Reducing the risk of catheter-related urinary tract infection

Linda Nazarko

Abstract

Primum non nocere **(first do no harm) is the ancient Latin phrase that reminds nurses that first principle of healthcare is not to harm those entrusted to our care. Yet, common healthcare interventions, such as urinary catheterization, have the potential to do patients great harm. The patient may even pay with his or her life if a urinary catheter is inserted without clinical indications or if the nurse fails to do his or her utmost to protect the patient from infection. Urinary tract infection (UTI) is the most common of healthcare-related infection. UTI in hospital inpatients normally occurs in people who have a urinary catheter inserted. Urinary catheterization is common and although the risks of catheter-associated UTI are small, the consequences or catheter-associated UTI can be life threatening. Urinary catheterization increases morbidity by a factor of three. Restricting catheterization to those who clinically require this invasive procedure can reduce the number of people who developed infection and life threatening bacteraemia. The use of silver-coated catheters can reduce the risks of infection. Evidence based practice can further reduce risks of catheterization. It is important that informed consent is obtained prior to catheterization. If a person lacks capacity the clinician must act in the person's best interests.**

Key words: Bacteraemia ■ Continence ■ Evidence-based care ■ Informed consent ■ Infection control ■ Urinary catheters

Indwelling urinary catheters are commonly used in healthcare. Estimates of the percentage of hospital inpatients who have a urinary catheter vary from 26–12% of hospitalized patients (Glynn et al, 1997; Stamm, 1998). Catheterization is fraught with risk (Trew et al, 2005), and is an invasive procedure that is sometimes unjustified or even forgotten when in place (Saint et al, 2005).

Urinary tract infection (UTI) is the most common healthcare-acquired infection (HCAI) and 34.6% of all HCAI are UTIs (Plowman et al, 1999). Most UTIs (80%) are associated with urinary catheterization (Department of Health, 2003), known as catheter-associated urinary tract infections (CAUTI). This article explores how urinary catheterization increases the risks of infection and to minimize those risks by minimizing catheterization and using evidence-based practice to select appropriate short-term catheters and facilitate early removal of catheters.

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Infection

HCAI claims the lives of 5000 people every year (National Audit Office, 2004). Although the latest research indicates that number of HCAI are falling, much more needs to be done to reduce infection risks (Hospital Infection Society, 2006). UTIs have human, financial and healthcare consequences, including death, a delay in recovery, increased healthcare costs and increased antibiotic resistance.

Death

Hospital-acquired UTI can cost lives. An estimated 2–6% of people with catheters will develop a UTI (Pellowe and Pratt, 2004), which can lead to bacteria in the blood stream that can be revealed by blood culture and microscopy (bacteraemia). An estimated 1–4% of people with UTI develop bacteraemia. This can be a life-threatening infection and 13–30% of people with catheter-associated bacteraemia will not survive (Stamm, 1998). If this is applied to the findings of the Public Health Laboratory Service (PHLS, 2002) survey of English acute hospitals, it indicates that CAUTIs lead to between 487 and 1116 deaths in England per year.

Delays in recovery and increased healthcare costs

Infection delays recovery, and the person who develops an infection will remain in hospital for longer than a person who does. Each hospital-acquired UTI adds £1327 to the cost of hospitalization, and the NHS spends £126 million pounds a year on treating these infections (Plowman et al, 1999).

Increased antibiotic resistance

When a person develops a UTI the infection is treated with antibiotics. Antibiotics are unique in that unlike other medicines their efficacy is affected by how they have been used to treat other people. Antibiotics can, by killing-non resistant bacteria, lead to the growth of resistant bacteria. When bacteria that are sensitive to antibiotics have been eliminated, resistant species may proliferate, such as *Clostridium difficile*, which is often kept in check by other bacteria in the bowel. When these bacteria have been eliminated, *C.diff* numbers can explode and an infection can occur (Nazarko, 2008). Prescribers must balance the need to treat infections with the need to reduce antibiotic prescribing to contain or reduce antibiotic resistance (Health Protection Agency, 2008).

