

INDWELLING URINARY CATHETERS

A STEP-BY-STEP CLINICAL PATHWAY
FOR BLADDER MANAGEMENT

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JUNE 2016





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0900-2813-03-84

Developed through an Educational Grant from Verathon Inc.

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ABSTRACT

At least 5% to 10% of all patients hospitalized in the United States develop a healthcare-associated infection (HAI) costing nearly \$45 billion in direct hospital costs. Urinary tract infection (UTI), a type of HAI, accounts for approximately one-third of infections reported by acute care hospitals and approximately one-fourth of all HAI bacteremias. The majority of HAI-UTIs are caused by instrumentation of the urinary tract, mainly from use of an indwelling urinary catheter (IUC). These “catheter-associated urinary tract infections” referred to as “CAUTIs,” can result in increased morbidity, mortality, hospital cost, and length of stay and is one of the most common infections in the world. Other patient safety problems, such as trauma, increased patient discomfort, and immobility are also associated with IUCs.

Infection prevention and control efforts have long focused on monitoring and preventing HAIs, but prevention is a priority in ensuring patient safety, with initiatives led by healthcare organizations, professional associations, academic centers, government and accrediting agencies, and others. The Agency for Healthcare Research and Quality (AHRQ) funded a national effort to reduce the risk of CAUTI and Johns Hopkins Medicine Armstrong Institute for Patient Safety and Quality developed the “On the CUSP: Stop CAUTI” project to reduce CAUTIs and to improve safety culture at the point of care, the bedside. The American Nurses Association’s *Partnership for Patients* is focused on quality improvement, patient safety and cost-effective patient care and developed CAUTI reduction tool designed for nurses. Implementing existing prevention practices can lead to up to a 70% reduction in certain HAIs. The financial benefit of using these prevention practices is estimated to be \$25.0 billion to \$31.5 billion in medical cost savings.

Hospital staffs, particularly nursing staffs, are developing clinical pathways for removal of IUCs and subsequent bladder management, to ensure patient safety and evidence-based practice (EBP). This paper is an updated review of current IUC indications and use, complications associated with an IUC, types of catheters, prevention of CAUTIs, and “best practices” for bladder management following IUC removal. In addition, methods and a step-by-step clinical pathway that may improve patient care and safety, while reducing associated costs, is provided.

CURRENT USE OF AN INDWELLING URINARY CATHETER

An IUC is a flexible hollow tube that allows for continuous bladder drainage. It remains in place through the use of a retention balloon, inflated to secure its place in the bladder. The end of the catheter is attached to a drainage system that includes a tube to drain the urine and a bag that collects urine. (See Figure 1). Urinary catheters are invasive devices, which in many instances, are placed unnecessarily, remain in without provider awareness, and are not removed when no longer needed. Catheters are usually inserted and managed by nurses.

Catheters are used in both men and women in all care settings, but the acute care setting uses IUCs more than any other medical device. At least one in five patients admitted to the acute care setting will receive a urethral catheter sometime during their hospital stay, mostly for short-term duration (defined as <30 days). Prevalence is greater in high acuity patient units, with critical care and intensive care units having the highest prevalence. It is felt that between 20% and 50% of catheters placed in acute care settings may not be medically necessary. CAUTIs can lead to increased length of stays, mortality rates, and ultimately higher hospital costs. Approximately 560,000 cases of CAUTIs are reported yearly to the CDC. The cornerstone of any CAUTI prevention program would be to remove the IUC as soon as possible.

A common reason for inappropriately and prolonged IUC use is that physicians forget or were never aware of the presence of the catheter. These forgotten catheters often remain in place until either a catheter-related complication occurs or the patient's discharge is imminent. However, these forgotten catheters are becoming a financial liability for hospitals. The cost of treating a single episode of a CAUTI in a hospital varies from \$980 to \$2,900, depending on the presence of associated bacteremia. According to the CDC, the total expense of these infections is \$450,000,000 per year in the United States.

In many cases, these catheters are inappropriately used and remain in place for too long. This inappropriate use has been equated to a "one-point restraint," because like a restraint, catheters can cause functional impairment, discomfort, and pressure ulcers.

