Best practices for the treatment and prevention of urinary tract infection in the spinal cord injured population: The Alberta context

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Abstract

The purpose of this review of clinical guidelines and best practices literature is to suggest prevention options and a treatment approach for intermittent catheter users that will minimize urinary tract infections (UTI). Recommendations are based both on evidence in the literature and an understanding of what is currently attainable within the Alberta context. This is done through collaboration between both major tertiary care centres (Edmonton and Calgary) and between various professionals who regularly encounter these patients, including nurses, physiatrists and urologists.

Bladder management in the context of a spinal cord injury

A pervasive issue in most neurologic diseases (Parkinson’s disease, multiple sclerosis, diabetes, stroke and spinal cord injury [SCI]) is bladder dysfunction (neurogenic bladder) or neurogenic lower urinary tract dysfunction (NLUTD). These dysfunctions result in symptoms of urgency, increased daytime and nighttime frequency, urinary retention, incontinence and urinary tract infection (UTI). Treatment involves non-invasive continence management through toileting, fluid management, containment products, medications and intermittent catheterization. UTIs have substantial negative physical and psychological effects and are a major burden on the health care system. Frequent UTI in the SCI population is defined clinically as 3 or more infections per year where both symptoms of infection and a positive urine culture are present. Despite the variety of treatment approaches to emptying the neurogenic bladder, UTI remains a complex and challenging clinical problem.

Intermittent catheterization (IC) is recognized as the gold standard for treating voiding disorders associated with the neurogenic bladder.1,2 Self IC is the preferred method of bladder emptying because it minimizes the risk of infection and decreases the risk of calcium phosphate and struvite stone formation.2 Intermittent catheterization involves the use of a short (15 to 40 cm) flexible catheter which is inserted up the urethra into the bladder to drain urine. IC has contributed to increased life expectancy of people with SCI. This was realized with the introduction of clean intermittent catheterization (CIC), which was simpler, faster and less costly than the original sterile method; people with SCI can benefit from CIC.1

Clarity is often lacking in the literature regarding which type of IC technique is being used by study participants. In this article, CIC refers to a method of catheterization where the hands and urethral area are cleaned with soap and the catheter is either washed or newly removed from sterile packaging. In sterile IC the urethral area is cleaned with an antiseptic. Sterile gloves are worn and a sterile field is maintained. A sterile single-use all-in-one collection device may or may not be used as part of this technique after cleaning the urethral area.

In Alberta, an individual’s choice of sterile or clean method depends on a number of factors, one of which is the availability of funding to purchase the products. See Fig. 1a, Fig. 1b for an assessment and treatment approach to urinary tract infection that is supported by current evidence and clinical best practice in Alberta. Alberta Aids to Daily Living (AADL) is a provincially funded program that provides financial assistance to Albertans with a long-term disability, chronic illness or terminal illness to buy medical equipment and supplies. AADL covers the cost of one sterile polyvinyl chloride (PVC) type catheter per day. Users are directed to wash the catheter and store it for up to 4 subsequent
catheterizations. Individuals with SCI and some healthcare professionals have raised questions about whether the risk of UTI is increased when catheters are reused.

The purpose of this review of clinical guidelines and best practices literature is to suggest prevention options and a treatment approach for intermittent catheter users that will minimize UTI. Recommendations are based on evidence in the literature and an understanding of what is currently attainable within the Alberta context, through collaboration between both major tertiary care centres (Edmonton and Calgary) and between various professionals who regularly encounter these patients, including nurses, physiatrists and urologists. Key references used to prepare this document included Canadian sources, such as SCIRE (Spinal Cord Injury Rehabilitation Evidence), along with the American Urological Association (AUA) and European Urological Association (EUA) documents on the topic and resources from Paralyzed Veterans of America. Currently, there are no documents on neurogenic bladder management with the Canadian Urological Association (see Table 1 for more resources). Finally, the impetus for preparing these protocols arose due to concerns identified by a survey of individuals with SCI regarding perceived gaps in knowledge and practice among caregivers and physicians about SCI and UTI prevention and management.

What constitutes UTI in the spinal cord injured population?