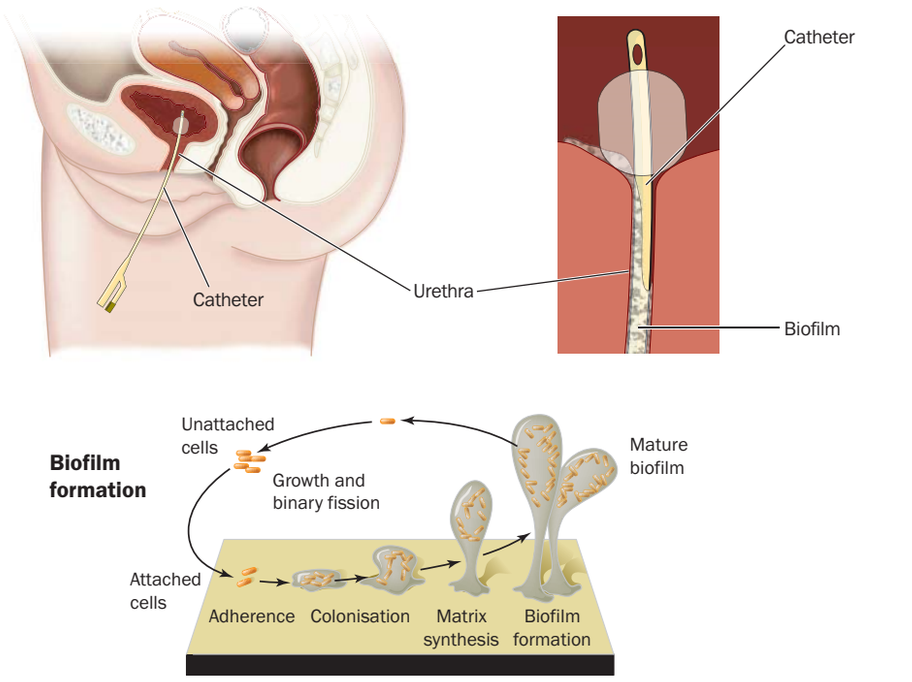
Why does catheterization increase the risk of urinary tact infection?

The urinary tract is normally protected from infection because it fills with acidic urine and urine acidity and the flushing mechanism prevents bacteria adhering to the urinary tract (Nazarko, 2008). Inserting a urinary catheter provides a portal of entry for bacteria. Bacteria can enter the

bladder during catheter insertion, through the catheter lumen and along the catheter urethral interface (Salgado et al, 2003). In hospital the bladder becomes colonized with bacteria within 7 days of catheter insertion. An estimated 2–6% of people with catheters will develop a UTI (Pellowe and Pratt, 2004), and infection rates are related to the number of days the catheter remains in place (Nicolle, 2005).

Bacteria colonize the surface of the catheter and drainage equipment, known as a biofilm. This biofilm (*Figure 1*) makes infections more difficult to treat because the biofilm protects bacteria from antibiotics (Trautner and Darouiche, 2004).

Figure 1. Formation of a biofilm on the surface of a catheter.



What can be done to reduce risks?

The epic project guidelines for preventing healthcare associated infections (Pratt et al, 2001) recommend four interventions related to reducing urinary catheter-associated infection:

- Assessing the need for catheterization
- Selecting the catheter type
- Aseptic catheter insertion
- Catheter maintenance.

In 2007, Pratt et al added a further recommendation – educating staff and patients – as part of the epic2 guidelines for preventing healthcare-associated infections in NHS hospitals in England.

Assessing the need for catheterization

It is difficult to obtain accurate information about the number of hospital inpatients who have a urinary catheter. Estimates vary from 12–26% of hospitalized patients (Glynn et al, 1997; Stamm, 1998). The prevalence of urinary catheterization varies by specialty and patients cared for on medical and geriatric wards are most likely to have a urinary catheter.

