Prevention of Catheter-Associated Urinary Tract Infections

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Outline

• Scope of the problem
• Lifecycle of the urinary catheter
  – Appropriate and inappropriate indications for catheter placement
  – Alternatives to indwelling urethral catheters
• Diagnosis of CAUTI
• Spread and Sustainability
Pathogenesis of CAUTI

- Inoculum at insertion
- Ascension of fecal or skin flora
- Contamination of collecting system
- Biofilm formation
- Incomplete bladder emptying

Epidemiology

• **UTI:**
  – Common healthcare-associated infection\(^1\)
    • 12.9% of HAIs; estimated 93,300 cases per year in US in 2011
    – ~70% attributable to an indwelling urethral catheter

• ~25% of hospital inpatients will have an indwelling urinary catheter during admission\(^1\)
  – Most have urinary catheters 2-4 days

• Daily risk of acquisition of bacteriuria:
  – 3% to 8% per day of urinary catheterization
  – ~100% at 30 days
  – Duration of catheterization = biggest risk factor

### Clinical and Economic Impact

<table>
<thead>
<tr>
<th></th>
<th>CA-ASB</th>
<th>CA-UTI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary bacteremia</td>
<td>&lt;1%</td>
<td>2%-4%</td>
</tr>
<tr>
<td>Length of stay</td>
<td>0.4 days</td>
<td>2.0 days</td>
</tr>
<tr>
<td>Direct cost*</td>
<td>$1200</td>
<td>$4000-$4700</td>
</tr>
</tbody>
</table>

* Adjusted (2009 dollars)

Downstream Effects of Urinary Catheters

- CAUTI
- Bacteriuria
- Antimicrobials
- Microbiome Disruption
- Immobilization
- Urinary Catheter
- Urethral Trauma
- Pressure Ulcers
- Increased LOS
- MDRO colonization
- MDRO infection
- MDRO transmission
- C. C. difficile infection
# National HAI Progress Report, 2012

<table>
<thead>
<tr>
<th>NATIONAL PROGRESS OVERVIEW</th>
<th>NATIONAL SIR</th>
<th>CHANGES IN INFECTION VS. NATIONAL BASELINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Line-associated Bloodstream Infections (CLABSI)</td>
<td>0.56</td>
<td>↓ 44%</td>
</tr>
<tr>
<td>Catheter-associated Urinary Tract Infections (CAUTI)</td>
<td>1.03</td>
<td>↑ 3%</td>
</tr>
<tr>
<td>Surgical Site Infections, Colon Surgery (SSI)</td>
<td>0.80</td>
<td>↓ 20%</td>
</tr>
<tr>
<td>Surgical Site Infections, Abdominal Hysterectomy Surgery (SSI)</td>
<td>0.89</td>
<td>↓ 11%</td>
</tr>
<tr>
<td>Hospital-onset Clostridium difficile Infections</td>
<td>0.98</td>
<td>↓ 2%</td>
</tr>
<tr>
<td>Hospital-onset MRSA Bloodstream Infections</td>
<td>0.96</td>
<td>↓ 4%*</td>
</tr>
</tbody>
</table>

CAUTI Standardized Infection Ratio Among 43 Minnesota HEN Hospitals Reporting to NHSN: 28 (65%) of 43 Hospitals Reporting 2% Decrease
“Lifecycle” of the Urinary Catheter

1. Catheter Placement
2. Catheter Care
3. Catheter Removal
4. Catheter Replacement

“Lifecycle” of the Urinary Catheter

1. Prevent Unnecessary and Improper Placement
2. Maintain Awareness and Proper Care of Catheters in Place
3. Prompt Catheter Removal
4. Prevent Catheter Replacement

1. Avoid Unnecessary and Improper Placement

**Recommendations:**

- Insert urinary catheters only for appropriate indications
- Avoid unnecessary and improper placement
- Ensure only properly trained persons insert catheters
- Insert using aseptic technique and sterile equipment