In the young able-bodied adult with a UTI, protocols for treatment and follow-up are well-documented. However, for those with a neurogenic bladder, diagnosis and follow-up procedures are complicated by the presence of comorbid conditions, decreased pain sensation or other potential sources of infection. A key message is that asymptomatic bacteriuria is not a disease and that the presence of bacteria in the urine is not unusual in the intermittent catheter user. Bacteriuria may be a sign of poor hydration or infrequent voiding (catheterizing) and can often be addressed by changing voiding (catheterizing) and can often be addressed by changing

UTI is defined by the presence of physical symptoms and high amounts of bacteria in the urine. Neither urine odour nor the presence of pyuria (i.e., pus, white blood cells or leukocytes) indicates a sufficient volume of harmful bacteria to constitute an infection. Individuals can be free of symptoms despite high levels of bacteria in the urine.

A treatable level of infection requires one or more of the following physical symptoms: new onset or worsening of fever, rigors; altered mental status; malaise or lethargy with no other identified cause; acute hematuria; pelvic discomfort; discomfort or pain over the kidney or bladder or during urination; development of, or increase of urinary incontinence; increased frequency of catheterization/voiding; increased spasticity; autonomic dysreflexia; and a sense of unease. It has been shown that 60% of individuals using IC to empty their bladders are chronically colonized (that is, they have a significant quantity of bacteria in their urine), however, without the physical symptoms to accompany positive urinalysis, they are considered “asymptomatic” and are not candidates for antibiotics.4

Where one or more of the above-mentioned symptoms exist, the urine should be tested by microscope (microscopy), urine dip (macroscopy) and by a culture and sensitivity (C&S) test. Numbers of bacteria are reported in colony forming units per litre (cfu/L). Urine cultures show the type and number of bacteria. Sensitivity indicates to which antibiotic the bacteria are “sensitive.”

Tests for bacteria or pyuria do not establish a diagnosis of UTI, but are important aspects of the diagnosis when symptoms are present. Both the SCIRE and the Scottish Intercollegiate Guidelines Network (SIGN) indicate that ≥10⁷ (cfu/L) represents significant bacteriuria and that antibiotics should be considered when symptoms are present. However, both groups note that false positive tests can occur depending on the method of urine sample collection. The only sample that should be considered for urinalysis is one that is collected with a new, sterile catheter, drained into a sterile container and taken to the laboratory immediately. When these conditions are met, SCIRE suggests that ≥10⁸ cfu/L in an intermittent catheter specimen represents sufficient bacteriuria to consider antibiotic treatment (with symptoms present). In clean-voided specimens from catheter-free men using condom catheters, ≥10⁷ (cfu/L) is a sufficient level.

Table 1. Additional resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Website/Link</th>
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<tr>
<td>American Urological Association (AUA)</td>
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<td>European Urological Association (EUA)</td>
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<td>Paralyzed Veterans of America</td>
<td><a href="http://www.pva.org/site/c.ajIRK9NJLcJ2E/b.6305401/k.BCBB/Home.htm">http://www.pva.org/site/c.ajIRK9NJLcJ2E/b.6305401/k.BCBB/Home.htm</a></td>
</tr>
<tr>
<td>Geneva Foundation for Medical Education and Research</td>
<td><a href="http://www.gfmer.ch/Guidelines/Urinary_tract_infections">http://www.gfmer.ch/Guidelines/Urinary_tract_infections</a>_</td>
</tr>
<tr>
<td>Spinal Cord Connections and SCI University</td>
<td><a href="http://www.spinalcordconnections.ca/default.aspx">http://www.spinalcordconnections.ca/default.aspx</a></td>
</tr>
<tr>
<td>The Canadian Paraplegic Association (Alberta)</td>
<td><a href="http://www.cpa-ab.org">http://www.cpa-ab.org</a></td>
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<tr>
<td>- Brochure: Bladder health for intermittent catheterization users</td>
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<tr>
<td>- Brochure: Treating frequent urinary tract infections: for intermittent</td>
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<td>catheterization users</td>
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Community RN
- Review history and symptoms of UTI (see text box below)
- Take patient in and out record over 3 days (frequency, and volumes including one weekend day)
- Review of bowels (constipation and hygiene)
- Review catheterization technique and hygiene
- Assess size and type of catheter
- Assess post void residual if patient usually voids (target less than 100 ml)

Primary Care Physician
- Review history and symptoms of UTI (see text box below)
- Order C&S and urinalysis
- Request renal ultrasound if not performed in previous 12 months
- Differential, vaginitis, prostatitis, epididymitis, chlamydial infection

Immediate cross referral

Does patient require changes to method, type of catheter, or catheterizing practices?