CATHETER SIZE AND MATERIAL

When selecting a specific catheter, staff should consider several factors such as: length of time the catheter will remain in place, patient comfort, presence of latex sensitivity or allergy, ease of insertion and removal, ability to reduce the complications such as urethral and bladder tissue damage, and ability to resist colonization by biofilms, microorganisms, and encrustation. The different material used for catheters are outlined in Table 1. Nurses should determine the reason for catheter use (e.g. post-surgical bladder drainage) and risk factors (e.g. need to use a curved or Coudé-tip in a man with an enlarged prostate) before deciding on the most appropriate one. Part of that selection includes determining a certain catheter size or catheter tip configuration (see Table 2).

REGULATIONS CONCERNING USE OF AN IUC IN HOSPITALS

The Centers for Medicare and Medicaid Services (CMS) has deemed CAUTI a "never event," limiting government-funded reimbursement. A "never event" is considered preventable. The urinary catheter life cycle (see Figure 2) is one way of identifying and addressing this risk. The first step is to prevent placement of any IUC that would not be of medical benefit to the patient. Avoiding unnecessary catheter placement will not only prevent the risk of infection, but it will also prevent

trauma associated with the catheter and other conditions (e.g., impaired mobility). But IUCs are inappropriately used in acute care patients for reasons including:

- As a substitute for care of the patient with urinary incontinence, basically for nurse convenience. Urinary incontinence is a major cause of initial unjustified catheter placement especially in hospitals that have staffing issues.
- As a means of obtaining urine for culture or other diagnostic tests when the patient cannot voluntarily void.
- For prolonged postoperative duration without appropriate indications (e.g., structural repair of urethra or contiguous structures, prolonged effect of epidural anesthesia, etc.).

Non-patient-related reasons for inappropriate IUC use include staff unaware of IUC guidelines and recommendations, physician uncertainty about the patient's medical course, and convenience of hospital staff.

Since CMS changed reimbursement, monitoring HAIs and comparison of CAUTI rates are required by both state and federal regulations. The National Healthcare Safety Network (NHSN) of the Center for Disease Control and Prevention is a performance measurement system devoted to tracking HAIs. The NHSN created the National Nosocomial Infection Surveillance (NNIS) system, a national database that benchmarks infection rates of similar hospitals.

The CDC HICPAC EB Clinical Practice Guideline on prevention of CAUTIs emphasizes quality improvement initiatives and provides suggestions for implementation. HICPAC has estimated that up to 69% of hospital-acquired CAUTIs may be prevented by implementation of an evidence-based prevention program. Although patients who have IUCs in place long term will most certainly develop a CAUTI, evidence suggests that certain interventions can reduce the incidence of CAUTIs in patients who have IUCs in place for short-term duration (defined as <30 days). These interventions include educating physician and nursing staff on indications and evidence-based care of the IUC to prevent infection. Hospitals must be proactive in:

1. Instituting hospital-wide administrative interventions
2. Implementing quality improvement programs
3. Putting in place physician reminder systems and automatic stop orders
4. Developing nurse-driven protocols
5. Limiting post-surgical patient use
6. Providing portable bladder volume ultrasound devices (e.g. BladderScan® bladder volume instruments) on nursing units to assess adequate bladder emptying

In hospitals, it is strongly recommended that an organization-wide program be implemented to monitor catheter use so that IUCs that are no longer necessary are promptly removed. There is evidence that a nurse-driven surveillance team is necessary and Figure 2 is an excellent example of a nurse-driven clinical pathway.

INDICATIONS FOR USE OF AN INDWELLING URINARY CATHETER

Prevention of a CAUTI starts with insertion of an IUC only when indicated. But this is not often the case as it has been determined that 21% to 54% of catheterized patients do not have appropriate indications. Evidence-based guidelines have identified six appropriate indications for an IUC:

1. Acute urinary retention or bladder outlet obstruction
2. Accurate measurements of urinary output in critically ill patients
3. Perioperative use for selected surgical procedures (e.g. prolonged duration of procedure, large volume fluid infusion) and should be removed in post-anesthesia care unit
4. Urologic/other surgeries (e.g. gynecologic, colorectal) performed on contiguous structures of genitourinary tract such as bladder or urethra for which a prolonged period of drainage is necessary for healing
 - a. When placed just for bladder decompression/filling, such catheters can usually be removed at end of surgery or when the patient is ambulatory postoperatively
 - b. When used for reconstructive surgery (urethroplasty, urethral diverticulectomy, urethrovaginal fistula, vesicovaginal fistula, bladder trauma, radical prostatectomy, bladder surgery, augment/partial cystectomy/neobladder/etc.) a catheter may be needed for as long as 7 to 21 days for proper wound healing and adequate urinary drainage
 - c. Management of hematuria associated with clots
5. To assist in the healing of open sacral or perineal pressure wounds in incontinent patients
6. Improved comfort for end-of-life care when urine collection by catheter addresses patient and family goals in a dying patient

