Effectiveness of a simple intervention for prevention of catheter-associated urinary tract infections on a medical hospital unit

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Abstract

Background: Urinary tract infections (UTI) are one of the most common hospital-acquired infections with 80% as a result of urinary catheterisation.

Aim/Objective: This study examined the impact of a simple intervention consisting of a daily chart reminder in patients with indwelling urinary catheters (IUC) on the duration of catheter use and the incidence of catheter-associated UTIs (CAUTIs).

Methods: The trial used a prospective pretest–post-test design with a control group over a six-month period conducted on two medical units of a community teaching hospital. We included all patients admitted to two medical units between 1 June and 30 November 2016 who had an IUC inserted at the study site. During the intervention phase, a sticker was placed in the charts of patients with urinary catheters reminding physicians to assess for catheter removal if not clinically necessary.

Results: A total of 195 patients participated in this study (112 control unit, 83 intervention unit). There was a decrease in the duration of IUC use on the intervention unit from 11.7 days to 7.5 days ($P = 0.0028$). There was a decrease in repeated catheterisation from 11.1% to 2.1% ($P = 0.0882$), and CAUTIs from 17.5% to 4.6% ($P = 0.0552$) but this did not reach statistical significance.

Discussion: The implementation of a daily IUC reminder sticker in patient charts was associated with a significant reduction in the mean duration of indwelling catheter use with a trend towards a reduction in the frequency of repeated urinary catheterisation and rate of CAUTIs.

Keywords

Catheter-associated urinary tract infections, hospital infections, catheter, urinary tract infection, infection control

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Background

In Canada, one in nine patients admitted to an acute care facility develop a nosocomial infection, with urinary tract infections (UTIs) being the most common (Gravel et al., 2007). Internationally, UTIs account for 18.9% and 12.9% of all hospital-acquired infections in Europe (Suetens et al., 2018) and the United States, respectively (Magill et al., 2014). Eighty percent of UTIs are attributable to urinary catheterisation, defined as catheter-associated urinary tract infections (CAUTIs) (Lo et al., 2008). In Canadian hospitals, CAUTIs are the most common type of hospital-acquired infection, accounting for 35.6% of all infections (Mitchell et al., 2019). These infections lead to increased length of hospital stay, morbidity and cost of care. In the USA, nosocomial UTIs increase the length of hospital stay by 1–4 days and a hospital-acquired UTI adds approximately \$676 to the cost of hospitalisation (Saint, 2000).

Approximately 25% of hospitalised patients in the USA have an indwelling urinary catheter (IUC) placed (Haley et al., 1981). Previous studies have reported a high rate of inappropriate urinary catheters among hospitalised patients (Gardam et al. 1998; Jain et al., 1995), with the development of a nosocomial UTI at 5% per day, and associated bacteraemia in 2%–4% of patients (Stamm, 1991). The duration of catheter use is the most important CAUTI risk factor (Lo et al., 2008). Of IUCs, 21%–54% do not meet appropriateness criteria (Gokula et al., 2004; Jain et al., 1995). Furthermore, physicians are often not aware that a patient has an IUC (Saint et al., 2000).

Current guidelines suggest that prevention of CAUTI involves limiting catheter use to situations where appropriate clinical indications are met, and prompt removal of catheters once no longer required (Healthcare Infection Control Practices Advisory Committee [HICPAC], 2009; Hooton et al., 2010).

Various strategies have been employed to decrease the incidence of CAUTIs with some success. These have included a written reminder on the charts of patients with an IUC in place (Bruminhent et al., 2010; Saint et al., 2005), use of urinary catheter indication sheet before IUC insertion (Gokula et al., 2007), a multifaceted intervention bundle (Clarke et al., 2013; Tillekeratne et al., 2014), daily nursing reminders to physicians (Huang et al., 2004) and the use of computer-based catheterisation order entry (Cornia et al., 2003).

This research study was undertaken to examine the impact of a simple intervention consisting of a daily reminder on the patient's medical binder in patients with IUCs on the duration of IUC use and the incidence of CAUTIs.

Methods

This trial used a prospective pretest–post-test design with a control group and was undertaken at a university-affiliated

community teaching hospital located in Edmonton, Alberta, Canada. Two medicine units were involved in this study, consisting of both internal medicine and family medicine patients. Patients aged ≥ 18 years admitted to these two units from 1 June to 30 November 2016 were included in the study if they had an IUC inserted at the study site. Patients with an IUC placed before arrival to the emergency department (i.e. before hospitalisation) were excluded.

