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Effect of a hospital-associated urinary tract infection reduction policy on general surgery patients

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ABSTRACT

Background: Hospital-associated UTI rates in surgery patients have not improved despite recommendations for reducing indwelling catheter days.
Methods: We performed a retrospective review of institutional NSQIP general surgery patient data, 2006–2015. During this time, a UTI-reduction policy was implemented. Demographics, HA-UTI incidence, CA-UTI incidence, indwelling catheter days, straight catheterization rates, and mortality were examined.
Results: Females had significantly higher risk of HA-UTI. There was no significant change in HA-UTI ($X12 = 0.02$, $p = .878$) or indwelling catheter days (5.18 ± 1.12 days v 3.73 ± 0.39 days, $p = .23$). Straight catheterizations among those with HA-UTI increased (0.04 ± 0.04 v 0.32 ± 0.12, $p = .029$). There was no change in CA-UTI (1.38 v 1.11 CAUTI/1000 patient hospital-days $P = .555$) or in initial indwelling catheter days of patients with CA-UTI (7.2 SD 8.89 v 47.0 SD 7.04 days $P = .961$) after policy implementation.
Conclusions: The reduction policy increased the number of straight catheterizations for patients developing HA-UTI, but did not reduce the number of initial indwelling catheter days, HA-UTI rates, or CA-UTI rates.

1. Introduction

Urinary tract infections (UTIs) account for one-third of the 1.7 million hospital-acquired infections that each year.[1] Hospital-acquired urinary tract infections (HA-UTI) have been shown to increase mortality,[2,3] length of stay (LOS),[4] and cost healthcare system an estimated 290 million dollars annually.[5] Guidelines by regulatory bodies, such as the Center for Medicaid and Medicare Services focus on reduction of indwelling catheter days to reduce HA-UTI.

Reasons behind the development of HA-UTIs are multifactorial, and may not be linked only to length of catheterization. Previous studies have shown some patients are more susceptible to HA-UTI due to risk factors, such as being female, elderly, and having diabetes.[6] Procedure type also plays a role; patients undergoing colorectal surgery, for example, have a higher rate of HA-UTI.[7] A subset of patients who have indwelling catheters develop catheter-associated UTI, or CA-UTI. The Center for Medicaid and Medicare Services (CMS) has listed catheter-associated UTI (CA-UTI) in particular as one of the high-cost, high-frequency "never events."[6]

It is important to identify if policies aimed at reducing catheter days have an impact in reducing HA-UTI, and by extension CA-UTI. In this study, we sought to investigate populations vulnerable to developing UTIs and determine the effects of a Centers for Medicare and Medicaid Services (CMS)-driven policy on HA-UTI and CA-UTI rate in a general surgery population at our institution.

2. Material and methods

2.1. Data source

Our study was approved by our Institutional Review Board. We performed a retrospective review of patients at a single institution undergoing general surgery procedures from 2009 to 2015. The data was collected using the American College of Surgeons' National Surgical Quality Improvement Program (ACS NSQIP) database of our institutional data. Data are entered in a HIPAA-compliant, secure, web-based platform.[8]

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2.2. Chart review

ACS NSQIP data collection is a standardized method of review. A trained Surgical Clinical Reviewer (SCR) abstracted data from patients at our institution, recording preoperative baseline demographics as well as postoperative data for up to 30 days. Since July 1, 2009, data collection by a SCR was been continuous, prospective, and complete. As required by NSQIP, our SCR passed a renewal exam every year for recertification.

For data collection beyond that which is collected for NSQIP, patients were identified through the NSQIP database, and a chart review through a patient's electronic medical record was conducted. This was performed by a single non-blinded reviewer. Datapoints not included in the NSQIP database were length of indwelling catheter time, number of straight catheterizations, and stipulated reasons for leaving catheter in place > two days, and CA-UTI.

2.3. Definitions

We defined HA-UTIs using the NSQIP definition of UTI. Patients were identified as having HA-UTIs by the SCR, who prospectively maintained the institutional NSQIP database. The NSQIP database identified patients who had UTIs present at the time of admission, and they were excluded from the study.

Patients with CA-UTIs were also examined. The National Health Safety Network definition of CA-UTI was used (a UTI where an indwelling urinary catheter was in place for >2 calendar days on the date of event, with day of device placement being Day 1, and an indwelling urinary catheter was in place on the date of event or the day before. If an indwelling urinary catheter was in place for >2 calendar days and then removed, the date of event for the UTI must be the day of discontinuation or the next day for the UTI to be catheter-associated).