Another common reason for prolonged IUC use is post-operative urinary retention (POUR). While there is no standard definition for POUR, it is characterized by impaired bladder emptying, with an elevation in the volume of retained urine. The risk of POUR is increased following certain surgical procedures and anesthetic modalities, and with patients' advancing age. Estimates of the prevalence POUR following surgery vary but rates after pelvic surgery range from 2.5% to 43%. But to better manage these patients and to minimize unnecessary IUC use, patients at increased risk of POUR should be identified before surgery or the condition should be identified and treated in a timely manner following surgery. If conservative measures do not help the patient to pass urine, the bladder will need to be drained by alternative methods (e.g. intermittent catheterization).

UNDERSTANDING CAUTI AND OTHER ADVERSE EVENTS

An IUC is associated with many adverse events, the most harmful and frequent complication is a CAUTI. The risk of bacteriuria leading to a CAUTI is based on duration of catheter use and catheter care. Urology defines a CAUTI as an infection of the urinary tract caused as a result of bacteria moving through or migrating around the IUC and infecting the bladder and urethral mucosa. CAUTIs are considered to be complicated infections, because normal host defense mechanisms are compromised by the presence of a foreign body, the catheter. Although frequently asymptomatic, up to one-third of patients with catheter-associated bacteriuria will develop symptoms of a CAUTI, especially if the catheter remains in place long-term (defined as >30 days). These CAUTIs are usually caused by biofilms, a collection of microorganisms that colonize the internal catheter lumen and drainage tube and bag. They can block the catheter and lead to sepsis. The only way to eradicate them is by changing the catheter system or catheter removal. The length of time IUCs remain in situ is directly related to increases in CAUTIs. Antimicrobial therapy is only transiently effective if the catheter remains in place.

Meddings and Saint have described adverse risks of an IUC through depiction of an IUC Life Cycle that ranges from insertion to removal (see Figure 2):

1. **Placement:** IUC use is based on appropriate indications
2. **Care:** Aseptic insertion and proper maintenance reduces the risk of introducing organisms into the bladder, delaying the occurrence of bacteriuria.
3. **Removal:** Catheter removal when no longer indicated reduces the risk of noninfectious and infectious complications.
4. **Re-insertion:** Preventing reinsertion of IUCs or intermittent catheterization by using alternative strategies for bladder management, such as bladder scanning, described in the Algorithm provided in Figure 3.

In addition to the length of time the IUC is in place, there are other risk factors for development of a CAUTI, including improper catheter insertion techniques, female gender, older age, compromised immune system, and co-morbid conditions (e.g. diabetes, renal dysfunction). Other contributing factors to the development of a CAUTI are non-evidence-based nursing care practices for managing catheters. Procedures such as care of the catheter, drainage tube and bag, and others, are routinely performed by nurses, are not supported by research and, in many cases, have been shown to contribute to the development of a CAUTI. The fact that nurses are not following specific practices to prevent CAUTIs was shown in a survey distributed to both nonfederal and federal U.S. hospitals about prevention of hospital-acquired UTIs and other device-associated infections. Additionally, only 9% of hospitals reported using an IUC stop-order or reminder, only 14% used condom catheters in appropriate men, and only about 30% used a portable bladder ultrasound scanner, a noninvasive method for determining post-void residual urine volumes (PVR). Use of the *Bladder Bundle*, developed by Saint, encourages nurses to follow specific care practices of aseptic insertion, daily monitoring of indication, use of non-invasive bladder management technology (see Table 3). In those patients with an IUC, following the “Do’s and Don’ts” of good nursing practices outlined in Table 4 can prevent associated complications, including CAUTIs. These recommendations are based on the most current evidence-based clinical practice guideline.

BLADDER MANAGEMENT FOLLOWING CATHETER REMOVAL

Hospitals are developing care pathways for removal of these catheters and step-by-step for bladder management post-IUC removal. Figure 3 is a Step-by-Step clinical pathway that was developed by this author to guide nursing staff in bladder management following IUC removal.