Research and anecdotal evidence suggests that urinary catheters are overused. Holroyd-Leduc et al (2007) found that 14% of older people with urinary catheters did not have any clinical indications for catheterization. Inappropriate catheterization was found to increase length of hospital stay also mortality rates.

Urinary catheters may be inserted ritualistically when patients enter accident and emergency (A&E) departments and medical assessment units. Gardam et al (1998) found that 50% of catheters inserted in A&E were inappropriately inserted without clinical indications. They may be inserted because patients are incontinent of urine (Brennan and Evans, 2001); however, inserting a urinary catheter when a person is unwell may deprive the individual of the opportunity to regain continence.

Urinary catheters should be the method of last resort in management of incontinence. Catheters may be inserted when a patient is having specific types of surgery, such as repair of hip fractures. Surgery to repair hip fractures can disrupt the nerve pathways that control bladder emptying and some people who have hip surgery may experience voiding difficulties postoperatively.

As clinicians are becoming more aware of the hazards of catheterization, practice is changing. In Sweden, staff concerned about the high number of UTIs in older people catheterized when having surgical repair of hip fractures decided not to routinely catheterize such patients. People who were unable to void postoperatively were treated with intermittent catheterization, which lead to a significant reduction in the number of UTIs (Johansson et al, 2002).

Avoiding routine use of catheters postoperatively ensures that only people who need catheterization are exposed to the risks of catheterization (Niël-Weise and van den Broek, 2005). If clinicians are to reduce infection risks it is essential to ensure that indwelling urinary catheters are only used when clinically indicated. *Table 1* outlines clinical indications.

Documentation of the reasons for catheterization and plans for ongoing care is often poor. Brennan and Evans (2001) recommend that staff document the reason why the catheter has been inserted, record the type of catheter used, and plan appropriate care and removal. *Table 2* summarises these recommendations.

Although there are risks associated with urinary catheterization, documentation seldom states that patients have given informed consent to catheterization (Conybeare et al, 2002). When the person has capacity he or she should be given sufficient information to make an informed decision about accepting or declining catheterization. If a person lacks

Table 1. Indications for urinary catheterization

- Monitoring urine output
- Postoperatively, i.e. operation on bladder or prostate
- Neurological bladder failure i.e. multiple sclerosis, spinal injuries
- Relief of urinary obstruction
- Postoperative care after spinal anaesthesia
- Urodynamic or X-ray intervention
- Chemotherapy intervention
- As a comfort measure in palliative care in the last stages of life
- To manage urinary incontinence when other methods have failed

Adapted from: Pomfret (2000)

Table 2. Documentation to improve catheter care

- Why the catheter is necessary
- Whose decision was it to insert the catheter?
- Who performed the catheterization?
- Who is responsible for planning catheter care?
- Who is responsible for ensuring that appropriate care has been given?
- Plan for the catheter to be removed (unless long-term catheterization is appropriate)
- The size and make of catheter
- The manufacturer's code number (this should be recorded in the patient's notes to allow faulty equipment to be traced)
- Any problems associated with the catheter

Adapted from: Brennan and Evans (2001)

capacity clinicians must act in the person's best interests. In such cases documentation is even more important than when the person has the ability to consent (Nazarko, 2004)

Selecting catheter type

The choice of catheter should be based on clinical experience, patient assessment and anticipated duration of catheterization. The smallest possible gauge catheter should be used. Adults should have a 10 ml balloon. Urology patients may require larger gauge and balloon (Pratt et al, 2007).

Silver-coated catheters

Urinary catheters made of papyrus – a tall, aquatic, Mediterranean sedge – were used by the ancient Egyptians over 2000 years ago to relieve urinary obstruction, and metal catheters have been used since Hippocratic times (Abdel-Halim, 1990). These were usually made from silver and third century writings indicate that our ancestors believed that silver protected from infection (Bloom et al, 1994). In the dark ages Islamic physicians developed straight metal catheters with drainage holes. These were made of gold, silver and copper as these were considered to reduce infection risks (Abdel-Halim, 2005).