The University of Alberta Health Ethics Research Office and Covenant Health Research Centre approved the study.

During the pre-intervention phase, active surveillance was carried out on both units over a three-month period (June to August 2016) to determine the baseline rate of urinary catheterisations and rate of CAUTIs. The charge nurse identified patients with an IUC during daily morning rounds.

After the three-month surveillance period, the intervention was implemented in one unit and the other unit served as a control. The intervention consisted of a reminder sticker placed by the unit clerk every morning (weekdays and weekends) in the order section of patients identified as having IUCs (Figure 1). The sticker asked physicians whether he/she wanted to continue or discontinue the IUC. If continued, the physician was required to identify the reason for continuing the IUC based on the list of indications provided. Acceptable indications for IUC use were based on the 2009 CAUTI guidelines by the HICPAC (2009). These included acute urinary retention or bladder outlet obstruction, need for accurate measurements of urinary output in critically ill patients, perioperative use for selected surgical procedures, to assist in healing of open sacral or perineal wounds in incontinent patients, patients requiring prolonged immobilisation and patients in whom an IUC will improve comfort during end-of-life care.

Data were collected by chart review. Baseline characteristics were obtained including age, sex, most responsible diagnoses and length of hospital stay.

The primary outcome was the rate of inappropriately retained urinary catheters during the pre- and intervention period and the rate of CAUTI. Secondary outcomes included length of hospital stay and number of patients with prolonged hospitalisations attributable to CAUTIs.

CAUTI was defined according to National Healthcare Safety Network criteria (Centers for Disease Control and Prevention, 2013). The patient has an IUC in place at the time or within 48 h before urine collection, plus one of the following criteria:

- (1) at least one of the following signs or symptoms with no other recognised cause: fever ($> 38^{\circ}\text{C}$); suprapubic tenderness or costovertebral tenderness; and a positive urine culture of $\geq 10^5$ colony forming unit (CFU)/mL with no more than two species of microorganisms;
- (2) at least one of the following signs or symptoms with no other recognised cause: fever ($> 38^{\circ}\text{C}$); suprapubic

Figure 1. Intervention sticker.

****URINARY CATHETER REMINDER****

Date _____/_____/_____

Indwelling Urinary Catheter in place since _____/_____/_____

Please indicate below **EITHER** (1) that the catheter should be removed **OR** (2) that the catheter should be retained. If catheter should be retained, please state **ALL** of the reasons that apply.

☐ Please discontinue indwelling urethral catheter, **OR**

☐ Please continue indwelling urethral catheter because the patient requires it for the following reasons (please check all that apply):

- ☐ Urinary retention
- ☐ Very close monitoring of urine output and patient unable to use urinal or bedpan
- ☐ Open wound in sacral or perineal area and patient has urinary incontinence
- ☐ Patient too ill to use any other type of urinary collection strategy
- ☐ Patient had recent surgery
- ☐ Other - please specify _____

Signature _____ Date _____

tenderness or costovertebral tenderness; and a positive urine culture of $\geq 10^3$ and $\leq 10^5$ CFU/mL with no more than two species of microorganisms and a positive urinalysis, demonstrated by at least one of the following findings:

- i. positive dipstick for leukocyte esterase and/or nitrite;
- ii. pyuria (urine specimen with > 10 white blood cells/mm³/high-power field of unspun urine);
- iii. microorganisms seen on Gram stain of unspun urine.

The frequency of CAUTI among catheterised patients was defined as the number of CAUTIs per 100 catheterised patients. The incidence rate of CAUTI was defined as the number of episodes of CAUTI per 1000 catheter days. A catheter day is defined as a 24-h period in which an IUC is in place. The rate of inappropriate catheterisations was calculated by the number of inappropriate catheterisations over the total number of catheterised patients during the study interval.

Data were explored descriptively. Normally or near normally distributed data were reported as means with SD and compared by Student's t-test. Non-normally distributed continuous data were reported as medians with interquartile ranges (IQR) and were compared by Mann-Whitney U test. For some non-normally distributed continuous features, both mean $\pm$ SD and median (IQR) were provided. Categorical variables were compared using the Chi-squared test.

Results

Over the six-month period, the number of patients catheterised was 112 on the control unit and 83 on the intervention unit (Table 1). The baseline demographics of patients on the control and intervention unit were similar (Table 1) except there was a higher rate of respiratory diagnoses on the intervention unit and metabolic conditions on the control unit.

