Multi-Disciplinary Development and Implementation of a Trial of Void Algorithm to Standardize and Reduce Indwelling Urethral Catheter Use

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QUALITY OR SAFETY PROBLEM
Indwelling catheter use is common, with 15-25% of patients undergoing catheter placement during hospitalization.\(^1\) Prolonged indwelling catheter use is associated with extended hospitalization and catheter-associated urinary tract infections (CAUTIs).\(^2,3\) Despite a shared consensus to minimize preventable hospital-acquired infections,\(^1\) various interrelated factors associated with catheter care result in CAUTIs (Figure 1). In 2022, our surgical Step-Down Unit was deemed a CAUTI target unit by our hospital’s Infection Prevention & Control team for high CAUTI rates (n=6 over 12 months).

Figure 1: Ishikawa Fishbone Diagram.

BACKGROUND
Though recommendations exist to minimize CAUTIs,\(^1\) catheter use varies due to the numerous competing influences surrounding patient care (Figure 1). Optimizing post-operative patients for trial of voids and standardizing voiding trial parameters may reduce duration of catheter use. Various modifiable predictors exist for successful voiding trials, such as prescribing alpha-1 adrenergic receptor antagonists and minimizing post-operative opioid use.\(^4-9\) While these protocols are helpful,\(^10,11\) few preemptively optimize patients before catheter removal.

PROJECT OBJECTIVES
The overall objective of this project was to curtail duration of catheterization by standardizing a trial of void protocol in a post-operative hospital unit. A secondary objective was to reduce the incidence of CAUTIs in this unit. Specific aims were: [1] to develop an evidence-based trial of void algorithm, and [2] to implement the algorithm by engaging with providers and nursing staff.

INTERVENTION
The intervention was a trial of void algorithm designed with input from urologists, general surgeons, nursing leadership, and nursing staff (Figure 2). Implementation was performed by introducing the algorithm during daily nursing huddles, leading up to launch on October 31, 2022. The study investigators
and staff met as a committee every 2 weeks. A committee representative in turn met directly with nursing staff every 4 weeks to garner feedback and share measured outcomes.

**MEASURES OF SUCCESS**

The primary outcomes were: (1) change in mean cumulative indwelling urethral catheter days* 90-days before and after algorithm launch and (2) change in catheter use variation (range, interquartile ratio, standard deviation, and variance). Total patient days on the Step-Down Unit (surrogate for patient volume), urinary catheter days, and number of CAUTIs were also measured as secondary outcomes, and these data points are all nationally reported outcomes defined by the Centers for Disease Control and Prevention (CDC).12 We measured these outcomes on a surgical unit where the algorithm was not implemented as a natural control.

*Cumulative catheter days reflects the total time patients were catheterized in the unit. For example, if 2 patients had indwelling catheters for 3 and 7 days respectively, then the cumulative catheter days would be 10. Suprapubic tubes, nephrostomy tubes, percutaneous nephroureteral tubes, and catheterized urinary conduits/diversions were excluded from analysis.

**OUTCOMES**

The mean number of patient days before and after algorithm introduction did not differ on the Step-Down Unit (32.2 vs. 32.0, p=0.60). After implementation, mean cumulative catheter days decreased (14.8 vs. 9.9, p<0.01, Figure 3), as did mean daily number of patients with catheters (3.8 vs. 3.2, p=0.01) and the mean urinary catheter days (3.7 vs. 3.1, p=0.02); measures of catheter use variation also decreased (Table 1). There was one CAUTI before and after algorithm implementation, the latter deemed potentially associated with unnecessary catheterization and algorithm non-adherence on root-cause analysis. Measures of catheter use in the surgical floor control group did not differ for any outcome (p>0.05), suggesting that pattern changes in catheter use on the Step-Down Unit were due to the trial of void algorithm. Unintended consequences of the quality improvement initiative included nursing staff more routinely documenting trial of voids with post-void residual bladder scans in the electronic medical record. Additionally, the recurrent nursing staff meetings allowed for more direct communication regarding patient care needs (ex. requesting male external urinary catheters when appropriate). In January 2023, the surgical Step-Down Unit was no longer a target unit for CAUTIs.
Figure 3: Control Chart of Total Cumulative Catheter Days.

