Methods and Types of Urinary Catheters Used for Indwelling or Intermittent Catheterization

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There are various urinary catheterization techniques, and unfortunately, it is not always clear what is exactly meant by a certain technique that is mentioned in the literature (Vahr et al., 2013). This Teaching Tool provides descriptive information on urinary catheterization methods, characteristics of catheter type, and material, specific uses (indwelling urinary catheter, intermittent catheterization), and considerations.

Catheter Characteristics

Urinary catheters can be divided into two categories: indwelling (referred to as indwelling urinary catheters [IUCs] or Foley catheters) or inserted as a single catheterization (referred to as "straight" or "in-and-out," or intermittent catheterization [IC]) (Newman, 2017; Newman et al., 2018). This section outlines the most commonly used catheters for IUCs and IC.

Urinary catheters come in varying sizes, configurations and material. There is insufficient evidence to determine whether there is an optimal catheter type for those requiring either short-term (Lam et al., 2014) or long-term bladder drainage (Jahn et al., 2012).

Catheter lumen: The main differences between an IUC and a catheter used for straight catheterization or IC is the number of lumens or channels and the presence of a balloon. Indwelling catheters have:

- Double lumens (two-way catheter), one for urine draining and the other for inflation/deflation of the balloon with an infusion port at the end for instillation of fluid for the balloon.
- Three lumens (three-way catheter) for continuous bladder irrigation. There is a three-way IUC available with a temperature-sensing probe built into the lumen, often used for monitoring the temperature of a patient intraoperatively.
- Four lumens (four-way catheter) for irrigation and prostatic surgical irrigation (Feneley et al., 2015).

The infusion port for the balloon channel is usually labeled with the size of the balloon and the size of the catheter. Catheters used for 'straight' catheterization or IC only have one lumen and no balloon.

Figure 1.
Color-Coded Catheter Size Chart

Color	Size French	Size Millimeter
Green	6	2.0
Blue	8	2.7
Black	10	3.3
White	12	4.0
Green	14	4.7
Orange	16	5.3
Red	18	6.0
Yellow	20	6.7
Purple	22	7.3
Blue	24	8.0
Black	26	8.7

Source: Courtesy of Robin Noel.

Catheter size: The accepted measurement unit for catheters is the French catheter scale, French gauge (Fr or F) or Charriere (Ch), based on the cross-sectional diameter of the catheter in millimeters (Newman et al., 2018). The cross-sectional diameter of a urinary catheter is equal to three times the diameter. For example, a 30 Fr catheter is 10 mm in diameter. Catheter size is measured by the external diameter because the size of the internal lumen depends on the material and manufacturing process (Figure 1). As the size of the catheter increases, the diameter of the catheter lumen increases. Recommendation is to use the smallest size catheter that will drain adequately. Catheter sizes are color-coded at the balloon inflation lumen for easy identification (Figure 1).

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Table 1.
Methods for Urinary Catheterization

Method	Description
Sterile	• Complete sterile setting, including genital skin antisepsis, sterile gloves, forceps, gown, and mask. • Technique used when urinary catheterization is performed in surgery, during procedures, and in hospitals for certain situations (e.g., isolation).
Aseptic	• Uses sterile gloves, single-use catheter, preceded by disinfecting the genitals with an antiseptic solution, and without direct manual contact with the catheter (e.g., no touch technique, single-use sachet lubricant, or pre-lubricated catheter). • Technique used when health care provider (e.g., nurse, physician) performs catheterization.
Clean single-use	• User touches the sterile catheter with clean hands. • Implies hand washing with soap and water or antibacterial soap and cleansing the genitals only if fecal or other wastes are present. • Lubricant is either included in the catheter package as a single-use sachet or multiple-use tube. • Product does not feature a protective sleeve or collection bag. • Catheter discarded after use.
No-touch technique	• Uses a ready-to-use catheter (pre-lubricated catheter, usually a hydrophilic catheter) with a sliding finger aid or guide or protective sleeve over the catheter. • Some have special packages that allows insertion without the person directly touching the sliding surface of the hydrophilic catheter. • Product may feature a collection bag. • Patient-friendly method for performing intermittent self-catheterization (ISC).
Clean multiple re-use (CIC)	• Lapides and colleagues (1972) hypothesized that regular emptying of the bladder is more important for prevention of a urinary tract infection than is the use of aseptic technique. • Multiple use of previously used but cleaned catheters. • Catheter cleaning method varies and may involve soaking the catheter in an antiseptic solution between uses or washing it with soap and water and air-dried and stored in ventilated container or bag between uses. • Lubricant packet is either a single-use sachet or multiple-use tube. • If a caregiver (parent catheterizing a child) is performing the catheterization, medical gloves are used. • No guidelines on when the catheter should be discarded: *The Food and Drug Administration (FDA) has labeled all sterile urethral catheters as single-use devices and not approved for multiple re-use. Manufacturer guidelines state that a catheter designed for intermittent drainage of the bladder is single-use and is to be discarded after used for catheterization.*