Applying infection control–based catheter practices may enhance patient safety while decreasing catheter related costs. One practice method is the use of the BladderScan® when assessing bladder volume and need for catheterization. Other practices that may decrease CAUTIs include:

1. Using IUCs only when necessary
2. Removing catheters when no longer needed via the use of various reminder systems
3. Using silver alloy or antimicrobial catheters in patients at highest risk of infection
4. Using external (or condom-style) catheters as appropriate for men and an external pouch for women
5. Ongoing use of a portable bladder volume ultrasound to detect residual urine amounts
6. Maintaining aseptic insertion technique
7. Using alternatives to IUCs, (e.g. intermittent catheterization) to manage urinary retention. Hospital medical and nursing staff will need to implement alternative bladder management strategies.

A Step-by-Step clinical pathway is followed to determine the best bladder management following IUC removal. This pathway emphasizes the need for non-invasive monitoring of bladder volume. Bladder monitoring should not be performed with repeat catheterizations, but through the use of non-invasive technology (e.g. portable bladder volume ultrasound instrument) to avoid unnecessary catheterizations and to prevent infections of the urinary tract (See Figure 4). Non-invasive bladder volume devices have been used for over two decades to monitor for bladder emptying and have been advocated by many, to reduce the need for catheterization. A portable bladder ultrasound accurately measures urine volume and is a nurse-friendly device. Additionally, these “scanners” have been found to reduce the number of catheterizations, thus decreasing the risk of UTI.

CONCLUSIONS

Best practices for use of IUCs that follow evidence-based guidelines are the only way to promote patient safety and reduce catheter associated UTIs. Nurses play a key role in ensuring IUC monitoring and care. Once an IUC is removed, managing the bladder through non-invasive bladder monitoring is the best nursing practice.

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TABLE 1: TYPES OF CATHETER MATERIAL

Type	Advantages	Disadvantages
Silicone-coated latex	<p>Coating is chemically bonded to the inner and outer surface of the latex catheter, ensuring minimum urethral irritation and good flow.</p> <p>Elastomer provides “elasticity” and prevents any chemical release from the latex catheter.</p>	<p>Should only be used short term because coating will dissolve and balloon will lose fluid over time.</p> <p>Latex hypersensitivity may still occur.</p>
Teflon-coated (PTFE or polytetrafluoroethylene)	<p>Developed to protect the urethra against latex.</p> <p>Has good biological compatibility and low friction.</p> <p>Absorption of water is reduced due to the Teflon coating.</p> <p>Smoother than plain latex, which helps to prevent encrustation and irritation.</p>	<p>Because these are Teflon-coated latex catheters, allergy remains a concern.</p>
100% Silicone	<p>Thin-walled, more rigid catheters with a wider lumen diameter (not coated) that does not allow buildup of protein and mucus.</p> <p>Superior resistance to kinking.</p> <p>May be preferable for more prolonged catheterization to reduce the risk of encrustation.</p> <p>Allows hospitals to ensure a “latex-free” environment.</p>	<p>Stiffer catheter that may be uncomfortable.</p> <p>The balloon loses fluid over time and tends to form creases or cuffs when deflated, which may make the catheter difficult to remove, and can cause the catheter to “fall out.”</p>

Hydrogel-coated latex	<p>Hydrogel absorbs secretions from the urethra (hydrophilic), causing the catheter to soften and be more comfortable.</p> <p>Produces a slippery (lubricious) outside surface that reduces friction and protects urethra from tissue damage.</p> <p>Resists encrustation and bacteria colonization.</p> <p>May be better tolerated and preferred for long- term usage.</p>	Because these are latex, allergy remains a concern.
Silver alloy	<p>Combines a thin layer of silver alloy with hydrogel which is antiseptic.</p> <p>Decreases CAUTIs in short-term use.</p> <p>Reduce bacterial adherence and minimize biofilm formation through their release of silver ions, which prevent bacteria from settling on the surface.</p>	<p>More expensive than other catheters.</p> <p>Effectiveness is shown only for short term use (e.g. 2 weeks).</p> <p>If CAUTI rate does not decrease after implementing a comprehensive strategy to reduce rates, consider using a silver antiseptic-impregnated catheters.</p>
Antimicrobial (nitrofurazone-releasing)	<p>May decrease symptomatic UTIs if used short term.</p> <p>Clear evidence bacteriuria is decreased, but not good evidence if symptomatic UTI is decreased.</p> <p>Consider using to reduce bacteriuria in patients who need IUC short-term (<14 days in situ).</p>	<p>More expensive than other catheters.</p> <p>May develop a resistance to antibiotic used for coating</p>

