American Journal of Infection Control ■■ (2018) ■■-■■

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major Article

Determinants of urinary catheter removal practices in the pediatric intensive care unit: A survey

Karen Trudel MD [a], Samara Zavalkoff MD [b], Nicholas Winters MSc [c], Caroline Quach MD, MSc [c,d,e], Jacques Lacroix MD [f], Patricia S. Fontela MD, PhD [b,e,*]

[a] London School of Tropical Medicine, University of London, London, UK
[b] Division of Pediatric Critical Care, Department of Pediatrics, McGill University, Montreal, QC, Canada
[c] The Research Institute of the McGill University Health Center, Montreal, QC, Canada
[d] Department of Microbiology, Infectious Disease and Immunology, Université de Montréal, Montreal, QC, Canada
[e] Department of Epidemiology, Biostatistics, and Occupational Health, McGill University, Montreal, QC, Canada
[f] Division of Pediatric Critical Care, Department of Pediatrics, Université de Montréal, Montreal, QC, Canada

Key Words:
Catheter-associated urinary tract infection
hospital-acquired infection
infection control
child
critical care
survey

Background: Prolonged use of indwelling catheters is associated with hospital-acquired urinary tract infections (UTIs). Literature is scarce about the factors influencing urinary catheter removal and maintenance in children. This study aims to describe the determinants of urinary catheter removal in pediatric intensive care unit (PICU) patients.

Methods: Cross-sectional survey of 171 physicians and nurses working at 2 tertiary PICUs in Montreal, Canada. We used focus groups and literature review to design the survey questions and 3 clinical scenarios. We analyzed our results using descriptive statistics and multivariate multinomial regression.

Results: There were 131 (77%) participants who answered the survey. Factors prompting urinary catheter removal ($P < .01$) included recent extubation, superficial sedation level, fever, and history of previous UTI. Presence of shock ($P < .01$) and fluid overload ($P < .05$) were associated with maintenance of catheters. Physicians were more likely to remove urinary catheters than nurses in all scenarios.

Conclusions: We identified a consistent set of variables that drive the removal of indwelling catheters in PICUs. Studies are needed to determine whether incorporating these determinants into infection control interventions will reduce urinary catheter use and catheter-associated UTIs in critically ill children.

Catheter-associated urinary tract infections (CAUTI) are the most frequent type of hospital-acquired infection. In adults, CAUTIs result in increased patient morbidity, ranging from urinary symptoms to bacteremia,[1] and prolongation of hospital stays by 1-4.5 days.[2,3] They are also associated with a mortality rate of 2.3%, accounting for 13,000 deaths annually in the United States.[4] Finally, CAUTIs carry a significant economic burden of $1,000-$4,700 per episode in the United States.[5,6]

The problem of CAUTI is less defined in children, but recent data support similar morbidity from these infections in the pediatric population, with the highest risk reported in critically ill children.[7,8] The recent pediatric intensive care unit (PICU) study by Samraj et al showed an increase in mortality from 5% to 17% in patients with CAUTI compared with matched patients without CAUTI.[9] It also revealed an increase in PICU and hospital median length of stay of 9 and 29 days, respectively, a median increase in duration of mechanical ventilation of 10 days, and hospital charges that were almost

* Address correspondence to Patricia S. Fontela, MD, PhD, Division of Pediatric Critical Care—McGill University, The Montreal Children's Hospital, 1001 Boulevard Décarie, Room B06.3822, Montreal, QC H4A 3J1, Canada.
E-mail address: patricia.fontela@mcgill.ca (P.S. Fontela).

Funding/support: Supported by an internal research grant from the Division of Pediatric Critical Care at McGill University, Montreal, QC, Canada.

Conflicts of interest: C.Q. reports grants from Sage and AbbVie for research activities unrelated to the submitted work; J.L. reports grants from The Canadian Institutes of Health Research and royalties on published textbooks for research activities unrelated to the submitted work; all other authors report no conflicts of interest relevant to this article.

Author contributions: All authors made significant contributions to the design or conduction of this study; all authors read and gave final approval for the submitted version. The specific contributions of each author are as follows: K.T.: study design and conduction, survey development, and manuscript writing; S.Z.: study design and conduction, survey development, manuscript writing, and manuscript review; N.W.: data analysis and manuscript review; C.Q.: study design, survey development, and manuscript review; J.L.: study design, survey development, and manuscript review; and P.S.F.: study design and conduction, survey development, data analysis, manuscript writing, and manuscript review.