Table 1: Primary and Secondary Outcomes 90-Days Before and After Trial of Void Algorithm Implementation on Surgical Step-Down Unit and Surgical Floor Control.

<table>
<thead>
<tr>
<th>Standardized Outcomes Outlined by the CDC</th>
<th>Surgical Step-Down Unit</th>
<th>Surgical Floor Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Patient Days</td>
<td>Before: 32.2</td>
<td>After: 31.5</td>
</tr>
<tr>
<td></td>
<td>p-value: 0.60</td>
<td>p-value: 0.08</td>
</tr>
<tr>
<td>Mean Urinary Catheter Days</td>
<td>Before: 3.7</td>
<td>After: 5.0</td>
</tr>
<tr>
<td></td>
<td>p-value: 0.02</td>
<td>p-value: 0.08</td>
</tr>
<tr>
<td>Number of CAUTI’s</td>
<td>Before: 1</td>
<td>After: 0</td>
</tr>
<tr>
<td></td>
<td>p-value: N/A</td>
<td>p-value: N/A</td>
</tr>
<tr>
<td>Hospital-Specific Measured Outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean Cumulative Catheter Days</td>
<td>Before: 14.8</td>
<td>After: 12.5</td>
</tr>
<tr>
<td></td>
<td>p-value: &lt;0.01</td>
<td>p-value: 0.89</td>
</tr>
<tr>
<td>Mean Number of Patients with Catheters</td>
<td>Before: 3.8</td>
<td>After: 4.5</td>
</tr>
<tr>
<td></td>
<td>p-value: 0.01</td>
<td>p-value: 0.93</td>
</tr>
<tr>
<td>Variation Measures for Cumulative Catheter Days</td>
<td>Before: N/A</td>
<td>After: N/A</td>
</tr>
<tr>
<td>Range</td>
<td>38.4</td>
<td>51.6</td>
</tr>
<tr>
<td>Interquartile Range</td>
<td>11.9</td>
<td>9.4</td>
</tr>
<tr>
<td>Standard Deviation (σ)</td>
<td>8.1</td>
<td>7.8</td>
</tr>
<tr>
<td>Variance (σ²)</td>
<td>65.1</td>
<td>60.0</td>
</tr>
</tbody>
</table>

Abbreviations: CDC: Centers for Disease Control and Prevention | CAUTI: Catheter-Associated Urinary Tract Infection

POTENTIAL IMPACT AND SCALABILITY
The trial of void algorithm led to lower overall indwelling catheter use, fewer daily number of patients with catheters, and decreased variation in catheter care. These results suggest that a concerted multi-disciplinary effort between nurses and surgeons can decrease catheter use without affecting patient care volume. The algorithm is publicly available via QR code (Figure 2), which includes creator contact information for any questions or comments during scaling.

SUSTAINING THE CHANGES
We plan to sustain this change by meeting with hospital leadership (March 2023) to discuss expanding the algorithm to other patient floors and eventual hospital-wide implementation. Monthly meetings between the research committee and nursing staff will provide continued opportunities for feedback and improvement.
ADDITIONAL RESOURCES

The CDC website provides valuable resources and information that can be used to guide similar initiatives to minimize CAUTIs.

KEY SUMMARY

a. A multi-disciplinary approach to standardize catheter care with an evidence-based trial of void algorithm is feasible and effective in reducing catheter use without affecting patient volume.
b. Mean cumulative indwelling urethral catheter days decreased (14.8 vs. 9.9 days) with simultaneous decreases in catheter care variation.
c. Mean daily number of patients with indwelling catheters decreased (3.8 vs. 3.2 patients).

REFERENCES


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