### Appropriate Indications for Indwelling Urinary Catheter Use

<table>
<thead>
<tr>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient has acute urinary retention or obstruction</td>
</tr>
<tr>
<td>Need for accurate measurements of urinary output in <em>critically ill</em> patients.</td>
</tr>
<tr>
<td>Perioperative use for selected procedures:</td>
</tr>
<tr>
<td>• urologic surgery or other surgery on contiguous structures of genitourinary tract,</td>
</tr>
<tr>
<td>• anticipated prolonged surgery duration (removed in post-anesthesia unit),</td>
</tr>
<tr>
<td>• anticipated to receive large-volume infusions or diuretics in surgery,</td>
</tr>
<tr>
<td>• operative patients with urinary incontinence,</td>
</tr>
<tr>
<td>• need to intraoperative monitoring of urinary output.</td>
</tr>
<tr>
<td>To assist in healing of open sacral or perineal wounds in incontinent patients.</td>
</tr>
<tr>
<td>Requires prolonged immobilization (e.g., potentially unstable thoracic or lumbar spine)</td>
</tr>
<tr>
<td>To improve comfort for end of life care if needed.</td>
</tr>
</tbody>
</table>

## Inappropriate Indications for Indwelling Urinary Catheter Use

<table>
<thead>
<tr>
<th>Inappropriate Indications</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>As a substitute for nursing care of the patient or resident with incontinence</td>
<td></td>
</tr>
<tr>
<td>As a means of obtaining urine for culture or other diagnostic tests when the patient can voluntarily void</td>
<td></td>
</tr>
<tr>
<td>For prolonged postoperative duration without appropriate indications (e.g., structural repair of urethra or contiguous structures, prolonged effect of epidural anaesthesia, etc.)</td>
<td></td>
</tr>
<tr>
<td>Routinely for patients receiving epidural anesthesia/analgesia.</td>
<td></td>
</tr>
</tbody>
</table>

*But what about the other well-intended reasons using urinary catheters?*

Other Reasons and Risk of Urinary Catheters

• **Other Reasons**
  – Urine output monitoring outside the ICU
  – Incontinence without skin breakdown/decubitus
  – Prolonged post-operative use beyond 24 hours
  – Transfer from ICU to floor
  – Morbid obesity or immobility
  – Confusion or dementia
  – Patient request

• **Other Risks**
  – Secondary bacteremia, sepsis, metastatic infection
  – “One-point restraint” = decreased mobility
    • DVT/PE, pressure ulcers
    • Fall risk by tripping over catheter
    • Deconditioning
  – Patient discomfort, need to retrain bladder

Perceived
Short term benefits

Real
cumulative
risks:
• LOS
• Cost
• Mortality
Inappropriate Catheter Placement

- **Initial indication for catheter placement**:  
  - Inappropriate in 21%-54% of catheterizations  
  - Varies by location of placement and site of care

<table>
<thead>
<tr>
<th>Indication</th>
<th>MICU (N=135)</th>
<th>Med Unit (N=67)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Justified No. (%)</td>
<td>Unjustified No. (%)</td>
</tr>
<tr>
<td>Monitoring urine output</td>
<td>74/80 (93)</td>
<td>6/80 (7)</td>
</tr>
<tr>
<td>Urinary incontinence</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Urinary retention</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Periop/periprocedural</td>
<td>31/32 (97)</td>
<td>1/32 (3)</td>
</tr>
<tr>
<td>Unclear reason</td>
<td>0/11 (0)</td>
<td>11/11 (100)</td>
</tr>
<tr>
<td>Other</td>
<td>12/12 (100)</td>
<td>0</td>
</tr>
</tbody>
</table>

1. Avoid Unnecessary Placement

- Ensure adequate resources to limit the use of urinary catheters for inappropriate indications.
  - **People**
    - Lift teams
    - Care assistants
    - Physical therapy
  - **Supplies**
    - Alternatives to urethral catheters
    - Bedside commodes, urinals, hats, daily weights
    - Incontinence pads
    - Skin care and barrier creams
  - **Communication**
    - On transfer from ER floor or ICU floor
Alternatives to Indwelling Urethral Catheters
1. Avoid Unnecessary Placement