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TABLE 2: IUC SIZE AND TIPS

SIZE

- Catheter diameter sizes are determined by the outer circumference and measured in Charrière (Ch or CH) also known as French Gauge (Fr).
 - Range is 6–24 Fr with each French unit equaling 0.33 mm in diameter (Most common size used is 14 Fr)
 - The size of the catheter is marked at the inflation channel as well as with an (international) color code (e.g. 14 Fr is green, 16 Fr is orange)
 - Smallest catheter size is recommended (14 Fr to 16 Fr)
- Inner lumen of the catheter varies quite a lot between different catheter materials (e.g. latex and a silicone catheter), so inserting a larger size catheter does not necessarily ensure a wider drainage.
- Use of large-size catheters (>18 Fr or larger) may cause:
 - Erosion of the bladder neck and urethral mucosa
 - Urethral stricture formation
 - Inadequate drainage of peri-urethral gland secretions, causing a buildup of secretions that may lead to irritation and infection

CATHETER TIPS

- Standard tip of the catheter is round with two drainage eyes
- For routine catheterization, a straight-tipped catheter is recommended
- Coudé-tip catheter, or Tiemann catheter which is angled upward at the tip and may be preferred as it allows easy passage in men with an enlarged prostate or urethral stricture

TABLE 3: BLADDER BUNDLE (ABCDE)

Adhere to general infection control principles

- Hand hygiene - most important factor in preventing nosocomial infections.
- Aseptic catheter insertion
- Proper IUC maintenance, education and care by nursing staff
- Catheter use, surveillance, and feedback

Bladder ultrasound use protocol in place to avoid unnecessary catheterizations

Catheter alternatives

- Intermittent (“in and out”) catheterization for incomplete bladder emptying
- External male catheter for men with urinary incontinence
- Absorbent pads and products for men and women with urinary incontinence

Do not use the IUC catheter unless medically appropriate, know appropriate indications.

Early removal of the IUC using a reminder or nurse-initiated (e.g. automatic “stop orders”) removal protocol appears warranted.

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TABLE 4: DOs AND DO NOTs OF NURSING MANAGEMENT OF IUCs

DOs

- ✓ **Conduct daily IUC evaluation of need and implement quality improvement programs.**
 - ✓ Early removal of the IUC using a reminder or nurse-driven (e.g. automatic “stop orders”) removal protocol appears warranted.
 - ✓ Use a non-invasive bladder volume instrument (e.g. BladderScan®) as part of bladder monitoring following IUC removal and prior to insertion of a urinary catheter.
- ✓ **Adhere to general infection control principles including:**
 - ✓ Hand hygiene - most important factor in preventing nosocomial infections.
 - ✓ Aseptic catheter insertion.
 - ✓ Wear disposable gloves when handling any part of the catheter system.
- ✓ **Bladder ultrasound use protocol in place to avoid unnecessary catheterizations**
- ✓ **Proper catheter insertion techniques**
 - ✓ Minimize urethral trauma during insertion by using generous amounts of sterile lubricant along the entire catheter (especially in male patients).
 - ✓ Hold the penis in a near vertical insertion position when catheterizing a male patient.
 - ✓ If a catheter becomes contaminated during insertion, discard and obtain a new sterile catheter and catheter tray if necessary.
- ✓ **Ensure proper catheter maintenance and care**
 - ✓ Secure or anchor catheter to prevent excessive tension on the catheter, which can lead to urethral trauma and tears.
 - ✓ Ensure an unobstructed urine flow by preventing any kinks or loops from occurring in the catheter and tubing.
 - ✓ Empty the drainage bag at least every 4 to 6 hours or when urine in the drainage bag reaches 400 ml to avoid migration of bacteria up the lumen of the catheter system. Empty the bag prior to transporting the patient.
 - ✓ Label graduated containers with patient name and date. Separate containers for a patient with multiple drainage tubes. With multiple drainage devices for one patient, keep drainage devices (especially a GI/rectal drainage bag) on opposite sides of the bed and keep drainage devices in semi-private rooms on opposite sides of the room.
 - ✓ Consider changing the catheter before obtaining a specimen for culture as cultures obtained through the old catheter may be inaccurate.

