RESEARCH ARTICLE

Intervention to reduce unnecessary urinary catheter use in a large academic health science centre: A one-group, pretest, posttest study with a theory-based process evaluation

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Abstract

Aim: To evaluate an intervention to reduce unnecessary urinary catheter use and prevent catheter-associated urinary-tract infections (CAUTI) in hospitalized patients across an academic health science centre.

Methods: We conducted a one-group, pretest, posttest study with a theory-based process evaluation. Phase 1 consisted of a pre/postintervention to test the impact of a CAUTI protocol. Audits on four units were conducted, and data were analysed descriptively. Phase 2 consisted of a theory-based process evaluation to understand the barriers/enablers to the implementation. Semistructured interviews were conducted and then analysed using a systematic approach.

Results: In Phase 1, all inpatients with urinary catheters admitted to the units ($N = 4$) during the study period ($N = 99$, pre) and ($N = 99$, post) were included. CAUTI prevalence rate was 18.2% pre versus 14.1% post ($p = .563$). In Phase 2, participants ($N = 18$) who worked on the units were interviewed, and a total of 13 barriers and 19 enablers were found.

KEYWORDS
patient safety, quality improvement, urinary catheter, urinary tract infections

1 | INTRODUCTION

Catheter-associated urinary-tract infections (CAUTI) are common hospital acquired infections (Clarke et al., 2013; Fletcher et al., 2016), and are a major patient safety concern. CAUTI pose a high risk for increased morbidity, mortality, costs and length of stay (Cassel & Guest, 2012). Approximately 25% of all hospitalized patients are catheterized during their stay, and almost half of those are catheterized unnecessarily (Cassel & Guest, 2012). In addition,

approximately 10% of the catheterized population are diagnosed with a CAUTI (Weinstein et al., 1999). The cost per case for CAUTI is estimated at 1,000$ US per patient (Zimlichman et al., 2013).

2 | BACKGROUND

Many studies have examined the implementation of evidence-based interventions on catheter use and on CAUTI rates (Fakih et al., 2012,

2013; Marigliano et al., 2012; Saint et al., 2013; Titsworth et al., 2012), and multiple guidelines have been developed by several organizations such as the Society for Healthcare Epidemiology of America (SHEA)/Infectious Diseases Society of America (IDSA) (Hooton et al., 2010; Lo et al., 2014), the Centers for Disease Control and Prevention (CDC) (Umscheid et al., 2010), and the Association for Professionals in Infection Control (APIC) (Lo et al., 2014). These evidence-based guidelines need to be embedded into all practice settings.

The CAUTI protocol was based on the Guideline for Prevention of Catheter-Associated Urinary-Tract Infections (Gould et al., 2019) and the International Clinical Practice Guidelines from the Infectious Diseases Society of America (Hooton et al., 2010). The protocol consisted of four evidence-based components of care to prevent the risk of CAUTI: (a) the avoidance of unnecessary urinary catheters, (b) the insertion of catheters using aseptic technique, (c) the care and maintenance of urinary catheters based on recommended guidelines, and (d) the review of urinary catheter necessity daily and prompt removal.

Previous pilot work on the general internal medicine units at a large academic health science centre showed a decrease in the incidence of catheter use from approximately 25% of patients down to 12%–15% after implementation of a standardized protocol (Wooller et al., 2018). This was also associated with decreased antibiotic prescribing for catheter-associated bacteriuria on these units, which was sustained for over a year (Wooller et al., 2018). Based on these positive pilot study results, this intervention was expanded across the organization. The overall purpose of the current study was to evaluate an intervention to reduce unnecessary urinary catheter use and prevent CAUTI in hospitalized patients across a large academic health science centre.

3 | METHODS

3.1 | Study design

This was a one-group, pretest, posttest study with a theory-based process evaluation. In Phase 1, we conducted a preintervention and postintervention study to test the impact of the intervention to reduce CAUTI in hospitalized patients between May 2017–February 2018. In Phase 2, we conducted a theory-based process evaluation to understand the barriers and enablers to the implementation between May–August 2018. We used the revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) Standards checklist when writing the report on our study findings (Ogrinc et al., 2016).

3.2 | Ethical considerations

Approval for this study was granted by the Ottawa Health Science Network Research Ethics Board (#20170078-01H) and the University of Ottawa Research Ethics Board (#A04-17-04). Informed consent was obtained from all individual participants included in the study.

What does this paper contribute to the wider global clinical community?