Source: Adapted from Newman et al., 2018, p. 49.

Catheter balloon: The most commonly used IUC has one balloon, but there are catheters with dual-balloons, which are intended to reduce the risk of bladder trauma. A disadvantage is that two balloons may trap more urine in the bladder (Feneley et al., 2015). Balloons are either 10 mL or cc or 30 mL or cc, but IUCs with a 75 mL balloon are available in three-way IUCs and are intended specifically for controlling postoperative hematuria. The balloon channel incorporates a valve to prevent the sterile water from escaping when the syringe is detached (Newman et al., 2018). It is vital that the correct volume of sterile water is used because over or under inflation can result in balloon distortion, with the risk that the catheter may become dislodged from the bladder. Saline should not be used to inflate the balloon because the fluid may crystallize in the balloon port, clogging it and preventing balloon deflation and catheter removal. The balloon sits at the base of the bladder, obstructing the internal urethral orifice resulting in 10 to100 mL of urine remaining in the bladder when its flow has ceased. The balloon port has a universal adapter that accommodates most Luer-lock syringes. Over-inflation of the balloon can cause occlusion of the drainage eyes.

Catheter eyelets: There are two eyelets at the tip end of urinary catheters that may be placed laterally or opposing. Larger size catheters do not necessarily have larger eyelets in proportion, but a catheter used for clearing clots will have much larger eyelets.

Catheter tip: The tip of a catheter can be either straight (Nelaton) or curved (referred to as "Coudé or "Tiemann"). Some catheters, both IC and IUC catheters, have a slightly larger bulb at the tip to assist in negotiation of urethral restrictions. A Coudé (pronounced "coo-DAY") tip can be useful in passage through the prostate gland in men and when negotiating the neck of the bladder in women, allowing easier insertion and reduced irritation. When inserted, the tip should face anteriorly (up) so it passes through the urogenital diaphragm, especially important in a male patient with an enlarged prostate. There are catheters

Table 2.
Catheter Type and Material

Types	Characteristics	Use	Considerations
Rubber/Latex (known as the Nelaton catheter)	• Soft, rounded tip. • Amber latex is most flexible, pliable catheter because it has a high stretch ratio. • Red latex is stiffer and radiopaque for visualization under fluoroscopy. • Uncoated catheter. • Requires lubrication. • Length is usually 32 cm.	• Indwelling and intermittent catheterization.	• Most common reusable catheter material in urologic practice. • Contraindicated in patient with latex allergy. • May be difficult insertion because of its flexibility. • Most susceptible for biofilm and encrustation formation. • Inexpensive.
Polytetrafluoroethylene (PTFE, commonly known as Teflon®)	• Latex catheter coated with Teflon, developed to protect the urethra against latex. • Coating provides a smoother surface. • Absorption of water is reduced due to the Teflon® coating.	• Indwelling catheterization.	• Decreases irritation and encrustations. • Not suitable for latex or Teflon-sensitive patient. • Dwell time for up to 4 weeks.
Polyvinylchloride (PVC)	• Medical grade plastic. • Large internal diameter. • Material stiff but softens at body temperature. • Uncoated catheter. • May require lubrication. • Basic catheter material of many hydrophilic-coated catheters.	• Intermittent catheterization.	• Most common thermoplastic polymer (di-2-ethylhesxyl-phthalate [DHEP]) used in the construction of intermittent catheters, emits toxic fumes (hydrogen chloride) when burned. • Increased concern about use because of patient safety and environmental reasons because of plasticizer material (Witjes et al., 2009). • Can be reused if no hydrophilic coating. • Stiffness may be helpful in patients who have difficulty passing catheters. • Packaged as “single-use” catheters but are reused by many patients. • Inexpensive.
Silicone-coated latex (silicone elastomer)	• Coating is chemically bonded to the inner and outer surface of the latex catheter allowing minimum urethral irritation during insertion. • Elastomer provides “elasticity” and prevents any chemical release from the latex catheter.	• Indwelling catheterization.	• Coating will dissolve over time and latex hypersensitivity may still occur. • Balloon may lose fluid over time. • Monitor for latex allergy. • Should only use short-term.

