization as infection and initiate unnecessary antibiotics, contributing to development of multidrug-resistant organisms and increased CAUTI incidence.

METHODS

We conducted a quasi-experimental study at an urban 860-bed academic medical center, where we implemented an electronic medical record (EMR) decision support tool across 5 adult intensive care units (ICUs) (medical-respiratory, cardiac, cardiac-surgery, neurosurgical, and surgical-trauma). We removed urinalysis with reflex urine culture as a preselected item from the default order set. We also embedded an ACCCM/IDSA-based guidance statement informing providers that they should only obtain urine cultures for populations at high risk of invasive infection, including: patients with kidney transplant, recent genitourinary surgery, neutropenia, or evidence of urinary obstruction. We evaluated guideline adherence for all urine cultures ordered for catheterized ICU patients during the 17 weeks before and after EMR intervention. We excluded patients who were <18 years old or pregnant. In our analysis, we defined recent GU surgery as ≤6 months, neutropenia as white blood cell count $<0.5 \times 10^9$/L, and provider documentation of urinary retention as meeting criteria for evidence of urinary obstruction. We compared mean guideline adherence rates with a 2-proportion z-test. We also conducted a prospective convenience sample survey to assess provider knowledge and perceptions of urine test stewardship. After institutional review board approval, we distributed voluntary anonymous paper surveys to the adult ICU providers and identical electronic versions of the survey via REDCap (Vanderbilt University,

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Table 1
Urine culture testing frequency and guideline adherence in catheterized ICU patients pre- and post-EMR intervention

	Met testing criteria	Total No. of cultures	Guideline adherence	*P* value*
Pre-EMR order change (June 7, 2017, to October 3, 2017)	98	1,124	8.7% (98/1,124)	.001
Post-EMR order change (October 4, 2017, to January 31, 2018)	152	1,176	12.9% (152/1,176)	—

EMR, electronic medical record; *ICU*, intensive care unit.
*The 2-proportion z-test.

Table 2
Provider awareness of urine culture stewardship in catheterized ICU patients

	Attending physicians/ fellows	Residents	NPs/PAs	Combined	*P* value
Familiar with concept of urine test stewardship	53.3% (8/15)	53.1% (26/49)	42.9% (3/7)	52.1% (37/71)	.475
Familiar with guidelines	60% (9/15)	46.9% (23/49)	42.9% (3/7)	49.3% (35/71)	.753
Adhere to guidelines	66.7% (6/9)	65.3% (15/23)	66.6% (2/3)	65.7% (23/35)	.132
Would culture based solely on new fever	73.3% (11/15)	81.6% (40/49)	42.9% (3/7)	76.1% (54/71)	.171
Would culture based solely on leukocytosis	66.7% (10/15)	30.6% (15/49)	14.3% (1/7)	36.6% (26/71)	.068
Would culture if patient did not meet guidelines	66.7% (10/15)	68.8% (33/48)	42.9% (3/7)	65.7% (46/70)	.610

NOTE. Answers to statements are agree or strongly agree unless otherwise specified. Comparison using the Pearson's X^2 test.
ICU, intensive care unit; *NPs*, nurse practitioners; *PAs*, physician assistants.

Nashville, TN). We compared responses with the Pearson's X^2 test in SPSS (version 25.0; IBM Corp, Armonk, NY).

RESULTS

Providers ordered 1,124 urine cultures prior to the intervention and 1,176 urine cultures after the intervention, totaling 2,300 urine cultures in the 34 weeks examined. Guideline adherence increased from 8.7%-12.9%, prior to and after the EMR change, respectively ($P = .001$) (Table 1).

We collected 71 surveys by convenience sample (20.7% response rate, 71/343). Respondents included attending physicians and fellows (n = 15), residents (n = 49), and nurse practitioners and physician assistants (n = 7). Most providers (52%) reported familiarity with urine test stewardship, with most providers (76%) responding they would likely order a culture for a catheterized ICU patient based on the presence of new fever. More than one-third (36.6%) of providers indicated they would likely order a urine culture based on the presence of leukocytosis. Nearly two-thirds (65.7%) of providers responded they would likely order a culture even when a patient did not meet testing criteria. We found no significant difference between provider types regarding knowledge of urine culture stewardship. Providers most frequently cited fever (n = 26), leukocytosis (n = 9), and changes in urine odor or appearance (n = 8) as clinical indications prompting them to obtain urine cultures in catheterized ICU patients.

DISCUSSION

Modification of our default fever workup order set resulted in a statistically significant improvement in urine culture guideline adherence for catheterized ICU patients, although overall adherence remained low. Despite self-reporting awareness of urine test stewardship, most providers indicated they would order a urine culture for a febrile catheterized ICU patient even if the patient did not meet ACCCM/IDSA testing guidelines. Most providers reported they would culture an ICU patient with a urinary catheter based solely on the presence of new fever (76.1%) or leukocytosis (66.7%) though neither are testing criteria. These findings suggest a discrepancy between providers' perceived and actual knowledge of evidence-based urine culture guidelines. This could in part be owing to the existence of different guidelines. For instance, 2009 IDSA CAUTI guidelines emphasize symptoms such as suprapubic tenderness and do not address ICU patients, who often cannot express such symptoms.[6] Implementing different criteria for urine culturing in ICU compared with non-ICU settings can, therefore, cause confusion for clinicians who practice in both environments. Using EMR support tools can be an effective component of multipronged efforts to bridge the gap between established guidelines and actual clinical application. Providers commonly order a set of blood, urine, and respiratory cultures to identify possible sources of fever in hospitalized patients.[7] Measures such as removing urinalysis with reflex from a default order set can promote more mindful ordering and reduce the likelihood of misdiagnosing asymptomatic bacteriuria as CAUTI.

Previous studies have shown providing clinicians with CAUTI screening algorithms to be beneficial in reducing unnecessary testing.[8] There are, however, few studies of EMR interventions on urine test stewardship. Existing reports suggest that EMR decision supports decrease urine culture testing in catheterized patients.[9,10] To our knowledge, this is the first study demonstrating that EMR enhancements increase adherence to ICCCM/ADSA guidelines in ordering urine cultures for catheterized ICU patients. Although significant improvement occurred, it is important to note our EMR intervention had a limited impact (adherence was only 12.9% following intervention). Study limitations include single-center design and low survey response rate. Study strengths include a diverse patient population spanning multiple ICUs and a large sample size of urine cultures assessed (n = 2,300).

CONCLUSIONS

False CAUTI diagnoses carry significant risks to both patients and health systems. Hospital infection prevention programs may consider leveraging the EMR as a decision support tool to promote a more structured and evidence-based approach to ordering urine cultures for catheterized, critically ill patients. EMR enhancements should be implemented alongside provider education to reinforce appropriate urine culture testing for catheterized ICU patients. Further studies are needed to define the optimal utilization of EMR decision support for urine test stewardship.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.ajic.2019.04.005.

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