- This theory-based process evaluation provided insights into barriers and enablers to the implementation of an intervention to reduce unnecessary urinary catheter use.
- The identification of barriers and enablers will not only help improve the intervention in a local context but will also help other institutions looking to implement similar protocols.

3.3 | Setting

The study took place in a large academic health science centre with approximately 1,080 inpatient beds in Ottawa, Ontario, Canada. A total of four inpatient units (A, B, C and D) not originally part of the pilot were selected to participate. These four units were selected because they had the highest rates of indwelling catheters in the hospital. The population on each unit was primarily as follows: vascular surgical patients (unit A), orthopaedic surgical patients (unit B), thoracic surgical patients (unit C) and general surgical patients (unit D).

3.4 | Phase 1: Preintervention and postintervention

3.4.1 | Population

Using a convenience sample, all patients with an indwelling catheter admitted to each of these units during the study period were included.

3.4.2 | Procedures and data collection

The CAUTI protocol was implemented using the 4 Es (Engagement, Education, Execution and Evaluation) of the Translating Evidence into Practice model (Pronovost et al., 2008). Resources such as preprinted order forms and a variety of education materials (i.e. posters, presentations) were developed. A nurse co-investigator conducted a train-the-trainer workshop for CAUTI champions focussed on the risk factors associated with indwelling catheters, recommended prevention and dissemination interventions, and competency-based catheter insertion technique. The workshop was held during a Nurse Educator Forum. Physician co-investigators presented the protocol at the Resident Orientation Day. Nurse Educators incorporated the education through their unit-specific in-services. Nurse co-investigators also conducted targeted education strategies for clinical staff to support the Nurse Educators as needed. An article was also published in the hospital journal and educational posters were placed on all the units to help create awareness of the protocol. The urinary catheter protocol was made widely available for use in the emergency department and the units hospital-wide.

Weekly catheter audits took place preimplementation and post-implementation to ensure a regular review of catheter necessity for all inpatients with urinary catheters admitted on the four units during the study period. Data were collected from patients' charts by two trained research assistants. Data-collected, included, documented evidence of (a) a CAUTI protocol in the chart, (b) a urinary catheter in place, (c) signs and symptoms such as fever (38°C and above), rigour, altered mental status, malaise, etc., and (d) positive urine culture. The specific data elements can be found in Appendix S1: Supplementary File 1.

3.4.3 | Data analysis

Patient characteristics (including service, age, sex, acute length of stay, Elixhauser score, presence of postoperative UTI, UTI diagnosis, positive urine culture) during the audit periods were compared pre and post using the hospital administrative database. Descriptive statistics including mean, median and/or standard deviation were used to summarize the patient characteristics. Independent t tests were used for continuous data (e.g. age) and chi-squares were used for dichotomous data (e.g. preintervention and postintervention CAUTI prevalence rates) to make comparisons on outcomes. A p-value of ≤.05 was considered statistically significant. Data were analysed in the Statistical Package for the Social Sciences version 26.0 (IBM Corp. Released 2019. IBM SPSS Statistics for Macintosh, Version 26.0. IBM Corp.).

3.5 | Phase 2: Theory-based process evaluation

3.5.1 | Procedures and data collection

All nurses, physicians, unit managers, nurse educators and clinical care leaders who worked during the study period on the audit units ($N = 4$) were invited to participate. A recruitment email was sent to all staff and physicians. The research assistant also visited the units during daytime working hours to recruit potential participants. Individuals who said an interest in participating were approached by the research assistant to further explain the study. All participants in Phase 2 provided written-informed consent. After informed consent was obtained, 30–45-min audio-recorded semi-structured interviews were conducted by the trained research assistant. The interviews, guided by the 14 domains in the Theoretical Domains Framework (TDF) (Atkins et al., 2017; Cane et al., 2012; Curran et al., 2013), were conducted either in person or by phone. The semi-structured interview guide can be found in Appendix S1: Supplementary File 2.

3.5.2 | Theoretical Domains Framework

The TDF is a robust and integrative theoretical framework, developed by health psychologists and health services researchers, based on a synthesis of 33 behaviour change theories, clustered into 14 theoretical domains (Atkins et al., 2017; Cane et al., 2012). The TDF was developed for implementation research across multiple disciplines, and use in behaviour change research (Atkins et al., 2017; Cane et al., 2012; Curran et al., 2013). The framework was validated with behaviour change experts (Cane et al., 2012), and has been used to investigate barriers and enablers to intervention implementation in a variety of clinical situations including blood transfusion (Francis et al., 2009), preoperative testing (Patey et al., 2012), hand hygiene compliance (Squires et al., 2014), screening in the emergency department (Kirk et al., 2016), and electronic fatal health surveillance (Patey et al., 2017). The TDF, to our knowledge, has not been used in implementation studies addressing CAUTI.