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bladder ultrasound</td>
<td>Urinary retention protocols, to avoid catheterization if no significant urine present</td>
</tr>
</tbody>
</table>
| Intermittent catheterization | •Chronic neurogenic bladder: spinal cord injury/disorder, other neurologic diseases  
                                 | •Prostate enlargement  
                                 | •Post-operative urinary retention                                                                 |
| External catheters          | •Condom catheters: Cooperative male patients with other catheter indications but no obstruction or urinary retention.  
                                 | •Female external catheters: being tested                                                                 |
Nursing Algorithm for Managing Patients after Catheter Removal

Post Removal of Indwelling Urinary Catheter (IUC)

- No void in 4-6 hours
- Spontaneous void ≥ 300 mls in 4-6 hours
- Spontaneous void < 300 mls in 4-6 hours (or incontinence)
- Scan Bladder for bladder volume
- Consider Scanning Bladder for PVR if retention suspected (e.g. feeling of bladder fullness)
- Scan Bladder for PVR

Key Points:
- PVR or “post void residual” is the amount left in the bladder 15 to 20 minutes after voiding.
- Amount of fluid intake should be factored in when determining need for bladder scanning/catheterization. Low intake may have lower urine volume, and vice versa.
- If oliguric (< 300-500 ml/day), contact a physician/provider.
- Based on PVRs > 500 mls, intermittent catheterization can be performed every 4 to 6 hours for 24 hours but if required beyond 24 hours, discuss potential alternatives with providers.
Bladder Ultrasound

• **Design:** Single center, observational study; 2 years
  – Assess whether computerized feedback to physicians + a nurse-driven protocol and handheld bladder scanners would decrease the incidence of CAUTI.

• **Results:**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Baseline</th>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUTI, per 1000 device days</td>
<td>36</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>Device utilization ratio</td>
<td>0.16</td>
<td>0.10</td>
<td>0.03</td>
</tr>
<tr>
<td>Inappropriate use</td>
<td>24</td>
<td>14.8</td>
<td>___</td>
</tr>
</tbody>
</table>

Intermittent Catheterization

- **Primary use**
  - Standard method of determining post-void residual urine volumes

- **Target population**
  - Urinary retention, primarily chronic
  - Neurogenic bladder

- **Vs. indwelling catheter**
  - Reduced risk of SUTI and pyelonephritis
  - Increased risk of urinary retention

- **Disadvantages**
  - Urethral trauma and stricture
  - Discomfort, especially with BPH (men) and atrophic urethritis (women)

Condom Catheters

• **Design:** Prospective, randomized, unblinded, controlled trial of 75 VAMC patients
  – condom catheter (34) vs. indwelling catheter (41)

• **Methods:** Outcome--cumulative risk of bacteriuria, symptomatic UTI, or death
  – Patient satisfaction

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Condom (N=34)</th>
<th>Indwelling Catheter (N=41)</th>
<th>Adjusted Hazard</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (%)</td>
<td>15 (44.1)</td>
<td>20 (48.8)</td>
<td>2.11</td>
<td>0.04</td>
</tr>
<tr>
<td>Time to outcome, median</td>
<td>11 days</td>
<td>7 days</td>
<td></td>
<td>0.09</td>
</tr>
<tr>
<td>Incidence, 1000 patient-days</td>
<td>70</td>
<td>131</td>
<td></td>
<td>0.07</td>
</tr>
<tr>
<td>Comfortable, %</td>
<td>89.5</td>
<td>57.6</td>
<td></td>
<td>0.02</td>
</tr>
<tr>
<td>Painful, %</td>
<td>5.0</td>
<td>36.4</td>
<td></td>
<td>0.02</td>
</tr>
</tbody>
</table>

Condom Catheters

• **Target population**
  – Typically used on elderly male patients with dementia