Until the 19th century urinary catheters were not retained in the bladder – they were passed, urine was drained and the catheter was removed. Top hats often had straps inside so that wearers could store their silver urinary catheters. In the mid-19th century the process of manufacturing rubber (latex) was perfected and rubber catheters began to replace metal ones. Rubber catheters were more flexible and comfortable than metal catheters, and balloons made from animal gut were developed and these held catheters in place. In 1930s, Frederick Foley developed catheters with rubber balloons – the indwelling urinary catheter known as the Foley catheter was born.

In the late 20th century awareness of growing infection risks led to the development of indwelling urinary catheters with a silver coating. On many catheters on the market, the inner and outer surfaces of the catheter are coated with a combination of silver and hydrogels (*Figure 2*). This coating slowly releases silver ions into the hydrogel, which dramatically reduces the number of bacteria colonizing the catheter surface, preventing the development of a biofilm. Preventing bacteria from adhering to the surface of the catheter and forming a biofilm reduces the level of bacteriuria (Niël-Weise and van den Broek, 2005), which in turn reduces the risk of CAUTI. It also means that if a CAUTI develops it is easier to treat because bacteria do not have the protection of a biofilm. Silver alloy-coated catheters may also reduce the risk of catheter blockage (Ahearn et al, 2000).

A recent cochrane review examined the evidence for silver-alloy coated catheters and found that they reduced infection rates significantly when catheters remained *in situ* for less than 7 days, although they were less effective when used for longer than 1 week (Schumm and Lam, 2008). Silver-alloy coated catheters are not commonly used for short-term catheterization because they are much more expensive than standard catheters; however, using standard catheters may be a false economy. Researchers have found that using silver-alloy coated catheters is cost-effective when the costs of infection are taken into account (Gentry and Cope, 2005; Seymour, 2006). Roodhouse (2004) found that using silver-alloy coated catheters instead of standard catheters reduced the incidence of UTI by 60.6% in an acute hospital.

Clinicians have two concerns regarding the use of silver-alloy catheters. The first is that bacteria will become resistant to silver; however, silver has been used for thousands of years, yet resistance has not developed (Rupp et al, 2004). This might be because silver acts on two levels: to prevent bacteria adhering to the catheter and by killing bacteria. When bacteria are unable to adhere they can not form a biofilm and multiply in the same way as they could in an ordinary catheter. And while silver also kills bacteria, the mode of action is not fully understood.

The second concern is that silver will prove toxic to the person. There are two reasons why silver toxicity is unlikely to develop: silver-alloy catheters are designed so that the silver is released slowly and catheters used in acute hospitals are used for short periods, usually days rather than weeks. Silver-alloy catheters must be changed every 28 days and are normally used only in people who require short-term catheterization. Estores et al (2008) used silver-alloy catheters for 6 months in an effort to prevent CAUTI in a patient with neurogenic