3.5.3 | Data analysis

Descriptive statistics, such as means and standard deviations were used to summarize the characteristics of the participants. Interviews were transcribed verbatim and were analysed using NVivo qualitative data analysis software (NVivo qualitative data analysis software; QSR International Pty Ltd. Version 12, 2018). Interviews were analysed using a six-step approach (Squires et al., 2014): coding, generation of specific beliefs, identification of themes, aggregation of themes into categories, assignment of barrier or enabler to each of the categories and analysis for shared, discipline-specific and conflicting barriers and enablers. Specifically, the approach consisted of the following steps. First, two reviewers independently coded the participant transcripts by assigning text segments to relevant domains of the TDF. Discrepancies were resolved through discussion until consensus was met. Second, specific belief statements were generated in each domain of the TDF for the coded segments of text, and then similar belief statements were grouped together. Belief statements are short statements that summarize and represent the underlying themes. Third, themes were generated inductively from the grouped belief statements. Fourth, themes were then grouped into broad categories. Fifth, each theme was classified as either a barrier or an enabler to using the CAUTI protocol. Sixth, themes were examined in relation to whether they were shared barriers and enablers (shared was defined as a similar statement mentioned by two or more individuals), discipline-specific (e.g. nurses, physicians, managers) or conflicting barriers and enablers. Theming was done first in and then across domains. Frequency scores were calculated for the number of participants describing each barrier and enabler.

4 | RESULTS

4.1 | Phase 1: Preintervention and postintervention

4.1.1 | Patient characteristics

Using the hospital administrative database, we compared patient characteristics preimplementation and postimplementation of the

protocol (Table 1). The demographics of participants were similar across the measurement periods except for greater number of patients on the medical service (p <.001), and a longer acute length of stay (p =.005) postintervention. Approximately half of patients were female, and the average age of the participants was 64 ± 17 years old in both the preintervention and postintervention group.

4.1.2 | Audits

Data were collected on patients who had an indwelling urinary catheter N = 198 (pre N = 99, post N = 99). Overall, the prevalence of CAUTI rates was 18.2% pre versus 14.1% post, but the difference was not statistically significant (p = .563). The audit results can be found in Table 2.

4.2 | Phase 2: Theory-based process evaluation

In phase 2, we recruited a total of 18 participants (N = 18), 4 were male (22.2%) and 14 were female (77.8%) to participate in the semi-structured interviews. More than half of the participants were nurses (N = 10, 55.6%). Additional demographic information is available in Table 3.

Using the TDF (Atkins et al., 2017; Cane et al., 2012; Curran et al., 2013), the barriers and enablers related to the use of the CAUTI protocol to manage patients with urinary catheters were identified.

4.2.1 | Relevance

All 14 TDF domains were relevant to the use of the CAUTI protocol. More beliefs reflected enablers (N = 19) compared to barriers (N = 13).

TABLE 1 Patient characteristics (audit units)

Variable	Preintervention 2017-05-01 – 2017-06-30	Postintervention 2018-01-01 – 2018-02-28	p-Value
Encounters (unique)	1,166	971	
Patients (unique)	1,117	934	
Service			
Acute medical	≤5 (0.4%)	30 (3.1%)	<.001
Acute surgical/ Planned surgery	1,161 (99.6%)	941 (96.9%)	
Age			
Mean ± SD	63.79 ± 17.16	64.12 ± 16.75	.655
Median (IQR)	66 (53–76)	66 (55–75)	.968
Sex			
F	600 (51.5%)	486 (50.1%)	.517
M	566 (48.5%)	485 (49.9%)	
Acute length of stay			
Mean ± SD	5.32 ± 5.00	5.95 ± 5.34	.005
Median (IQR)	4 (2–7)	4 (2–8)	.001
Elixhauser score[a]			
Mean ± SD	2.37 ± 5.02	2.67 ± 5.30	.176
Median (IQR)	0 (0–2)	0 (0–4)	.073
NSQIP Flag[b]	67 (5.7%)	66 (6.8%)	.317
NSQIP Post-operative UTI[c]	0 (0.0%)	0 (0.0%)	
UTI diagnosis[d]	≤5 (0.4%)	≤5 (0.5%)	.771
Positive urine culture[e]	9 (0.8%)	16 (1.6%)	.061

[a]Overall score calculated based on the 31 comorbidity indicators (van Walraven et al., 2009).

