Reducing Inappropriate Urinary Catheter Use

A Statewide Effort

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Background: Indwelling urinary catheters may lead to both infectious and noninfectious complications and are often used in the hospital setting without an appropriate indication. The objective of this study was to evaluate the results of a statewide quality improvement effort to reduce inappropriate urinary catheter use.

Methods: Retrospective analysis of data collected between 2007 and 2010 as part of a statewide collaborative initiative before, during, and after an educational intervention promoting adherence to appropriate urinary catheter indications. The data were collected from 163 inpatient units in 71 participating Michigan hospitals. The intervention consisted of educating clinicians about the appropriate indications for urinary catheter use and promoting the daily assessment of urinary catheter necessity during daily nursing rounds. The main outcome measures were change in prevalence of urinary catheter use and adherence to appropriate indications. We used flexible generalized estimating equation (GEE) and multilevel methods to estimate rates over time while accounting for the clustering of patients within hospital units.

Results: The urinary catheter use rate decreased from 18.1% (95% CI, 16.8%-19.6%) at baseline to 13.8% (95% CI, 12.9%-14.8%) at end of year 2 (P < .001). The proportion of catheterized patients with appropriate indications increased from 44.3% (95% CI, 40.3%-48.4%) to 57.6% (95% CI, 51.7%-63.4%) by the end of year 2 (P = .005).

Conclusions: A statewide effort to reduce inappropriate urinary catheter use was associated with a significant reduction in catheter use and improved compliance with appropriate use. The effect of the intervention was sustained for at least 2 years.

The reasons for use. Appropriate indications for catheter use were from each facility collected all the data prospectively, including and appropriate practices were reinforced. A health care worker following the intensive intervention periods, catheter use was tracked the presence and need for the catheter during nursing rounds and the education of nurses on evaluating patients for urinary catheter use and appropriateness (week 1); this was followed by the decision to choose the unit involved. No use and increased unnecessary use; however, each hospital made to implement the process at each facility. We suggested that is used inappropriately. It also addressed the proper insertion nary retention, and urologic studies or surgery on contiguous struc- and the evaluation for urinary catheter necessity on the partic- cation. The St John Hospital and Medical Center institutional re- sults. Most units (127 of 163 or 77.9%) collected data for at least 80% of the maximum possible fol- low-up time, and most collected data for at least 90% of the maximum (105 of 163 or 64.4%) (Figure 1); in other words, most missing data was the result of administra- tion (appropriate catheter-days/catheter-days), and multilevel models with empirical Bayes prediction to explore unit-specific rates. Population average rates captured trends across rather than within hospital units, and could be viewed as a weighted average of unit-specific rates. Both GEE and multi- level approaches accounted for clustering of patients within units, and the empirical Bayes method accounted for differential sample sizes across units by shrinking less reliable unit-specific esti- mates toward the overall mean.

To allow for nonlinearity across time, we modeled population average rates as a function of continuous time (from baseline) using natural cubic splines with 5 knots. The clustered robust (or “sandwich”) variance estimator was used to ac- count for correlation among patients within hospital units. Multilevel models allowed intercepts and slopes to vary random-ly across units and assumed a linear relationship between rates and log-transformed time (log transformation was deemed to be sufficient via likelihood ratio tests for more complicated spline structure). Odds ratios for specific units comparing week 20 to baseline were calculated using multilevel model empirical Bayes predictions; for this analysis we used only those units that collected data for up to 20 weeks.

Both GEE and multilevel analyses were done at the patient level rather than at the unit level, and models did not include covariates (besides time from baseline), since covariate data were not collected, and interest centered on urinary catheter preva- lence. Units that failed to collect data for any of the first 3 weeks (ie, during baseline or intervention) were excluded from analy- sis. A total of 194,162 patient-days of data were collected across 163 units within 71 acute-care hospitals (55% of 300 eligible Michigan hospitals). Urinary catheters were used for a total of 29,990 patient-days (15.4%) across the study period. Most units (127 of 163 or 77.9%) collected data for at least 80% of the maximum possible follow-up time, and most collected data for at least 90% of the maximum (105 of 163 or 64.4%) (Figure 1); in other words, most missing data was the result of administra- tion. The average urinary catheter use rate decreased from 18.1% (95% CI, 16.8%-19.6%) to 17.2% (95% CI, 16.0%-18.4%) (P = .01) at week 3 (the second week of the intervention), representing a statistically signifi- cant 6% decrease in the odds of catheter use. The rate decreased to 15.9% (95% CI, 14.7%-17.2%) (P < .001) by week 8, and to 14.8% (95% CI, 13.6%-16.0%) (P < .001)
by week 20 (Table 1 and Figure 2). The proportion of appropriately indicated catheter-days increased from 44.3% (95% CI, 40.3%-48.4%) at baseline to 46.8% (95% CI, 42.6%-51.0%) (P < .001) at week 3 (the second week of the intervention), representing an 11% increase in the odds of appropriately indicated catheter use. By weeks 8 and 20, the proportion had increased to 50.4% (95% CI, 45.4%-55.4%) (P < .001) and 53.5% (95% CI, 48.7%-58.4%) (P < .001), respectively (Table 1 and Figure 2). Two years after baseline, the catheter use rate was 13.8% (95% CI, 12.9%-14.8%) (P < .001), and appropriate catheterization increased to 57.6% (95% CI, 51.7%-63.4%) (P = .005). However, estimates after week 104 are relatively unreliable owing to limited data collection (Table 1, Figures 1 and 2). Table 2 lists the crude distribution of the indications (both appropriate and inappropriate) for urinary catheter use at weeks 1, 3, 8, and 20.