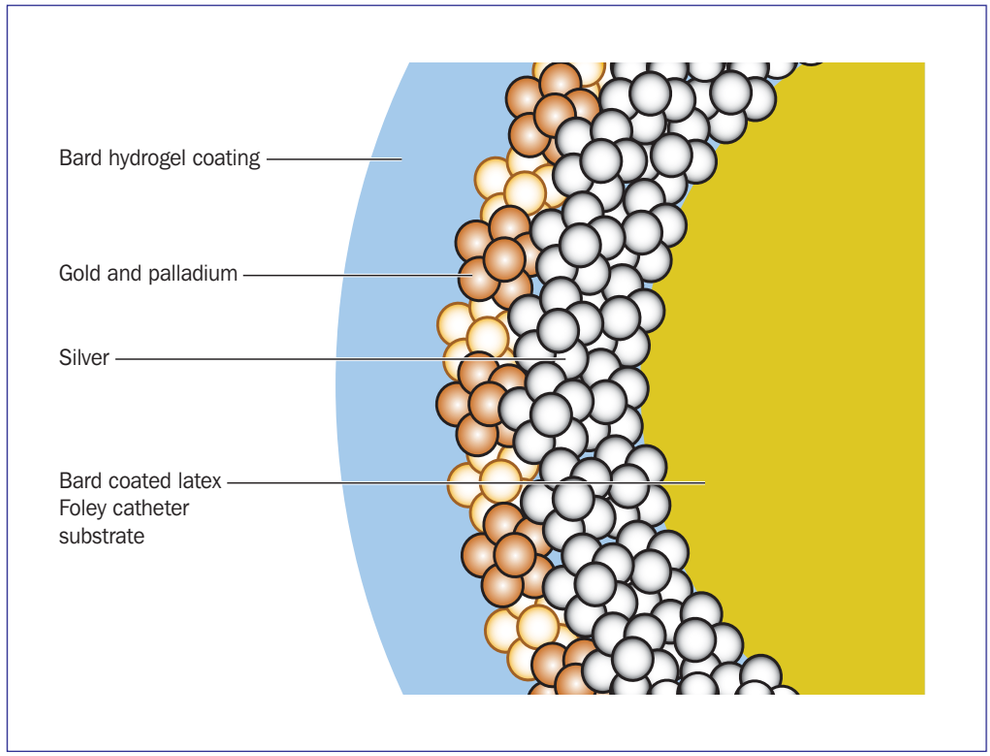
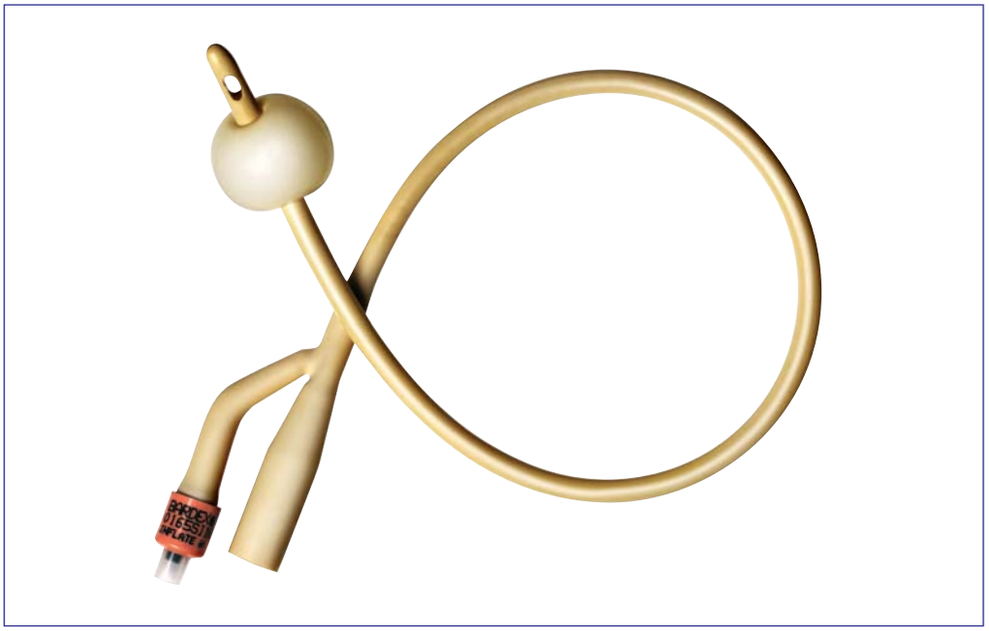


Figure 2. The silver-alloy and hydrogel coating of the Bardex IC Foley catheter.

bladder dysfunction. They found that silver alloy catheters prevented infection. The patient did not display any increased blood serum levels of silver or any signs of silver toxicity. The authors recommend further trials on the effectiveness of silver alloy-catheters in people who require long-term catheterization.