• **Advantages**
  – Reduces risk of complications and better tolerated compared to indwelling catheter

• **Disadvantages**
  – One size does not fit all
  – Leakage, skin necrosis, edema, allergy
Antimicrobial Catheters for Reducing CAUTIs

• **Methods:**
  – Unblinded, randomized clinical trial; 24 UK hospitals
  – 7102 patients requiring short-term urinary catheterization
  – Randomized 1:1:1 to receive silver alloy-latex vs. nitrofural-silicone vs. standard urinary catheter

• **Results:**

<table>
<thead>
<tr>
<th>Catheter</th>
<th>SUTI Rate by 6 wks</th>
<th>AOR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver alloy</td>
<td>263/2097 (12.5%)</td>
<td>0.99 (0.81-1.22)</td>
</tr>
<tr>
<td>Nitrofural</td>
<td>228/2153 (10.6%)</td>
<td>0.81 (0.65-1.01)</td>
</tr>
<tr>
<td>Standard</td>
<td>271/2144 (12/6%)</td>
<td>reference</td>
</tr>
</tbody>
</table>

• **Conclusion:**
  – Routine use of antimicrobial-impregnated catheters was ineffective in reducing symptomatic UTI rates

1. Avoid Improper Placement

- Ensure only properly trained persons insert catheters, and insert using “aseptic technique and sterile equipment.”\(^1-^2\)
- Supplies:
  - Sterile catheter (smallest bore)
  - Gloves, drape, sponges, antiseptic or sterile solution for periurethral cleaning
  - Single use lubricant jelly
- Hand Hygiene immediately before and after insertion.
- Secure catheter to leg to prevent movement, urethral trauma/irritation.
- Position bag below bladder (“dependent”) with closed unobstructed tubing.

“Lifecycle” of the Urinary Catheter

1. Prevent Unnecessary and Improper Placement
2. Maintain Awareness and Proper Care of Catheters in Place
3. Prompt Catheter Removal
4. Prevent Catheter Replacement

2. Maintain Awareness of Catheters in Place

<table>
<thead>
<tr>
<th>Category</th>
<th>% Unaware of urinary catheter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Students</td>
<td>21%</td>
</tr>
<tr>
<td>Interns</td>
<td>22%</td>
</tr>
<tr>
<td>Residents</td>
<td>27%</td>
</tr>
<tr>
<td>Attending Physician</td>
<td>38%</td>
</tr>
</tbody>
</table>

• Options:
  – Daily care checklists
  – More obvious catheter documentation
  – Routine reminders of catheter presence to physicians/nurses

2. Maintain Proper Care of Catheters in Place

Appropriate Management

- Properly secure catheters
- Maintain a sterile, continuously closed drainage system
- Do not disconnect the catheter and drainage tube
- Collect specimens aseptically
- Maintain unobstructed flow of urine
- Empty the collecting bag regularly
- Do not allow the spigot to touch the collecting container
- Keep the collecting bag below the level of the bladder at all times

Who impacts this?

- Nurses
- Patient care assistants
- Patient
- Family members
- Transporters

Audit and report IUC process measures!
“Lifecycle” of the Urinary Catheter

1. Prevent Unnecessary and Improper Placement
2. Maintain Awareness and Proper Care of Catheters in Place
3. Prompt Catheter Removal
4. Prevent Catheter Replacement

3. Prompt Catheter Removal

**Traditional Steps to Catheter Removal**

1. Physician recognizes catheter is present
2. Physician recognizes catheter is no longer needed
3. Physician writes order to remove catheter
4. Nurse sees order and plans to remove the catheter
5. Urinary catheter is removed

**Prompt Catheter Removal**

- **Reminder:**
  - Reminds that a urinary catheter is still in use; may also remind of appropriate indications to continue catheterization.