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Table 2. (continued)
Catheter Type and Material

Types	Characteristics	Use	Considerations
Silicone (100%)	• Synthetic rubber. • Thin-walled with a larger lumen diameter compared to coated catheters. • Catheters used for IC are more flexible while catheters used for IUCs are stiffer. • Biocompatible with low coefficient of friction, low tissue toxicity, and inflammatory response. • Non-allergenic, uncoated catheter. • Repeated folding can cause damage to the catheter.	• Indwelling and intermittent catheterization.	• Hypoallergenic, latex-free. • Superior resistance to kinking than latex catheters (Feneley et al., 2015). • May be preferable to reduce the frequency of obstruction from catheter encrustation in long-term IUC patients where frequent obstruction has been a problem (Gould et al., 2010). • Some ISC patients may have trouble advancing soft silicone IC catheter. • Latex-free, which allows hospitals to ensure a "latex-reduced" environment. • Newer design for IC includes three layers: a soft outer silicone, a stiffer silicone middle layer, and an inner silicone layer, which is pliable. • The balloon of an IUC may lose fluid over time, which can cause the balloon to form a crease or cuff on deflation compared to latex IUCs, especially when used suprapubically. • IUC may "fall out" if balloon loses fluid.
Plastic-polyether block amide (polyolefin-based elastomer (POBE), polyurethane tube material	• PVC-free plastic. • Durable and flexible but maintains some strength. • Resistant to chemicals. • More biocompatible than PVC.	• Intermittent catheterization.	• Softer and pliable during insertion. • Lower environmental impact.

Sources: Adapted from Goetz et al., 2018, pp. 55-56; Newman, 2017, p. 443; Newman et al., 2018, pp. 6-7.

available used by patients performing intermittent self-catheterization (ISC) that have an introducer tip that bypasses the part of the urethra that is colonized with bacteria during insertion.

Catheter length: Standard length for most urinary catheters is 40 to 45 cm, and shorter length (20 to 25 cm) female IUCs are available but are not routinely used in the United States. Shorter length catheters are often used by women performing ISC.

All urinary catheters are packaged as "single-use" devices, and manufacturer guidelines recommend the catheter is discarded after use, although some patients performing ISC reuse the same catheters for multiple catheterizations. Catheter differentiation is by material and coatings, properties that may be of importance when it comes to catheter-associated urinary tract infections (CAUTIs), urethral complications, patient satisfaction, and preference. Catheter material and coatings are used for different types of catheters and are manufactured from latex, rubber, silicone, or polyvinylchloride (PVC). Catheter material or type influences rigidity. There are several types of catheter coatings (e.g., silver alloy, hydrophilic) that differ between those used for indwelling or intermittently. Catheters coated with antibiotics are no longer available. There are a variety of catheters available to men and women who are performing ISC. These catheters may be compact, standard uncoated, hydrophilic-coated, gel-coated, have sleeved protectors and/or bags, part of closed systems, or kits (see "Teaching Tools: Intermittent Self-Catheterization (ISC) Patient Education Checklist"). Selection of a catheter is dependent on availability, cost, and patient/caregiver preference. Tables 1-3 provide descriptions, characteristics, and considerations of currently available urinary catheters. ◉