[b]Cases available in the National Surgical Quality Improvement Program (NSQIP) database.

[c]Patients who developed a symptomatic urinary tract infection in 30 days after the principal operative procedure in the NSQIP database.

[d]Patients with post admit diagnosis of urinary tract infection during inpatient hospital admission.

[e]Patients who had a positive urine culture (colony count > 100,000/ml urine) during admission.

Variable	Preintervention (June 2017)	Postintervention (January 2018)	p-Value
Patients with assessed indwelling urinary catheter	99	99	
Patients with a documented catheter in last 48 hr	83 (83.8%)	98 (99.0%)	.000
Catheter inserted in the ED	8 (8.0%)	6 (6.0%)	.783
Protocol form completed in chart	n/a	12 (12.1%)	
Patients with culture results available	44 (44.4%)	46 (46.5%)	.887
Patients with positive culture	32 (32.3%)	32 (32.3%)	1.000
CAUTI prevalence	18 (18.2%)	14 (14.1%)	.563

Characteristics	Nurse (N = 10)	Physician[a] (N = 3)	Managers[b] (N = 5)	Total (N = 18, 100%)
Gender				
Male	3	1	0	4 (22.2%)
Female	7	2	5	14 (77.8%)
Highest educational level				
College	2	0	0	2 (11.1%)
Bachelor degree	8	0	3	11 (61.1%)
Medical school	0	2	0	2 (11.1%)
Master's degree	0	1	2	3 (16.7%)
Years of experience on unit				
<1	0	0	1	1 (5.6%)
1–5	4	3	1	8 (44.4%)
6–10	4	0	2	6 (33.3%)
11–15	2	0	1	3 (16.7%)
16+	0	0	0	0 (0%)

[a]1 physician assistant based on role at the hospital.

[b]Clinical care leader, educator, and unit manager.

4.2.2 | Shared themes

Shared themes are defined as being barriers or enablers that are shared by at least two people or shared between two different provider groups.

4.2.3 | Barriers

There were a total of 13 barriers across 11 TDF domains. The top three barriers to the implementation of the CAUTI protocol were: (a) competing priorities or time constraints (N = 11, 61.1%), (b) patient characteristics, preferences and previous patient history (N = 10, 55.6%), (c) availability of the protocol (N = 8, 44.4%); confusion with the protocol overlapping with other orders related to catheters (N = 8, 44.4%). Table 4 provides further details of the barriers.

4.2.4 | Enablers

There was a total of 19 enablers across 12 TDF domains. The three most common enablers were: (a) knowing the benefits of using the protocol (N = 16, 88.9%), (b) the importance of education and training (N = 13, 72.2%); the protocol being all-inclusive, easy and ready for use (N = 13, 72.2%); easy access to the protocol (N = 13, 72.2%), and (c) the awareness and agreement with the evidence (N = 12, 66.7%). Table 5 provides further details of the enablers.

4.2.5 | Conflicting themes

In certain instances, themes were identified as both a barrier and an enabler depending on the participants' responses. A total of five themes were conflicting including: (a) competing priorities:

TABLE 4 Barriers to CAUTI intervention

Overarching barriers across domains	Frequency in theme		Domains	Who said It?	Example quote
	N	%			
Competing priorities or time constraints[a]	11	61.1	Environmental Context and Resources; Goals	RN, Managers, Physician	R: You have four patients and one's going to get discharged, so patients going to the OR would take priority, discharges of patients will take priority. Moving patients will take priority. Giving meds will get priority. So, you know, it is a priority but there are a lot of other things to compete with it. (Participant 5, Manager)
Patient characteristics, preferences, and previous patient history (e.g. difficult catherization, pain, retention issues, immobility, existing UTI/catheter)	10	55.6	Memory, Attention and Decision Processes; Environmental Context and Resources; Social Influences	RN, Physician	R: Patients who dribble, patients who have urinary retention problems, patients who have-- but never had have had a clinical long-term catheter in. Doctors will always say, you know, try this, try this technique, just keep working on it. And, at some point you're going, well if you're dealing with skin breakdown, you're dealing with...dignity, nursing time care. So, in order-- if I just put a catheter in, all the problems are solved. (Participant 16, RN)
Availability of the protocol (not available, or cannot get signed by physician)	8	44.4	Social/Professional Role and Identity; Environmental Context and Resources	RN, Managers	R: Well, I really feel that this stems from the physician side, to be honest, because they're the ones who have to actually make the order or write the order. So, I really feel that it would be beneficial for them to complete it as soon as the surgery's finished, to be honest. Like if the patient's just had surgery, they're not on a clinical pathway, I think they should pull that PPO and sign it off. You know, that's as simple as it gets. And from a nursing perspective, I think don't be beaten down by the fact that it's not being completed. Keep trying. And get the message across, saying look, this is going to save you phone calls from me you know. I didn't... I used this on my patient two weeks ago and I didn't have to call three times because these three steps of the algorithm I was able to follow. (Participant 10, Manager)
Confusion with protocol overlapping with other orders related to catheters[a]	8	44.4	Environmental Context and Resources	RN, Managers, Physician	R: Honestly, the form in and of itself, I think probably... do you want some feedback from that... I think has a lot of information in it. Can seem intimidating at times but when you really look at it, there's less boxes than there are fingers on like one hand to be able to count. So maybe the visualization of it can sometimes push people off or push people away, but that would be my only thing that I have to say about it. It just looks very busy. (Participant 14, Physician)
More paperwork not seen as beneficial	5	27.8	Beliefs about Consequences; Emotion	RN, Managers, Physician	R: We do it every day we reassess. Do they need the Foley? So, every morning at rounds if the patient has a Foley, it's on our discharge board, and we discuss it. Do they still need it? Why would they need it? If they don't, let's pull it and try to do a trial void. So, I don't think the actual physical thing on orthopaedics is beneficial. (Participant 9, Manager)

(Continues)

TABLE 4 (Continued)

Overarching barriers across domains	Frequency in theme		Domains	Who said It?	Example quote
	N	%			
High patient turnover and high volume of patients with catheters	5	27.8	Environmental Context and Resources	RN, Managers	R: Is it going to be the same tomorrow? I don't know. This is the surgical floor. We have a fast-pace of patient turnover, so... (Participant 7, RN)
Protocol not always relevant	5	27.8	Environmental Context and Resources; Intentions	RN, Physician	R: I think there's a little bit of a grey area where I think it's a little bit less practical or relevant to our particular population. (Participant 14, Physician)
Not trained	3	16.7	Environmental Context and Resources; Skills	RN, Physician	I: Did you receive any training or information on this protocol? R: No. Well, training yes, but the protocol isn't necessarily anything new, it's just a compilation of what we've been taught. Just like a composition of everything that they taught, right? I: Right. R: So, this specific protocol, no. (Participant 16, RN)
I have not used the protocol[a]	3	16.7	Social/Professional Role and Identity	RN, Physician	R: I guess it's a way to standardize things so everybody's on the same page, although I don't really use it... I've never actually went out of my way to take it and initialize it. (Participant 3, Physician)
Do not intend to call for signature or to complete the protocol	2	11.1	Intentions	RN	R: ...but I'm not calling the doctor to sign the protocol. You say like he's just going to do, "Okay, in and out him." (Participant 1, RN)
Need for a reminder[a]	2	11.1	Memory, Attention and Decision Processes	RN	R: Sometimes when you're busy you don't remember all these things. Plus, if I see this, the truth is if they back this here, it's not going to click my head to say oh, I have one. I'm just going to go with this because it's in my care plan. (Participant 7, RN)
Not aware of protocol[a]	2	11.1	Knowledge	RN, Physician	R: I don't know exactly what's on the protocol, to be honest. I just... in terms of length, like is that what you mean? (Participant 3, Physician)
Previous experience (e.g. with finding protocol, patients with catheters without UTIs)	2	11.1	Reinforcement	RN	R: I have had-- I've never had a patient with ins and outs, personally, that's had a UTI. I think I've had one. You know, dealing with medicine patients, nursing home patients. Surgery patients are our bread and butter so most of them will not have catheters, but there are the some. But I find it in my experience, not research-based; UTIs from a catheter are fairly rare in our practice of surgery. I don't deal with medicine patients so much, and often I find doctors will go with the research to say avoid it because it causes a UTI. In my experience goes, you save a lot of clinical time, dignity, and potential other risks beyond just a UTI by just putting the catheter in. (Participant 16, RN)

[a]Both a barrier and an enabler.