There was no change in the rate of inappropriate retained urinary catheters between the pre-intervention and intervention periods for both the control and intervention unit. There was also no change in the frequency of catheterisation between the pre-intervention and intervention periods for both the control and intervention units. However, the mean duration of catheter use significantly decreased in the intervention unit from 11.68 days pre-intervention to 7.46 days post-intervention ($P = 0.0028$), whereas there was no change in the control unit (Table 2). The frequency of CAUTIs decreased on the intervention unit from 7/40 (17.5%) to 2/48 (4.6%), which nearly reached statistical significance ($P = 0.0552$). While there was also a reduction in the frequency of repeated catheter placement on the intervention unit from 11.1% to 2.1%, this did not reach statistical significance ($P = 0.0882$).

The intervention was not associated with improvement in hospital length of stay or reduction in prolonged hospitalisations attributed to CAUTIs.

Discussion

The implementation of a daily IUC reminder sticker in patient charts was associated with a significant reduction in

Table 1. Demographics of the study population.

Variables	Total	Control unit	Intervention unit	P value
Patients (n)	195	112	83	
Age (years)				
Mean $\pm$ SD	76.21 $\pm$ 13.73	75.92 $\pm$ 13.37	76.62 $\pm$ 14.31	
Median (IQR)	79 (68–87)	78 (70–86)	80 (66–89)	0.49
Male (n (%))	96 (50.53)	55 (49.55)	41 (51.90)	0.11
Most responsible diagnoses (n (%))				
UTI	27 (13.85)	16 (14.29)	11 (13.25)	0.16
Respiratory	23 (11.79)	9 (8.04)	14 (16.87)	0.03
Metabolic	14 (7.18)	12 (10.71)	2 (2.41)	0.02
Cancer	22 (11.28)	11 (9.82)	11 (13.25)	0.14
Infection	24 (12.31)	16 (14.29)	8 (9.64)	0.11
CHF	16 (8.21)	9 (8.04)	7 (8.43)	0.21
Length of hospital stay in days				
Mean $\pm$ SD	23.11 $\pm$ 28.52	25.34 $\pm$ 31.86	19.97 $\pm$ 22.87	
Median (IQR)	13 (7–29)	13 (7–33)	13 (7–26)	0.49

CHF, congestive heart failure; IQR, interquartile range; SD, standard deviation; UTI, urinary tract infection.

the mean duration of IUC use with a trend towards a reduction in repeated catheter placement as well as rate of CAUTIs. Hospital length of stay was not impacted likely because prolonged hospitalisation as a result of CAUTI was rare in this study.

While our study intervention of placing a reminder sticker in the chart of catheterised patients is similar to other studies (Bruminhent et al., 2010; Saint et al., 2005), the main strengths of our initiative include its simplicity, with negligible addition of time or resources, cost-effectiveness at only \$0.10/sticker and physician-centric approach, which increases uptake. The identification of catheterised patients was incorporated into the charge nurse's pre-existing daily morning rounds. Thereafter, a sticker was applied by the unit clerk, thereby negating need for additional staff or resources. In the study by Saint et al. (2005), a study nurse went to each ward to download the patient census, collect data, then place reminder stickers in the chart. Our method is more sustainable in the long term as it does not require a dedicated person to continue this initiative at the completion of the study.

Physician workflow was optimised in order to increase uptake of the intervention. Placing the reminder sticker in the order section of the chart likely added to its success as physicians are likely to see and address the sticker on their daily patient rounds as the majority of medicine patients have daily orders placed. In the Saint et al. study (2005), the sticker was placed in the physician note section, which is often missed. As such, initial uptake to their intervention

was low and required the addition of email reminders, plastic tape flags and alphanumeric paging to further enhance uptake. Furthermore, as we placed the sticker in the order section, no additional time is needed to flip to another section of the chart should the physician want to write an order to remove the catheter.

As many hospitals transition to electronic medical records (EMR), there will be greater capabilities to incorporate checks for appropriate catheter use in an automated fashion. Justification for IUC use, according to a selection of guideline-based criteria, could be incorporated at the time of ordering. Similarly, pre-programmed alerts at a specified interval can prompt physicians to reassess the need for a catheter in their catheterised patients. However, we believe our intervention continues to be valuable because EMRs are not feasible for all institutions, particularly those with resource constraints, whereas our intervention can be implemented regardless of setting and resources.