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Table 3.
Catheter Coatings

Types	Characteristics	Use	Considerations
Non-coated (uncoated)	• Most commonly used catheter. • Made of medical-grade plastic (di-2-ethylhexyl phthalate [DEHP]) or silicone. • Available in ranges of stiffness. • Requires separate external gel for lubrication.	• Intermittent catheterization.	• May cause a more traumatic insertion, leading to urethral irritation, discomfort, increased bacteriuria and long-term complications. • Lubricant may be packaged with the catheter. • Often used in hospital catheter sets. • If reused for multiple catheterizations, concern over method for cleaning and storing as no consensus on most effective method. • Least expensive.
Hydrophilic coating (HC)	• PVC material with surface polymer coating of polyvinylpyrrolidone (PVP) or sodium chloride (NaCl) crystal that when activated, water or saline binds to the catheter surface for hydrophilic coating. • NaCl crystals act to enhance water-binding ability by increasing osmolality. • Self-lubricating coating ensures lubrication of the entire urethra during the catheter insertion and withdrawal, reducing the coefficient of friction by at least 95%. • Single use only.	• Intermittent catheterization.	• Most preferred catheter for IC. • Different types: 1) surface hydrated and ready to use when opened, 2) surface not activated but includes a sachet of sterile water that activates the coating when pressed or 3) surface activated when water added by user. • Handling difficulties due to the slippery surface and fluid splashing can occur when opening. • May have an introducer tip. • May have an insertion aid (sleeve or finger grip). • Discomfort on withdrawal if the IC process is prolonged, due to the urethral wall absorbing fluid from the coating, leading to the catheter sticking to the wall. • Those with a plastic sleeve or grip provides ease for the patient to grasp and manipulate for insertion while maintaining touchless technique. • May need documentation as to medical necessity to be covered by patient's medical insurance.

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Table 3. (continued)
Catheter Coatings

Types	Characteristics	Use	Considerations
Hydrogel-coated "Lubricath" latex	• Polymer absorbs secretions from the urethra increasing biocompatibility, causing the catheter to soften. • Produces a slippery (lubricious) outside surface that reduces friction and protects urethra from tissue damage. • Resists encrustation and bacteria colonization.	• Indwelling catheterization.	• Popular acute care IUC. • Consider for long-term IUC use as may be better tolerated and less encrustations. • May be more comfortable than other coated catheters. • Because these are latex modified with hydrogel, allergy remains a concern. • Dwell time for up to 12 weeks.
Silicone elastomer coated catheters/ latex silicone coated	• Outer 100% silicone coating. • Hydrophobic material that rejects moisture. • Provides a smooth surface, decreasing urethral irritation during insertion and protection from latex surface. • Permanent coating.	• Indwelling catheterization.	• More comfortable than other coated IUCs. • Reduces encrustation. • Not suitable for latex sensitive patient. • Dwell time for up to three months.
Pre-lubricated or gel-coated	• Pre-lubricated gel reservoir catheters are available. • Non-hydrophilic in nature. • Usually packaged with a gel lubricant or have a pocket of gel reservoir at the tip that lubricates the catheter as it is passed. • Pre-lubricated intermittent catheter kit (closed system) with an attached collection bag. • Some include an introducer tip that contains gel. • Used by nurses for sterile insertion in hospitals. • Single use only.	• Intermittent catheterization.	• Catheter self-lubrication may reduce risk of bacterial contamination from separate lubrication application. • Can be difficult if limited hand dexterity, especially with those systems that require advancing catheter through gel tip. • Closed system allows user to catheterize without touching the catheter.
Silver-alloy/ hydrogel-coated	• Combination of noble metals and hydrogel coats both the inside and outside surfaces of the catheter, allowing a slow release of silver ions which prevent bacteria bonding to the surface of the catheter. • Available in both silicone and latex silver hydrogel-coated catheters. • Minimizes biofilm and encrustation formation through release of silver ions, which prevent bacteria from settling on the surface.	• Indwelling catheterization.	• Reduce and delay the incidence and onset of biofilm formation if used short-term (< 7 days). • Have a low risk for generating antibiotic resistance. • More expensive than other catheters. • A 2014 Cochrane group review (Lam et al., 2014) of patients with IUCs in-situ short-term (<10 days) concluded silver alloy catheters prevented asymptomatic bacteriuria. • Dwell time for up to 12 weeks.

Sources: Adapted from Goetz et al., 2018, pp. 55-56; Newman 2017, p. 443; Newman et al., 2018, pp. 6-7.

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