NO

No special follow-up.

NO

Is there evidence of UTI? (> 105 cfu/L with symptoms present in persons using inter-mittent catheterization)

YES

STEP A

Patient presents with suspected UTI

Initiate patient teaching:
- Try different products/technique
- Hygiene
- Hydration
- Frequency
- Bowel care

Two week follow-up with primary care physician (even in the absence of symptoms).

YES

Are there symptoms of recurring UTI?

NO

No special follow-up.

NO

Does patient require changes to method, type of catheter, or catheterizing practices?

YES

Referral to urologist or physiatrist.

Referral to nurse specialist.

Repeat urinalysis and C&S.

**Symptoms of UTI**

UTI warrants antibiotic treatment when a positive dipstick/urine culture is obtained AND the patient presents with any three of the following symptoms, lasting 24 hours or longer.

- fever
- chills
- delirium or confusion
- malaise/lethargy
- back or side pain above the pelvis and below the ribs
- blood in urine
- pelvic discomfort
- increased spasticity
- autonomic dysreflexia
- the need to catheterize more frequently
- increased or new incontinence

**WARNING:** In the absence of symptoms, urine odor and pyuria are not indicators of UTI.

* Recurrent UTI is defined clinically as three or more UTIs per year and should be treated as complicated infections. In this case, antibiotic treatment for a course less than 7 days is not recommended.

**Fig. 1a:** A flow diagram of evidence-based assessment and treatment in the Alberta context. UTI: urinary tract infection.
Treatment and prevention of UTI in spinal cord injury patients

**Urology Investigations:**
- Cystoscopy
- Review bladder and kidney ultrasound results
- Perform and analyze urodynamic studies
- Analyze post void residual
- Catheter type/size assessment
- Treat urethral trauma
- Treat elevated bladder pressure, reflux and small capacity bladder
- Oral medications
- Botox
- Surgery if indicated

**Physiatry Investigations:**
- Assess and adjust bowel routine
- Treat for incontinence
- Adjust bladder management drugs
- Assess impact of transfers, seating and positioning on self-catheterization

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**Potential findings at the specialist level and their common solutions:**

**High post void residual**
- => medication adjustment
- => change in bladder routine

**Bladder stones**
- => surgical removal by urologist

**Small capacity / high pressure bladder**
- => may be treated by a change in bladder routine, medication, Onabotulinum toxin (Botox) injections, or surgery

**Resistant bacteria**
- => consult general medicine/urologist/physiatrist; medication changes

Treatment should be proceeded by a three-month follow-up by the relevant specialist.
If symptoms of UTI recur, patient should visit their primary care physician.
If symptoms do not recur, patient should continue with regularly scheduled follow-up by primary care provider, and/or urologist and/or physiatrist.

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**Fig. 1b.** Current treatments for recurring bladder infections: Information for individuals with neurogenic bladder due to spinal cord injury or other causes. UTI: urinary tract infection.
How should UTI be treated in the SCI population?

Treatment with antibiotics is initiated on the basis of a positive urine C&S and the presence of clinical symptoms as described above. It is generally understood that treating asymptomatic colonization of the urine with antibiotics does not benefit the patient, except in patients with urea-splitting bacteria (e.g., proteus), which can help to prevent bladder calculi (bladder stones).

Which antibiotics should be considered?

The oral drugs often recommended, depending on bacterial sensitivity, are ciprofloxacin or ofloxacin administered over either a 3- or 7-day treatment regimen. In clinical practice, a 7-day treatment course is often used due to the complex and recurrent nature of the UTI in those with NLUTD. (Recurrent UTI is defined clinically as 3 or more UTIs per year and should be treated as a complicated infection. In this case, antibiotic treatment for a course less than 7 days is not recommended.) Ciprofloxacin has also been studied in this population with a 14-day administration period with some indications of a reduced re-infection rate. Ofloxacin has higher bladder bacterial biofilm eradication rates than trimethoprim-sulfamethoxazole.