Two silver-coated catheters are available on drug tariff: the Dover™ silver 100% silicone Foley catheter from Covidien (Hampshire, UK), which uses silver phosphate, and the Bardex® IC anti-infective latex Foley catheter from Bard (West Sussex, UK), which uses silver alloy. The Bardex® IC has a unique coating consisting of Bacti-Guard® silver alloy and Bard hydrogel, including gold and palladium (*Figure 2*). This coating ensures that the silver is released slowly; such slow release mechanisms prevents bacteria from settling on the catheter, forming a biofilm and growing (Curtins and Perry, 2006).

Figure 3. The 2-way Bardex IC Foley catheter.



Aseptic catheter insertion

Urinary catheterization is an aseptic procedure and should be performed by staff who are trained and competent to carry it out (Pratt et al, 2007). The urethral meatus should be cleaned with sterile normal saline and an appropriate lubricant, such as Instillagel® (CliniMed, Buckinghamshire), a sterile gel containing a local anaesthetic and antiseptic, used to minimize the risks of urethral trauma and infection.

Catheter drainage systems

Indwelling urethral catheters must be connected to a sterile closed urinary drainage system. The connection between the drainage system should not be broken except for good clinical reasons such as changing the drainage bag. Clean hands and wear a new pair of clean, non-sterile gloves before handling a patient's catheter and clean hands after removing gloves (Pratt et al, 2007).

Catheter maintenance or management can prevent infection and other complications of catheterization. The urinary drainage bag should be placed below the level of the bladder as urine can not drain uphill. A leg bag or stand should be used to prevent the drainage bag from coming in contact with the floor. The urine drainage bag should be emptied frequently enough to maintain urine flow and prevent reflux. Heavy overfull drainage bags, or inadequately supported drainage bags, can also cause pressure damage on the bladder wall. It is important to ensure that catheter bags are emptied before they become overfull. A separate clean container should be used for each patient. Routine daily personal hygiene is all that is needed to maintain meatal hygiene.

Bladder irrigation, instillation or washouts should not be used in an effort to prevent catheter-associated infection (Pratt et al, 2007). Staff and patients should be educated so that the risks of infection and other complications are reduced.

Planned removal

The need for continued catheterization should be reviewed regularly for all patients as the risk of developing complications is related to duration of catheterization (Getliffe, 1994). If the indication for catheterization is no longer relevant the catheter should be removed as sometimes catheters can be forgotten. Setting up systems to remind clinicians to review the need for catheters leads to urinary catheters being removed earlier and to a fall in infection rates (Saint et al, 2005; Apisarnthanarak et al, 2007). Urinary catheterization should be avoided, whenever possible, in patients who are incontinent of faeces as contamination of the catheter with faeces may predispose the patient to UTI.

Conclusion

Urinary catheters have become common place in 21st century hospitals and may even be considered a normal part of healthcare. It is important to remember that they are invasive devices that increase the risks of infection. If clinicians are to meet their obligation to do no harm to patients they should ensure that urinary catheters are only used when there are clear clinical indications. It is important that information about the indications, review dates and catheter care are clearly documented and reviewed. If catheterization is clinically indicated, staff must use evidence-based practice to reduce risks of complications. Evidence suggests that using silver-alloy urinary catheters, such as the Bardex® IC Foley catheter, reduces the risk of infection when short-term catheterization is indicated.

If clinicians are to work in partnership with patients they must ensure that they inform patients about the benefits and potential harms of this procedure. The person can then make an informed choice about consenting to urinary catheterization. If the person does not have capacity to make a decision about catheterization, staff should act in the person's best interests. It is important that such information is documented. BJN

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KEY POINTS

- The frist principle of health care is to not to harm those entrusted to our care.
- Urinary tract infection (UTI) is the most common healthcare-acquired infection.
- Eighty per cent of UTI are associated with urinary catheterization.
- UTI can increase the risk of death, delay recovery, increase healthcare costs and increase antibiotic resistance.
- The person must give informed consent to catheterization whenever capacity is present.
- If the person lacks capacity the clinician must act in the person's best interests.