Education was an important component of our study. Rather than simply using a sticker requesting physicians evaluate the need for an IUC (Bruminhent et al., 2010), our sticker listed appropriate indications for IUC use representing an opportunity to educate not only the attending physicians, but also the residents and medical students who participate in patient care.

This study elegantly demonstrates that education on appropriate catheter use alone is insufficient for practice change. Clinicians manage patients on multiple medical units; therefore, one would expect that education provided

Table 2. Outcomes of CAUTI and catheter utilisation rates.

	Pre-intervention	Post-intervention	P value
<i>Catheter days</i>			
Control	7.39 $\pm$ 8.15	7.32 $\pm$ 10.09	0.4102
Intervention	11.68 $\pm$ 10.26	7.46 $\pm$ 6.95	0.0028
<i>Catheterisation</i>			
Control	72 (53.73)	62 (46.27)	0.3877
Intervention	40 (45.45)	48 (54.55)	0.3938
<i>CAUTI</i>			
Control	8 (11.94)	3 (4.92)	0.1568
Intervention	7 (17.50)	2 (4.55)	0.0552
<i>Inappropriate catheterisation</i>			
Control	33 (49.25)	25 (40.98)	0.3479
Intervention	11 (27.50)	15 (34.09)	0.5140
<i>Patients with repeated catheter placement</i>			
Control	8 (14.04)	9 (16.36)	0.7313
Intervention	4 (11.11)	1 (2.13)	0.0882
<i>Patients with prolonged hospitalisation as a result of CAUTI</i>			
Control	1 (1.49)	0 (0.00)	0.3421
Intervention	1 (2.50)	0 (0.00)	0.3025
<i>Length of stay (in days)</i>			
Control	18.00 (9.00–42.00)	12.50 (7.00–30.00)	0.0340
Intervention	16.50 (8.00–28.50)	12.50 (6.00–22.50)	0.1605

Values are given as n (%), mean $\pm$ SD or median (IQR).

CAUTI, catheter-associated urinary tract infection; IQR, interquartile range; SD, standard deviation.

from the reminder sticker on the intervention unit would be applied to patients managed in the control unit as well. However, the intervention did not reduce catheter use on the control unit, suggesting that education was insufficient to reduce catheter use. Rather, a physical prompt in the form of the reminder sticker was required to instigate practice change on a patient level, though no formal survey was conducted to ascertain physicians' knowledge during this study.

While the location of the catheter placement was not formally documented, it was noted by chart reviewers that the majority of the catheters were placed in the Emergency Department. Thus, the finding that the frequency of total catheterisation and inappropriate catheterisation did not change pre- and post-intervention was expected, as the intervention took place on the medical unit, which would not affect the decision to place a catheter in the emergency room. Conversely, on the medicine units, the reminder sticker appeared to decrease the frequency of catheterisations, as the number of repeat catheter placements was

lower in the intervention unit compared to the control unit, presumably reflecting the sticker's educational value.

A limitation of this study included the inconsistent protocol follow-through and documentation on weekends. The same charge nurse and unit clerk worked from Monday to Friday, but there were rotating charge nurses and unit clerks on the weekends. These weekend personnel may not have remembered to identify patients consistently and reminders to follow the study protocol may have been missed on the weekends. However, since the mean duration of catheterisation was seven days during the intervention phase (in both the control and intervention groups), we feel that the majority of patients would have been identified during one of the non-weekend days. This highlights the need for consistency in promoting sustainability and behaviour change if it is to occur on all days. Interestingly, despite completion of the study, the weekday staff continued to identify patients and collect data suggesting that once incorporated into their daily tasks, this could be a sustainable practice. A further limitation of this study is the small sample size. While there was a trend toward

a decrease in repeated catheterisations and number of CAUTIs on the intervention unit, a larger study population may have resulted in a statistically significant result.

Upon completion of the study, we sought feedback from stakeholders in order to optimise the process. Recommendations included minimising the size of the sticker and excluding patients with chronic IUCs, as these often cannot be removed. As a result of the positive findings, the goal is to introduce this modified intervention to other units in the hospital, including the Emergency Department where the majority of IUCs are inserted.

In conclusion, the daily placement of IUC reminder stickers in patient charts is a simple intervention which led to a significant reduction in the mean duration of IUC use and a trend towards a reduction in the rate of CAUTIs.

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