- ✓ Consider changing the entire catheter and system if infection or obstruction occurs.
- ✓ Change catheter before starting antibiotic therapy.
- ✓ **Encourage adequate fluid intake (approximately 30ml/kg/day with a 1,500 ml/day minimum or as indicated based on the patient's medical condition).**

DO NOTs

- ✓ Do not perform rigorous, frequent cleansing of the catheter entry site (meatus or suprapubic).
 - ✓ Do not use antiseptics for routine cleansing, rather just wash the catheter entry site with soap and water daily or after fecal contamination.
- ✓ Do not disconnect the catheter from the drainage bag for any reason.
 - ✓ Consider the use of a pre-connected catheter seal may prevent disconnection.
- ✓ Do not clamp the catheter or drainage tube.
- ✓ Do not perform routine cultures in the absence of infection because all chronically catheterized individuals have bacteria and the organisms change frequently (about one to two times per month). Urine cultures should only be obtained if the patient demonstrates clinical symptoms of a UTI.
- ✓ Do not give prophylactic antibiotics and antimicrobials as a UTI prevention strategy.
- ✓ Do not perform bladder or catheter irrigation unless medically necessary (e.g. tissue/blood clots obstructing drainage). If catheter patency is questioned or occlusion is suspected, scan the bladder to assess urine volume.