TABLE 5 Enablers to CAUTI intervention

Overarching facilitators across domains	Frequency in theme		Domains	Who said it?	Example quote
	N	%			
Knowing the benefits of using the protocol (e.g. decreased UTIs, decreased costs, improved knowledge, improved nursing autonomy, improved patient flow - not chasing doctors, standardized care, justification for catheter)	16	88.9	Beliefs about Consequences; Social/Professional Role and Identity; Goals; Optimism; Reinforcement	RN, Managers, Physician	R: Because sometimes if you look back through orders and charts people will just write DC Foley, or reinsert Foley, and they don't have any sort of note as to why there's a catheter in there… it's just keeping people on track with whether or not they're following the protocol with respect to should we be trialling void on this patient, or continuing bladder scan to make sure that we can get the Foley out as soon as possible. (Participant 18, Physician Assistant) R: The doctors are aware that instead of doing in and out six, every six hours, the first… like in the pathways, it's just per protocol and the protocol signed. We do first, we make sure the patient retained because by bladder scan them how much it is. Then after that, we just do the protocol. Put it in… put it in the care plan and use it. When it's not needed, then we see, without calling the doctor, because once they sign it, they are giving us the authority to do what we think best for the patient. (Participant 1, RN)
Importance of education and training	13	72.2	Behavioural Regulation; Environmental Context and Resources; Skills	RN, Managers, Physician	R: I think just educating the people that need it the most; mostly the doctors, residents. And just making them aware that the protocol is there so that it makes everything so much easier. Because you're going to be calling for a catheter insertion anyways, so instead of writing it out you can just tick the box and sign it that away. (Participant 17, RN)
Protocol all-inclusive, easy and ready for use[a]	13	72.2	Beliefs about Capabilities; Environmental Context and Resources; Skills	RN, Managers, Physician	I: And how easy or difficult would you say it is? R: It's easy because we already know it. It's not new information. (Participant 11, RN) I: Do you think that the protocol is all inclusive and applies to all patients? R: Probably, I mean it doesn't specify anything about orthopaedic procedures… Otherwise, I think it pretty much covers everything of reasons why you'd have a catheter. (Participant 18, Physician Assistant)
Easy access to the protocol (improving flow, simplifying, automating e.g. presigned in chart, placed with other orders/ Pathways)	13	72.2	Behavioural Regulation	RN, Managers, Physician	R: It is signed already. When you need it, you just take it out and you just co-sign it and you just show why you need it and then assess it. I think that's a good idea, like in emerge or in the OR… if you are having it, like assess, the protocol is always there. (Participant 1, RN)
Awareness and agreement with the evidence	12	66.7	Beliefs about Consequences; Knowledge	RN, Managers, Physician	R: In theory, I agree with it… they'll avoid catheters to a certain degree to avoid a UTI. (Participant 16, RN)
Influence by other team members to use the protocol (e.g. through role modelling)	10	55.6	Social/Professional Role and Identity; Environmental Context and Resources; Social Influences	RN, Managers, Physician	R: Allied health could be useful for sure because they're mobilizing the patients. They're moving them around in rooms, especially in thinking of the physiotherapy in particular on our unit. If we could get them on board to say, 'Okay, I want to mobilize this patient. Do they really need that catheter?' 'Can we get that out of there?' (Participant 10, Manager)

(Continues)

TABLE 5 (Continued)

Overarching facilitators across domains	Frequency in theme		Domains	Who said it?	Example quote
	N	%			
Intention to use the protocol, or already use the protocol[a]	8	44.4	Intentions; Memory, Attention and Decision Processes; Social/ Professional Role and Identity	RN, Physician	I: So, do you think following the protocol is automatic or do you need to remember, to be reminded to use it? R: If I do it, I'll remember. If it's in the care plan, I'll remember to do it. That's just the truth. If I have an order here, I'm going to go back to this. If I have an order here, I'm not going to think about it. (Participant 7, RN)
Triggers (e.g. order in chart, seeing nurse educator, patient has a catheter) and reminders help me remember	8	44.4	Behavioural Regulation; Memory, Attention and Decision Processes	RN, Managers, Physician	R: Sometimes people just need a reminder and I think that's probably the case, and just to reiterate the importance of why we're trying to use the protocol. (Participant 18, Physician Assistant)
Confidence about using protocol	7	38.9	Beliefs about Capabilities	RN, Physician	I: How confident do you feel using the protocol? R: I know it inside and out and I like it. So, I use it. (Participant 17, RN)
Some of my colleagues agree	6	33.3	Social/Professional Role and Identity	RN, Physician	I: And, do you think your colleagues agree with the use of the protocol? R: It's variable. So, some of the resident physicians I work with use it all the time and some of the resident physicians I don't think know that it exists. So, it's quite variable on depending which team working with. (Participant 18, Physician Assistant)
Increase buy-in and awareness (e.g. discuss at rounds)	5	27.8	Behavioural Regulation	Managers, Physician	R: I'd say probably kind of what I was saying before, just having the whole team kind of being on board with it and making sure that the nurses are aware about the protocol. Having the physicians educated on the use of the protocol. And, just kind of the team, whole team supporting it, I think that's the way to get it to be promoted. (Participant 18, Physician Assistant)
Emotions influence its use (e.g. worry if do not use)	4	22.2	Emotion	RN, Physician	I: Does not using the protocol ever evoke any worry or concern? R: Yes. You wonder if the protocol isn't used, at what point would be triggering what thought process. Right? Because I'm not always here, you're here 40 hr, let's say, actively on the unit a week. But you have many more hours during the day so yeah, the protocol does give some sort of like sense of security that the stuff will get done for sure. (Participant 14, Physician)
No negative aspects	4	22.2	Beliefs about Consequences	RN, Managers	I: Do you think there's any other negative aspects to using the protocol? R: Hmm, I can't think of anything that's negative about it. (Participant 17, RN)
Automatically use it[a]	4	22.2	Memory, Attention and Decision Processes	RN, Physician	I: Do you have any triggers to remembering to use it? R: I think it's been drilled into my head for the last 10 months that I know. (Participant 11, RN)