- **Stop order:**
  - Prompts removal of urinary catheter based upon specified time after placement (e.g., 24 hours), based upon clinical criteria.
# Systematic Review of Reminder Systems to Reduce CAUTI and Urinary Catheter Use

## Meta Analysis Results

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUTI</td>
<td>RR (95% CI)</td>
</tr>
<tr>
<td>- Reminder</td>
<td>0.44 (0.13, 0.74)</td>
</tr>
<tr>
<td>- Stop order</td>
<td>0.59 (0.45, 0.73)</td>
</tr>
<tr>
<td>- Overall</td>
<td>0.52 (0.28, 0.68)</td>
</tr>
<tr>
<td>Catheter days</td>
<td>↓2.61 d (37%)</td>
</tr>
<tr>
<td>Reinsertion</td>
<td>NS</td>
</tr>
</tbody>
</table>

## National Survey of CAUTI Prevention Strategies

Nursing Algorithm for Managing Patients after Catheter Removal

Nurse Driven:
Nurse removes Foley when patient no longer meets criteria

Removal Guidance MUST be provided when Ordering IUC (Foley)

Provider Driven:
Provider chooses specific time or condition for Foley removal, or a daily removal reminder

For All Patients
Nurse Follows Post-Foley Removal Protocol:
- Bladder Scans
- If Patient is Retaining Urine, Intermittent Straight Caths are Performed

Most appropriate approach for post-operative IUC management
“Lifecycle” of the Urinary Catheter

1. Prevent Unnecessary and Improper Placement
2. Maintain Awareness and Proper Care of Catheters in Place
3. Prompting Catheter Removal
4. Preventing Catheter Replacement

4. Preventing Catheter Replacement

• Do reminders or stop orders lead to increased need for re-catheterization?
  – No evidence higher rates of re-catheterization

• Tools to prevent catheter replacement:
  – Urinary retention evaluation protocols
    • Use bladder scan and straight catheterization
    • Do not require physician order
  – Same tools as for preventing initial placement

Diagnosis of UTI in Catheterized Patients

• Appropriate Specimen Collection
  – Short-term catheterization
    • Sample from the catheter port using aseptic technique
  – Long-term catheterization (>2 weeks)
    • Replace catheter before collecting a specimen
      – Multiple organisms present in biofilm—not all causing infection
  – Do not sample from drainage bag
Asymptomatic Bacteriuria and Symptomatic UTI Clinical Criteria

**CA-ASB**

- CA-bacteruia ($\geq 10^5$ cfu/ml)
  - AND
  - The absence of symptoms
  - Easy to determine in patient without catheters because symptoms are easier to ascertain

**SUTI/CAUTI**

- CA-bacteruia ($\geq 10^3$ cfu/ml)
  - AND
  - New fever or rigors with no other source
  - New onset delirium, malaise, lethargy with no other source
  - CVA tenderness, flank pain, pelvic discomfort
  - Acute hematuria
  - OR
  - Usual UTI symptoms if the catheter has been removed in the past 48 hours

Asymptomatic Bacteriuria (ASB)

- Up to 90% or more of hospitalized patients with catheter-associated bacteriuria (CA-ASB) are asymptomatic.\(^1\)
- Bacteremia complicates CA-bacteruia in <1% to 4% of cases.
- CA-ASB has no clear association with mortality risk.
- CA-ASB should not be treated routinely in any care setting.
- CA-ASB:
  - Reservoir of multidrug-resistant organisms
  - Driver of inappropriate antimicrobial utilization
    - 15/29 (52%) of patients with CA-ASB received treatment\(^2\)