From baseline to week 20 (and for units with data up to week 20), the top decile of units in terms of decreased odds of catheter use had estimated odds ratios (ORs) ranging between 0.48 and 0.25, while the top decile of units in terms of increased odds of appropriate catheter use (not necessarily the same as the previous decile) had estimated ORs ranging between 5.06 and 10.92. Such performance may represent best-case scenarios for response to the interventions. Conversely, the bottom decile of units had ORs for increases in catheter use ranging between 1.22 and 1.88 and ORs for decreases in appropriate catheterization ranging between 0.36 and 0.04 during this period. The median units, however, had ORs of 0.80 for catheter use and 1.71 for appropriate catheterization. This decrease in use and increase in appropriate catheterization is aligned with the results seen in the GEE analysis (where the corresponding ORs were 0.79 and 1.45, respectively). Figure 3 shows the ORs for catheter use and appropriate catheterization for units with data for both quantities up until at least week 20. Figure 3 indicates that high-performing units with respect to catheter use (ie, those with low ORs) were not necessarily high-performing units with respect to appropriate catheterization (ie, those with high ORs); however, most units (56.6%) that continued to collect data until week 20 saw both a decrease in catheter use and an increase in appropriate catheterization.

We examined the results of a statewide quality improvement initiative among a large cohort of hospitals that implemented an intervention to evaluate the presence and appropriate use of urinary catheters. Overall, the intervention led to a significant reduction in use and an improvement in the appropriateness of use. Our results largely parallel the improvement seen when the intervention was piloted in a single hospital. The improvement in urinary catheter use was apparent within the first 2 weeks of the intervention, and the progressive improvement in use continued throughout the study period from a baseline rate of 18.1% to 13.8% at year 2. This translates to an overall 28% reduction in the odds of catheter use. Our results show that Michigan hospitals were able to reduce use significantly to levels comparable to the 25th percentile reported by the National Healthcare Safety Network for urinary catheter use in medical-surgical inpatient wards.

Avoiding initial urinary catheter placement and reducing the duration of use once placed are associated with fewer infectious complications. Previous studies have shown that urinary catheter reminders and stop orders leading to a reduction in use were associated with a significant reduction in CAUTI. In addition to reducing the infection risk, promoting the appropriate use of the catheter may lead to fewer noninfectious complications, such as...
as urethral injury. Moreover, patients may experience less discomfort and be free of the restraints associated with catheter use.

The appropriate use of urinary catheters also improved significantly over the course of the study. By year 2, the odds of appropriate placement among those with urinary catheters increased by 71% compared with baseline. Despite this significant improvement, appropriate use (based on the 1983 CDC guidelines) reached only 57.6% at year 2. While this suggests that there may be further opportunity for improvement, the 1983 CDC guidelines and the newer HICPAC guidelines are consensus-based and may not be inclusive of all conditions where the catheter may be required.

We observed between-unit variation in response to the intervention. Possible differences between high- and low-performing hospitals might include varying levels of commitment from each institution to make this effort a high priority or differential involvement of champions to support the effort. External forces influencing the decision to fully adopt safe processes may also play an important role, whether related to public reporting or financial incentives. Moreover, organizations have different contextual characteristics: hospitals with a strong

Table 2. Reasons for Catheter Use Across Time (Raw Percentages)

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<th>Reason</th>
<th>Week</th>
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<td><img src="https://example.com/graphA.png" alt="Graph A" /></td>
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<tr>
<td><img src="https://example.com/graphB.png" alt="Graph B" /></td>
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![Figure 2. Rates of catheter use (A) and appropriate catheterization (B) across time. The tick marks at the x-axes indicate times at which data were collected. The darkness of the tick marks reflects the number of units contributing data (darker marks indicating more units and lighter marks, fewer units); black represents all units, and white represents no units.](https://example.com/figure2.png)  

