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Concise Communication

Reducing catheter-associated urinary tract infection rates in surgical critical care units via an informal catheter exchange protocol

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ABSTRACT

Urinary catheter replacement prior to urinary tract infection assessment, introduced as a quality improvement recommendation in two surgical intensive care units, was associated with (88% and 84%) reduction in catheter-associated urinary tract infections and significant reductions in urine cultures performed.

Keywords: catheter-associate urinary tract infection; urinary tract infection; catheter exchange; Urine Culture Stewardship; hospital epidemiology; hospital-associated infections

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Introduction

Catheter-associated urinary tract infections (CAUTIs) represent >8% of hospital acquired infections (HAI)[1] in the United States and contribute to increased morbidity and estimated costs of $340–450 million per year.[2] CAUTI's are reported to the National Healthcare Safety Network (NHSN), and are used as markers of hospital quality.[3,4] Since 2014, the Society for Healthcare Epidemiology of America, the Infectious Diseases Society of America, and others have collaborated on CAUTI prevention strategies,[5] including recommending urine culture (UCx) stewardship to reduce detection of asymptomatic bacteriuria (ABU). Underlying this is the fact that over-detection of ABU leads to increase in CAUTI diagnosis and unwarranted antibiotic use.[6,7]

Recently, there have been emerging recommendations supporting the practice of replacing urinary catheters (IUCs) prior to UCx to reduce ABU and CAUTI,[5] however, there is little data surrounding this practice. Here we present the results of a novel initiative to reduce CAUTI and ABU in two surgical ICUs using IUC replacement.

Methods

This quality improvement initiative was implemented in a 24-bed Cardiothoracic Surgery ICU (CT-ICU) and a 24-bed Surgical/Trauma ICU (SICU) at a 915-bed tertiary-care academic hospital in Los Angeles, California. When patients with IUCs in place over 48h were evaluated for UTI, a urinalysis without laboratory reflex to culture (UA) would be ordered first; if there was concern for UTI based on the UA (per clinician discretion, parameters not specified in the protocol), then catheter exchange (CathX) would be performed prior to UA with reflex to culture [UAR]. Previously, UAR was the recommended evaluation for UTI, with no recommendation for CathX. The 48h cutoff period was based on operational feasibility and influenced by the NHSN CAUTI criteria. At our institution, a UAR reflexes to culture for >5 WBC, leukocyte esterase, nitrites, or bacteria.

The protocol was developed jointly by Hospital Epidemiology and unit leadership, and implementation of the protocol was done separately on each in a similar model. The recommendation was presented to the ICU physicians by their director at a monthly faculty meeting, and trainees were educated by the attending MDs. Nursing leaders communicated the protocol to staff at huddles and bedside rounds. Medical and nursing directors also performed quality of care rounds (not tracked), which included reminders and education as necessary. No changes were made to testing availability, orders, order-sets or best practice advisories throughout pre- and post-periods. Compliance was encouraged but not tracked.

Assessment periods differed in the CT-ICU (July 2021–October 2023) and SICU (February 2023–October 2023) due to initiation in the CT-ICU first as a trial. For each, the pre-intervention comparison period was two calendar years immediately prior to initiation (January 1, 2019–June 1, 2021 in CT-ICU and January 1, 2021–January 31, 2023 in SICU). Primary outcome was CAUTI (per 1,000 catheter days), secondary outcomes were CathX, UA, UAR and UCx (per 100 catheter days); positivity rates of UAR and

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Table 1. Urine studies: Urinalysis without reflex to culture (UA), urinalysis with reflex to culture (UAR), urine culture (UCx), urinary catheter exchange (CathX), and CAUTI rates - as well as the percent-positivity of the UAR and UCx before and after the intervention

Cardiothoracic Surgery ICU (CT-ICU)							
Metric	UA per 100 catheter days**	Catheter Exchanges per 100 catheter days**	UAR per 100 catheter days**	*UAR Positivity*	UCx per 100 catheter days**	*UCx Positivity*	CAUTI per 1,000 catheter days**
Pre-intervention Period Jan 2019–Jun 2021	2.18	3.9	9.15	*35%*	6.65	*24%*	1.6
Post-intervention Period Jul 2021–Oct 2023	5.83	5.2	5.61	*30%*	3.69	*15%*	0.2
Percent Change*	167%	33%	−39%	*−14.29%*	−45%	*−37.5%*	−88%
*P*value	<0.01	<0.01	<0.01	*0.03*	<0.01	*<0.01*	<0.01
Surgical ICU (SICU)							
Metric	UA per 100 catheter days**	Catheter Exchanges per 100 catheter days**	UAR per 100 catheter days**	*UAR Positivity Rate*	UCx per 100 catheter days**	*UCx Positivity Rate*	CAUTI per 1,000 catheter days**
Pre-intervention Period Jan 2021–Jan 2023	3.67	6.6	10.43	*40%*	9.14	*24%*	1.9
Post-intervention Period Feb 2023–Oct 2023	4.87	8.0	6.23	*35%*	4.75	*23%*	0.3
Percent Change*	33%	21%	−40%	*−12.5%*	−48%	*−4.17%*	−84%
*P*value	<0.01	<0.01	<0.01	*0.20*	<0.01	*0.83*	0.03

* Negative sign (−) denotes a percent change decrease between the pre- and post-intervention periods.
** In the CT-ICU there were 13,287 catheter days and 18,031 patient days pre-intervention and 12,814 catheter days and 17,452 patient days in the post-intervention. In the SICU there were 9,552 catheter days and 14,999 patient days pre-intervention and 3,244 catheter days and 5,210 patient days in the post-intervention.