0196-6553/
https://doi.org/10.1016/j.ajic.2017.12.020

double the charges incurred by the PICU patients without CAUTI. In the aforementioned study, the CAUTI rate was 3.0 CAUTIs per 1,000 catheter days, which is in keeping with the 2010 National Healthcare Safety Network report of 2.2-3.9 CAUTIs per 1,000 catheter days in the PICU population.[10]

For adults and children alike, duration of use of indwelling catheters has been identified as the greatest risk factor for developing a hospital-acquired urinary tract infection (UTI),[11-14] with 80% of these infections being associated with the presence of such devices.[15] Periurethral contamination with rectal flora is the most common mechanism of CAUTI; catheters are a foreign surface that promote bacterial colonization, thereby acting as a portal through which bacteria can enter the sterile urinary tract.[16-18] Studies estimate that urinary catheter use is inappropriately prolonged in one-third to one-half of adult hospitalized patients.[19-22] One possible explanation is that many hospitals do not routinely monitor their use.[22] Moreover, catheter removal is still often at the discretion of the treating physician who may be unaware of the presence of an indwelling catheter.[13,23]

Limiting catheter use has been shown to be the most effective way to reduce the incidence rate of CAUTIs.[13,24-27] As such, most CAUTI prevention bundles, designed for adults, include a daily review of the need for ongoing urinary catheterization.[28-30] In pediatric patients, removal of catheters at the earliest opportunity is also a key strategy to prevent CAUTIs.[8,9] However, we lack knowledge about the relevant risk factors and best practices in children compared with adults. We believe that gaining a better understanding of the attitudes and perceptions around catheter removal in PICUs is critical before developing and implementing infection control and quality improvement strategies to remove urinary catheters in such a setting. Hence, we performed a survey to describe the factors that influence PICU physicians' and nurses' decision-making process when using urinary catheters in critically ill children.

METHODS

Study design and population

We conducted a cross-sectional survey for which the sampling frame included all the nurses and pediatric intensivists (n = 171) who work at either of 2 tertiary PICUs in Montreal, Canada (The Montreal Children's Hospital and CHU Sainte-Justine). We identified potential participants through direct contact with both PICU directors and head nurses.

Survey development

We developed our survey using a multistep methodologic approach.[31] We generated the survey items through literature review and focus group sessions with pediatric critical care and infectious diseases specialists, and clinical epidemiologists. Domains included patient characteristics, fluid overload, hemodynamic compromise, sedation, and past UTI. We then developed 3 clinical scenarios that addressed different clinical cases (acute myocarditis, severe pneumonia, and traumatic brain injury). In addition, we generated potential survey questions that represented the aforementioned domains (item generation process). Subsequently, we performed an item reduction process using the same previously described focus group to remove redundant items, while maintaining all important concepts. Survey questions refer to the likelihood of removing the urinary catheter in different clinical situations, which we measured using a 10-point Likert scale (1-10, with 1 meaning very unlikely and 10 meaning very likely).

We used a stepwise approach to test the survey. The survey was first completed by coinvestigators and subsequently by pediatric intensivists, pediatric critical care nurses, and a pediatric infectious diseases specialist to assess its clarity, relevance, completeness, face validity, content validity, redundancy, and time for completion. After each step, the survey was revised accordingly. Finally, to test intrarater (test-retest) reliability, we invited 3 pediatric intensivists to complete the survey on 2 occasions, 2 weeks apart, and subsequently modified the questionnaire accordingly. These individuals were removed from the final list of participants; their surveys are not included in the analysis. The final version of the survey can be made available on request to the corresponding author.

Survey administration

Data were collected using paper versions of the survey. The initial contact with eligible responders was through an in-person invitation by one of the researchers (K.T.). Remaining nonresponders received a second in-person invitation to complete the survey by the same researcher (at the Montreal Children's Hospital) or by the nurse in charge (at CHU Sainte-Justine).

Research ethics board and ethical conduct

The Research Ethics Boards of the Montreal Children's Hospital and CHU Sainte-Justine approved this study.

Statistical analysis

No a priori sample size calculation was performed because the survey's main objective was to be descriptive. However, because we planned to use multivariable multinomial regression models (subsequently described), we would need 10 observations for each independent variable included in the model.[32] Because we had included only 4 independent variables (professional group, site, years of experience in PICU, and quality improvement experience), our study population of 131 health care professionals became more than sufficient to safely run our regression models.

We summarized the survey responses using descriptive statistics including mean (standard deviation [SD]) or median (interquartile range [IQR]) for continuous data and proportion for categorical data. Because of the nonparametric nature of the data, we used Wilcoxon rank-sum test to compare answers of different professionals (physicians and nurses) and institutions, and Wilcoxon signed-rank test to compare the likelihood of removing the urinary catheter for the original and the modified clinical scenarios by the same group of individuals. Furthermore, we used multivariable multinomial regression models to evaluate associations between respondent characteristics and the likelihood of removing the urinary catheter. $P < .05$ was considered statistically significant. We performed the statistical analysis using Stata 12 (StataCorp, College Station, TX).

RESULTS

Characteristics of respondents

Out of 171 potential respondents, a total of 131 health care professionals (HCPs) completed the questionnaire (overall response rate of 77%): 25 out of 31 medical staff (81%) and 105 out of 140 nursing staff (75%). As shown in Table 1, 29 participants were men (22%), but this differed significantly ($P < .05$) between the medical (68%) and nursing staff (11%). The mean ± SD overall clinical experience reported was 15.5 ± 11 years, whereas the mean overall pediatric critical care experience was 12.6 ± 12 years. Forty-four respondents (34%) reported having experience with quality improvement and infection control: 19 HCPs (15%) described participating in training and projects (direct involvement), whereas 34 HCPs (26%)