(Continues)

TABLE 5 (Continued)

Overarching facilitators across domains	Frequency in theme		Domains	Who said it?	Example quote
	N	%			
No influence from family/patient	3	16.7	Social Influences	RN, Physician	I: Do you think patients and families influence the use of this protocol? R: No, I don't think so, no. They wouldn't know about it, they would just know that my fathers supposed to have a catheter or not, and that's about it. (Participant 16, RN)
Nurses typically initiate the protocol and discussions about removing catheters (seen as nursing role)	2	11.1	Social/Professional Role and Identity	RN	I: Do you think any other team members influence the use of the protocol? So like allied health for an example. R: Not really that I've seen. Mostly just nurses initiating and, yeah, I can't say I've ever an MD initiate. It's just, just nursing really. (Participant 13, RN)
Awareness and role clarity (who should be initiating, using)	2	11.1	Environmental Context and Resources	RN, Managers	R: All I know is that the doctors didn't know how to use that sheet and no one knew how long we should keep it in and then the nurse ended up wanting to take it out because the doctor ordered it out and it was very confusing for everyone. So, on that sheet, it's hard to tell who's supposed to be assessing what, whether it's all the nurse or whether it's the physician. (Participant 2, RN)
There are no competing tasks/Priorities[a]	2	11.1	Environmental Context and Resources	RN, Managers	I: Are there any competing tasks or time constraints that you find influence the use of it? R: No. Not the actual task of like doing our in and out catheters or removing Foleys, but I mean the paper if it's there, no. (Participant 11, RN)
Aware of protocol[a]	2	11.1	Knowledge	RN, Physician	I: So, are you aware of the protocol? R: Yes. (Participant 1, RN)

[a]Both a barrier and an enabler.

participants (N = 10, 55.6%) identified competing priorities or time constraints as a barrier, whereas other participants (N = 2, 11.1%) felt that there were no competing tasks or priorities (an enabler); (b) protocol use: Participants (N = 3, 16.7%) did not use the protocol (a barrier), however, others (N = 8, 44.4%) intended to use or had already used the protocol (an enabler); (c) awareness of protocol: Participants (N = 2, 11.1%) stated that they were aware of the protocol (an enabler), and (N = 2, 11.1%) were not (a barrier); (d) protocol clarity: Participants (N = 8, 44.4%) felt that the protocol was confusing and overlapping with other orders (a barrier) whereas other participants (N = 13, 72.2%) stated that the protocol was all inclusive, easy and ready for use (an enabler); and (e) remembering to use the protocol: Participants (N = 2, 11.1%) needed a reminder (a barrier) whereas others (N = 4, 22.2%) were automatically using it.

4.2.6 | Nurse-specific themes

Registered Nurses were the only key informant group to describe discipline-specific beliefs. There were three nurse-specific barriers (N = 3) and one enabler (N = 1). The barriers included: (a) do not intend to call for signature or to complete the protocol (N = 2, 11.1%), (b) need for a reminder (N = 2, 11.1%), (c) previous experience (i.e. with finding protocol, patients with catheters without UTIs) (N = 2, 11.1%). The nurse-specific enabler was that nurses typically initiate the protocol and initiate the discussions about catheter removal (seen as nursing role) (N = 2, 11.1%).