<table>
<thead>
<tr>
<th>Discourage Urine Culture Use</th>
<th>Appropriate Urine Culture Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine quality: color, smell, sediments, turbidity (do not constitute signs of infection)</td>
<td>Part of an evaluation of sepsis without a clear source (CAUTI is often a diagnosis by exclusion)</td>
</tr>
<tr>
<td>Screening urine cultures (whether on admission or before non-urologic surgeries)</td>
<td>Based on local findings suggestive of CAUTI (example, pelvic discomfort or flank pain)</td>
</tr>
<tr>
<td>Standing orders for urinalysis or urine cultures without an appropriate indication</td>
<td>Prior to urologic surgeries where mucosal bleeding anticipated or transurethral resection of prostate</td>
</tr>
<tr>
<td>“PAN” culturing (mindfulness in evaluating source is key)</td>
<td>Early pregnancy (avoid urinary catheters if possible)</td>
</tr>
<tr>
<td>Obtaining urine cultures based on pyuria in an asymptomatic patient</td>
<td></td>
</tr>
<tr>
<td>Asymptomatic elderly and diabetics (high prevalence of asymptomatic bacteriuria)</td>
<td></td>
</tr>
<tr>
<td>Repeat urine culture to document clearing of bacteriuria (no clinical benefit to patients)</td>
<td></td>
</tr>
</tbody>
</table>
Spreading the Practice: Tailoring Urinary Catheter Use by Environment

<table>
<thead>
<tr>
<th>Setting</th>
<th>Strategy</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency Department</td>
<td>Indication checklists, stickers attached to catheter kits</td>
<td>Gokula, 2005</td>
</tr>
<tr>
<td>Peri-Procedure</td>
<td>Procedure-specific protocols for catheter placement and post-op stop orders.</td>
<td>Stephan, 2006 Multiple genitourinary catheter protocol studies</td>
</tr>
<tr>
<td>ICU</td>
<td>Daily checklists used in multidisciplinary rounds</td>
<td>Dumigan, 1998; Jain, 2006 Reilly, 2008; Huang, 2004</td>
</tr>
<tr>
<td>Acute Care Units</td>
<td>Reminders vs. stop order written, verbal, electronic</td>
<td>Saint, 2005; Fakih, 2008 Topal, 2005; Crouzet, 2007 Apisarnthanarak, 2007</td>
</tr>
<tr>
<td>Acute Rehab Units</td>
<td>Use alternatives to indwelling urinary catheters Clean intermittent catheterization</td>
<td>HICPAC, 2009</td>
</tr>
</tbody>
</table>
Endure — Plan for Sustainability

- Things you can do now to support long term viability of your CAUTI reduction:
  - Policy Development/institution wide/ across clinical disciplines
  - Include in orientation for all relevant staff
  - Include in annual competency review process
  - Periodic audits; Check to be sure it is routine practice
  - Set up reliable supply chain (borrowing protocol; alert system)
  - Quarterly review by executive partner
  - Set up a Learning Network of peers
Imbedding the Practice: Making Urinary Catheter Assessment Part of the Workflow

• The intervention(s) should become part of the workflow

• For insertion, Emergency Department is paramount:
  – Require a physician order
  – Consider catheter removal on hospital admission

• For removal, focus on catheter appropriateness and removal:
  – Daily work rounds (ICU)
  – Reminders and stop orders (acute care units)

• Address disincentives to inappropriate catheter insertion and ongoing use: All settings
Periodic Evaluation and Feedback

• Practice audits—identify gaps in processes of care
  – Catheter insertion
  – Catheter maintenance
• CAUTI event audits
• Process measures—trend performance
  – Proportion of catheters inserted for appropriate indication
  – Catheter device utilization ratio (DUR)—goal is to reduce DUR over time
• Outcome measures
  – CAUTI rates
  – Non-infectious events:
    • Hematuria, other trauma, pressure ulcers
Summary

• Appropriate indications for catheter placement
  – Strong clinical rationale; can be modified based on local consensus

• Reducing inappropriate catheter use requires:
  – Focus on both placement and continued use
  – Understanding the clinical and economic impact of inappropriate catheter use
  – Adequate resources for alternative methods of voiding

• Reminders, stop orders, and nurse driven protocols can disrupt the catheter “lifecycle” at all stages

• Do don’t screen for or routinely treat asymptomatic bacteriuria

• Plan for spread and sustainability of your efforts
• David Pegues, MD
  – david.pegues@uphs.upenn.edu