UCx, IUC device utilization ratio (DUR) (device days over patient days), and gram-negative antibiotic days of therapy (DOT). We defined CathX for this analysis as a catheter removed and replaced within a 4h period, to exclude voiding trials, based on discussion with nursing. We hypothesized that post-intervention, we would observe an increase in UA and CathX, and a reduction in UAR, UCx, and CAUTI.

The Department of Hospital Epidemiology conducted surveillance for CAUTI per NHSN criteria.[3] CAUTI prevention included standard IUC kits, daily chlorhexidine bathing, twice-daily IUC care, monthly unit HAI report cards, and case reviews for all CAUTI. There were no changes to testing, reporting, or prevention practices during the study. For all analysis, only indwelling foley catheters were considered as IUC.

Statistical analysis was performed using SAS version 9.4 software (SAS Institute, Cary, NC) and the NHSN Statistics Calculator, utilizing the mid-P Exact test to determine statistical significance. Statistical significance was at $P<0.05$.

Results

There were 24 CAUTIs in the CT-ICU and 19 in the SICU reported during the study period. In the CT-ICU there was an (88%) reduction in CAUTI (1.6–0.2 CAUTIs/100 catheter days, $p<0.001$), (33%) increase in CathX (3.9–5.2 exchanges/100 catheter days, $P<0.01$), (45%) reduction in UCx (6.65–3.69 UCx/100 catheter days, $P<0.01$), (39%) decrease in UAR (9.15–5.61 UAR/ 100 catheter days $P<0.01$), (167%) increase in UA (2.18–5.83 UA/100 catheter days, $P<0.01$) and reductions in UAR and UCx positivity rates. In the SICU, there was an (84%) reduction in CAUTI (1.9–0.3 CAUTIs/100 catheter days, $P=0.03$), (21%) increase in CathX (6.6–8.0 exchanges/100 catheter days, $P<0.01$), (48%) reduction in UCx (9.14–4.75 cultures/100 catheter days, $P<0.01$), (40%) decrease in UAR (10.43–6.23 UAR/1,000 patient days $P<0.001$), (33%) increase in UA (3.67–4.87 UA/100 catheter days) and no difference in UAR or UCx positivity (Table 1). DOT was unchanged (710–697 per/1,000 patient days, $P=0.3$ in SICU and 470–458 per 1,000 patient days, $P=0.1$ in the CTICU) as was DUR (0.7 in the CT-ICU and 0.6 in the SICU both pre and post intervention).

Discussion

This study demonstrates a strategy for reducing CAUTI in critically ill patients with medically necessary catheters. Obtaining nearly identical sustained CAUTI reduction in two high-complexity units significantly increases the strength of the data and the relevance of this intervention. In the CT-ICU, where this approach was first trialed, outcomes have been sustained for over two years in the setting of high urinary catheter use, and in the SICU, though follow up is briefer, our results have been nearly identical.

Implementation of the protocol was done without expectation that it would be strictly followed; given the lack of existing data, it was left to the CT-ICU to have final decision-making for all patient testing. While we anticipated CAUTI reduction, the magnitude was surprising and led to expansion to the SICU and further data collection. For this reason, this analysis is retrospective and population-level.

A challenge is that we do not know the degree of protocol adherence. In both units, we observed changes in UA, UAR, CathX, and UCx supporting the hypothesis and suggesting adherence. Conversely, the lower magnitude increase in UA in the SICU possibly indicates lower compliance, and anecdotally we were aware of cases of CathX without a preceding UA. This approach however, while not recommended by the protocol, would likely have had similar outcomes.

Our data also suggests that the mechanism of CAUTI reduction was likely more complex than just reduction in ABU, illustrated by the difference in UCx and UAR positivity between the units. Interpretation of this is challenging, since there is no conclusive data on how CathX would impact pyuria and the relationship between UAR and UTI. For example, CathX could possibly increase UAR positivity through mechanical trauma, increasing downstream UCxs, and possibly reducing positivity. Ultimately, these variables likely interacted in ways difficult to extrapolate from population data. While encouraging, we need patient-level data to attribute the changes observed to ABU reduction.

Prior studies have highlighted the overtreatment of ABU and the association between over-detection of ABU, CAUTI rates, and antimicrobial use.[7–9] Our intervention is first to demonstrate the impact of replacing catheters immediately prior to obtaining urine cultures. Future studies incorporating prospective monitoring, per-patient analysis of compliance and antibiotic use, and larger sample sizes could provide further insights into this intervention.

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