The rates of appropriate catheterization given in Table 1 are estimated at specific time points and arise from modeling the rate of appropriateness as a continuous function across time (see Figure 1). In contrast, for Table 2, the observed data are binned by week, and simple percentages are computed; as a result, the raw rates presented herein should not agree exactly with the estimated rates given in Table 1.
emotional commitment to patient care and an active clinical leadership provide a milieu favorable to quality improvement activities.\textsuperscript{21} In contrast, while some hospitals lacking emotional commitment to patient care or with weak leadership support may respond favorably to externally facilitated initiatives, others may face substantial barriers that inhibit implementing evidence-based practices in their institution.\textsuperscript{21}

Our findings should be interpreted in the context of the following limitations. First, not all hospitals collected data throughout the entire study period, mostly due to staggered start times. Although we did observe continued decreases in catheter use and increases in appropriately indicated catheters in those placed throughout the 3-year study period, fewer than half of the units collected data for more than 2 years. If low-performing hospitals were more likely to discontinue data collection or more likely to start the study later, our results could be misleading. Still, most hospital units collected data through 20 to 30 weeks after intervention, so immediate effects of the intervention are unlikely to be compromised by such selection bias. Furthermore, discontinued data collection largely resulted from the ending of the study (administrative censoring) rather than unit dropout.

Second, we did not have data for a control group of hospitals that did not receive the intervention; thus, the possibility exists that some portion of the effects would have occurred even without the intervention. For example, some hospitals may have established programs to reduce the risk for CAUTI in response to the CMS non-reimbursement. However, owing to the complexity of coding cases of hospital-acquired CAUTI, errors in coding may underestimate the number and lessen the financial impact on hospitals.\textsuperscript{22}

In addition, our results may not be universally generalizable because hospitals self-selected into the study, and units that were enrolled in the study were chosen by individual hospitals rather than selected at random. Finally, we explored only the process measures of urinary catheter use and appropriateness of urinary catheter placement because we did not have data available to investigate the influence of the intervention on infectious or noninfectious outcomes.

Limitations notwithstanding, the MHA Keystone Center initiative was successful in reducing urinary catheter use and increasing appropriateness of catheterization in a large number of hospitals throughout the state of Michigan. Our results indicate that hospitals can improve appropriate urinary catheter use and that such efforts can be successfully implemented on a broad scale. Our findings may help motivate and guide other hospitals to undergo similar intervention programs to reduce inappropriate catheter use and collectively achieve the Department of Health and Human Services\textsuperscript{23} goal of reducing CAUTI rates by 25% by 2013.

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Figure 3. The relationship between catheter use and appropriate catheterization.
ulty for presentations sponsored by Advanced Sterilization Products, Baxter Healthcare, BD, CareFusion, Ethicon, and several not-for-profit organizations. Mr Olmsted is also serving as an expert consultant on an extended faculty group for a multistate CAUTI prevention project with the Agency for Healthcare Research and Quality/Health Educational and Research Trust. Dr Saint has received travel reimbursement and numerous honoraria from hospitals, academic medical centers, specialty societies, state societies (including the MHA), and other non-profit organizations (including the Institute for Healthcare Improvement) for speaking about health care–associated infection prevention.

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REFERENCES


INVITED COMMENTARY

Improving Use of the “Other” Catheter

An Important Opportunity to Reduce Hospital Infections

The duration of urinary catheterization is the most important risk factor for catheter-associated urinary tract infection (CAUTI). Thus, best-practice guidelines recommend both limiting the number of patients who receive a urinary catheter, and promptly removing it when it is no longer indicated in patients who must receive it.

Despite the apparent simplicity of these guidelines, programs seeking to reduce CAUTI have to overcome well-defined barriers involving health care providers, including (1) lack of knowledge of the criteria for appropriate urinary catheter use; (2) failure to recognize that a urinary catheter is present, particularly if the catheter was placed elsewhere; and (3) failure to remove the catheter at the appropriate time. Bedside placards, computer reminders, and automatic stop orders have been tried as approaches to improve urinary catheter use. There is substantial evidence supporting the effectiveness of these techniques, termed in combination the bladder bundle.

Despite the success of these interventions, clinical implementation of these practices remains low. Urinary catheter reminders or a stop order to prevent CAUTI are used in fewer than 1 in 10 US hospitals. These findings speak to the complexity of