FIGURE 1: COMPONENTS OF AN IUC SYSTEM

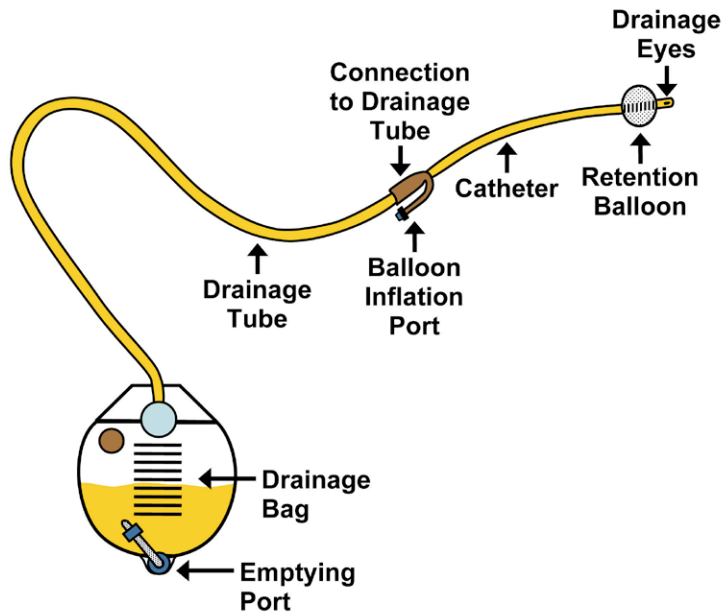
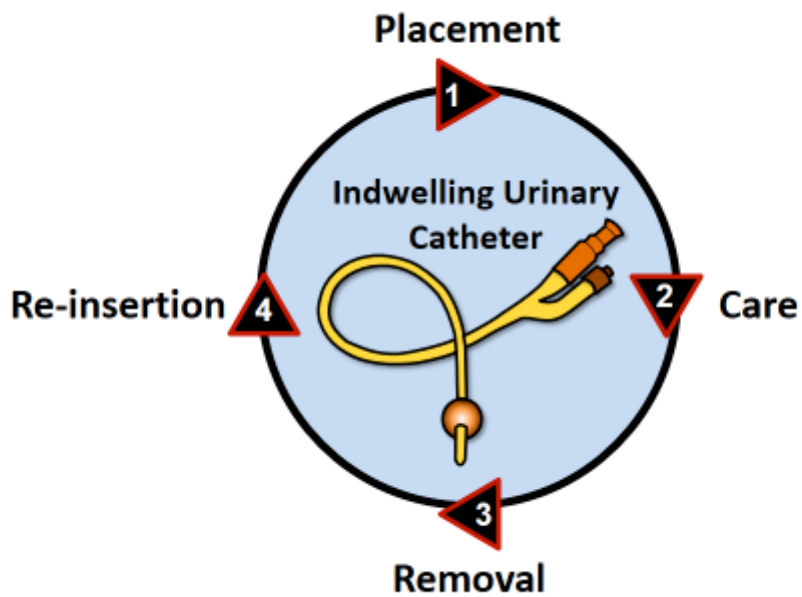
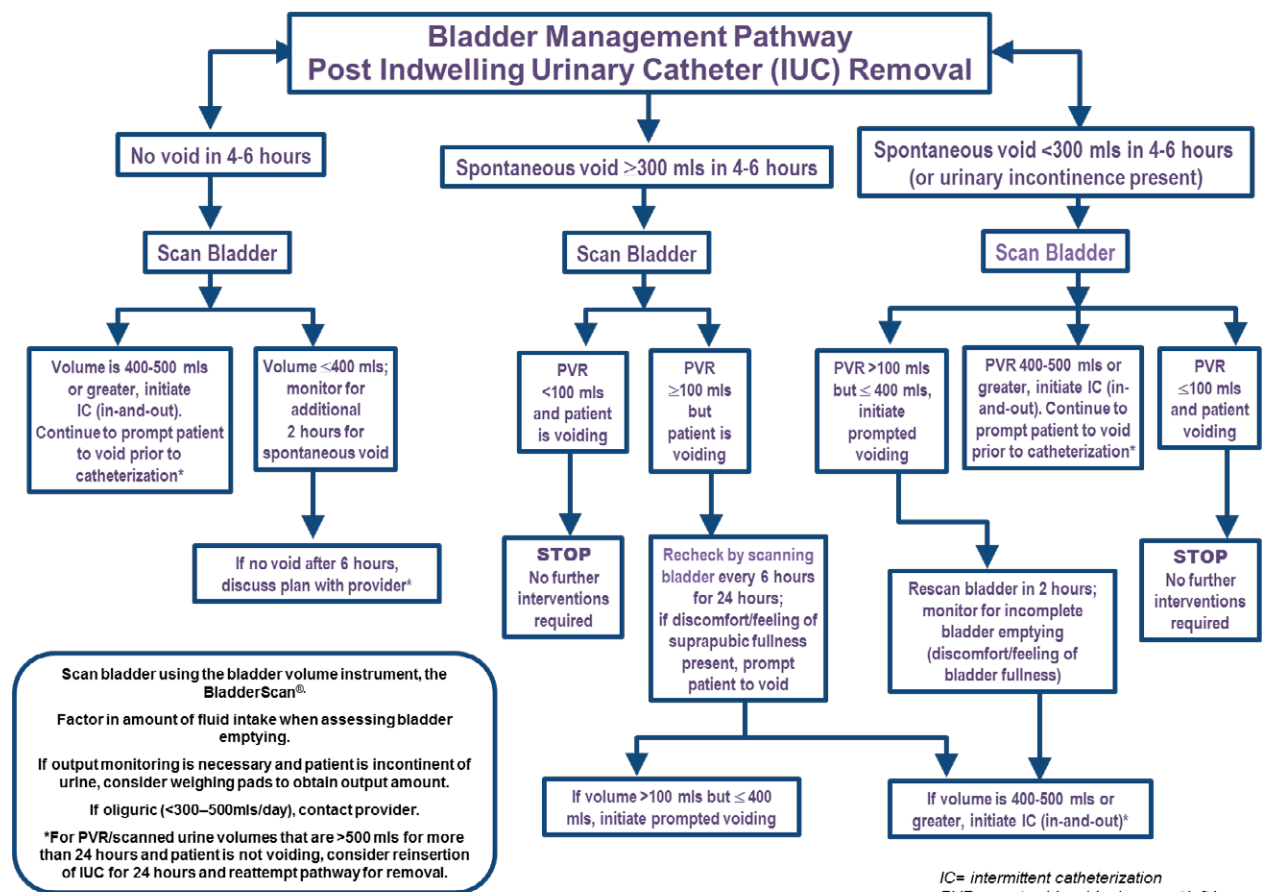


FIGURE 2: INDWELLING URINARY CATHETER LIFE-CYCLE



Adapted from: Meddings J, Saint S (2011) Disrupting the life cycle of the urinary catheter. *Clin Infect Dis.* Jun;52(11):1291-3

FIGURE 3: STEP-BY-STEP CARE CLINICAL PATHWAY FOR MANAGING THE BLADDER FOLLOWING IUC REMOVAL



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IC= intermittent catheterization
 PVR = post void residual, amount left in the bladder 10 to 20 minutes after voiding