5 | DISCUSSION

5.1 | Summary of the findings

Overall, our findings showed the difficulties in implementing a CAUTI protocol across a large academic health science centre. In phase 1, our findings demonstrated that the implementation intervention did not work across the four audit units. Phase 2 was put in place as a theory-based process evaluation to help us improve the implementation process, whether it was successful or not. Our study identified some common enablers to the implementation of the CAUTI protocol such as knowing the benefits; education and training; protocol all-inclusive, easy and accessible; and awareness and agreement with the evidence. However, some key barriers were not addressed in the implementation process which included competing priorities or time constraints; patient characteristics, preferences and previous patient history; availability of the protocol; confusion with the protocol overlapping with other orders related to catheters.

5.2 | Comparison to previous research

Meddings et al. (2014) evaluated interventions to reduce catheter use and CAUTIs. They found that interventions to reduce unnecessary catheter use were successful, and they also identified the importance of addressing socioadaptive factors (Meddings et al., 2014). These socioadaptive strategies, which focussed primarily on enhancing attitudes and behaviours related to CAUTI, included leadership, staff and patient engagement, and enhanced communication (Saint et al., 2016). Another systematic review of interventions to reduce catheter-related infections found that all interventions had some form of education as a key component (Flodgren et al., 2013). In our study, although education was a key component, other components were lacking to address the main barriers determined during the process evaluation. Thus, the benefits of performing a process evaluation are that in cases such as in our study where despite the evidence that this protocol worked in another setting (Lo et al., 2014; Torpy et al., 2012), and did not work at our hospital we can gain insight into why this was the case.

Strategies targeting the identified barriers need to be implemented (French et al., 2012). This included having better integration of the protocol with current processes. For example, a possible method to mitigate competing priorities and time constraints of the CAUTI protocol could be to model the practice by a peer expert and conduct audit and feedback at the individual level. In order to reduce the confusion with protocol overlapping with other orders related to catheters, a redesign of the process specifically in light of the recent changes to an electronic health record system at the hospital. The CAUTI protocol could be incorporated into the electronic documentation. This may also reduce the number of steps for physicians to manually obtain and fill out the order sheet. We also identified the need for tailoring the protocol to the needs of local units. For example, on the surgical and orthopaedic units, the CAUTI protocol needed to be embedded into the existing clinical pathways. We also needed to ensure that the protocol was always available. Furthermore, tools would need to be developed to support providers in teaching patients about catheter use. According to a systematic review (Jones et al., 2019), no single intervention can be recommended to effectively reduce CAUTI. Therefore, the identification of barriers and enablers not only helped to improve the intervention in a local context but will also help other institutions looking to implement similar protocols.

5.3 | Strengths and limitations

This study included a broad range of providers to better gain insight on the implementation issues. A clear limitation was the low uptake of the intervention, which was further explained by the process evaluation. The audits were done only on four units, which may not represent the uptake of the intervention across all the other units. Only four themes were discipline-specific and therefore could be a reflection of the sample size. This study also highlights the challenges in scaling up quality improvement work. Even though something worked in a different service line in a hospital it does not necessarily translate to a different service line implying the need for true local efforts as being part of the "secret sauce" for quality improvement.

6 | CONCLUSION

In conclusion, this study used multiple methods to evaluate the implementation of the CAUTI protocol across a large academic health science centre. No statistically significant differences in CAUTI prevalence rates were noted preintervention and postintervention.

7 | RELEVANCE TO CLINICAL PRACTICE

The theory-based process evaluation provided insights into barriers and enablers to the implementation which may help reformulate the intervention in the future. In addition, more attention should be paid to translation into daily practice and to the importance of ongoing evaluation. Finally, further research on larger scale implementation of the intervention are required to draw sound conclusion about its effectiveness.

CONFLICT OF INTEREST

The authors have no relevant financial or non-financial interests to disclose.

AUTHORS' CONTRIBUTIONS

CB was a major contributor in writing the manuscript. All co-authors were involved in the design of the project and critically appraised and edited the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL

Approval was granted by the Ottawa Health Science Network Research Ethics Board (#20170078-01H) and the University of Ottawa Research Ethics Board (#A04-17-04).

CONSENT TO PARTICIPATE

Informed consent was obtained from all individual participants included in the study.

CONSENT FOR PUBLICATION

Not applicable.

DATA AVAILABILITY STATEMENT

No additional data are available.

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