2.4. Population

Our population included all general surgery patients who received an operation at our institution from 2006-2015. We excluded patients who had a hospital LOS of two days or less.

3. Statistical analysis

3.1. Demographics

We used Cox proportional hazards regression to examine the association between patient characteristics and the rate of HA-UTI. Body mass index (BMI, kg/m^2) was divided into six classes, according to National Institute on Health (NIH) guidelines: < 18.5 kg/m^2 (underweight), 18.5 -< 25 kg/m^2 (normal weight), 25 - < 30 kg/m^2 (overweight), 30 - < 35 kg/m2 (class I obesity), 35 -< 40 kg/m2 (class II obesity), and >40 kg/m2 (class III obesity). Models initially included all potential explanatory variables, and non-significant ($p > .10$) terms were eliminated. A likelihood ratio test was used to quantify lack of significance for omitted terms after reaching the final model. First-order interactions involving variables in the final model were checked for significance and retained if $p < .10$. The Grambsch and Therneau test was used to check the assumption of proportional hazards, and overall model performance was summarized through the Harrell's C.

3.2. HA-UTI rates before and after policy implementation

Rates of HA-UTI before and after the policy were compared with a test for non-inferiority. This test required at least a five percentage point decrease in HA-UTI after policy implementation to confirm effectiveness. Non-inferiority was assessed at three, seven, ten, 14, and 21 days after surgery, and significance set to 0.05. Incidence rate was computed for each cohort and overall to compare with reported national rates of other institutions.

3.3. CA-UTI rates before and after policy implementation

Rates of CA-UTI before and after the policy were compared with a simple students T test. There were too few events to allow for analysis with a test for non-inferiority, our preferred test in a situation where a power analysis was not performed prior to initiation of the study.

4. Results

4.1. Demographics

Data consisted of N = 3224 patients. After eliminating records with missing information, 3057 patients were used to create the model (Table 1). Among the n = 3057 patients, 144 HA-UTI events accumulated over 29,362 person-days at risk (incidence rate = 0.0049; 95% CI: 0.0042–0.0058). The final multivariable model (Table 2) showed that HA-UTI was strongly associated with female sex ($X^2_1 = 41.41$, $p < .001$). The association with sex was modified by smoking status ($X^2_1 = 4.87$, $p = .027$, test of sex: smoking interaction). Among non-smokers, risk of HA-UTI for women was 3.88 (95% CI: 2.56–5.88; $p < .001$) times the risk for men. Female smokers were 1.32 (95% CI: 0.55–3.14; $p = .538$) times as likely to experience a HA-UTI, when compared to male smokers. The risk of infection was 63% (95% CI: 27–82%, $p = .004$) lower for emergency cases, when compared to non-emergency cases. Having an ASA ≥3 was associated (HR = 1.47; 95% CI: 0.95–2.28, $p = .084$) with increased risk of HA-UTI. This did not, however, reach significance. No other variable (surgical duration, age, BMI category, history of diabetes, NSQIP-defined dependence, whether the surgery was open vs laparoscopic, or having used mechanical ventilation) was associated with time to HA-UTI ($X^2_{16} = 9.50$, $p = .892$).

Mortality within 30 days was 1% for patients who developed

Table 1
Descriptive patient characteristics.

Characteristic	Mean (SD)	Median (IQR)	N (%)
Age (years)	57.3 (14.9)	59.0 (47.8–68.0)	
Sex (female)			1670 (51.8)
Smoke[a]			683 (21.19)
BMI (kg/m^2)[b]	29.7 (9.1)	27.8 [23.6–33.2]	
<18.5			97 (3.11)
18.5-< 25.0			931 (29.86)
25.0-< 30.0			921 (29.54)
30.0-< 35.0			555 (17.80)
35.0-< 40.0			274 (8.79)
>40.0			340 (10.90)
DMII			552 (17.12)
Dependence[c]			132 (4.10)
Emergency case			299 (9.27)
Laparoscopic surgery			536 (16.63)
Ventilator use			97 (3.01)
Surgery duration (hours)	4.1 (2.6)	3.6 [2.3–5.4]	
Time to HA-UTI[d]	11.4 (7.9)	9.0 [6.0–16.0]	
LOS (days)	9.7 (10.1)	7.0 [4.0–10.0]	

[d] N = 3178 excluding 46 missing.
[f] based on N = 3061 non-UTI subjects, excluding 10 missing LOS.
[a] N = 3223 excluding 1 missing.
[b] N = 3118 excluding 106 missing.
[c] N = 3220 excluding 4 missing.
[d] Based on N = 153 patients with UTI.

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