In Alberta, resistant patterns for all of these antibiotics are becoming increasingly common. Norfloxacin places an individual at risk for subsequent bacterial resistance and
individuals need to be monitored. High rates of bacterial resistance in Alberta to both amoxicillin and trimethoprim-sulfamethoxazole make them poor first-line choices. Amoxicillin in combination with clavulanic acid, however, is a reasonable choice, as the potassium clavulanate imparts increased efficacy and lower resistance rates.

In certain cases where quinolone drugs cannot be used and/or resistant organisms are present, cephalosporins, such as cephalaxin (first generation) and cefuroxime (second generation) may be used. Nitrofurantoin is acceptable for simple bladder infections, however it is not recommended for more serious deep tissue infections, like prostatitis or pyelonephritis, because it is exclusively excreted in the urine with no tissue penetration. For complex UTI, aminoglycoside antibiotics may be administered intravenously. Occasionally, intermittent bladder irrigation with neomycin/polymyxin has been used, but the evidence to support this practice is weak.

What is the relationship between type and method of catheterization and UTI?

Three types of intermittent catheter products are available for CIC: standard PVC catheters (pre-lubricated or not); single-use hydrophilic-coated catheters; and all-in-one urine collection systems (which may be pre-lubricated or hydrophilic-coated). Of these three types, only the standard PVC catheters can be reused after being washed thoroughly with soap and water. Hydrophilic-coated and catheters with an attached urine collection system may only be used once and then discarded.

There is some recent evidence involving hospitalized individuals. In these patients, it was found that UTIs are lower and antibiotic treatment is reduced when single-use pre-lubricated or hydrophilic catheters are used as compared to single-use sterile non-hydrophilic catheters. Prelubricated catheters may have the added benefit of reducing the urethral microtrauma compared to PVC catheters; however, the clinical relevance of this finding is unclear, particularly for community dwelling (i.e., not hospitalized) individuals who independently perform self-catheterization.

Social and environmental factors play a role in UTI, as does choice of catheter. For example, the method and type of catheterization must be matched to patients’ ability to maintain cleanliness and to their access to facilities that enable them to catheterize frequently and in a sanitary manner. Financial resources also play a role. For individuals with limited access to wheelchair accessible bathroom facilities and running water throughout the day, single-use catheters may be more appropriate.

The current literature and the most recent Cochrane systematic review indicate that there is inadequate evidence to state with certainty that sterile single-use IC or sterile hydrophilic-coated catheters are better at reducing UTI than multi-use PVC catheters. According to the Cochrane Review, there are no definitive studies showing the incidence of UTI is improved with any catheter technique, type or strategy. However, the EAU Guidelines state that sterile IC significantly reduces the risk of UTI and/or bacteriuria compared with clean IC. Although Wyndaele is quoted as stating, “Based on the current data, it is not possible to state that one catheter method is better than another and further research on the topic is strongly recommended.” Guttmann is clearly in favour of sterile IC based on in-patient research with the endpoint of urine sterility on discharge from hospital.

It must be noted, however, that until recently, studies on NLUTD were limited by sample size, sample heterogeneity and imprecise outcome measures, particularly with respect to defining UTI. SCIRe also indicates that both sterile (single-use) and clean (multi-use) approaches to IC have similar rates of UTI, but the studies upon which this conclusion is based were conducted primarily with an in-patient rehabilitation population.

At present, there is no gold standard for cleaning reusable PVC catheters for IC, but the practice typically recommended by clinicians in Alberta is to clean them thoroughly with liquid dish soap (i.e., Sunlight, The Sun Products Canada Corporation, Etobicoke, ON), air dry and store them in a clean plastic bag or container. Further randomized controlled trials are desperately needed to provide answers to this important clinical question.

Why should we review product, technique and hygiene with the patient?

A variety of bladder management techniques can reduce UTI risk in community-dwelling persons with SCI, although limited evidence exists as to which approach is the most effective (Table 2). Poor technique includes inadequately cleansing catheters, inadequate perineal hygiene or hand washing, excessively long or too short intervals between catheterization, or the inability to insert the catheter without contaminating it in the process.

If UTIs persist and there is an indication of consistently high bladder volumes (generally in excess of 500 mL), adjust fluid intake and/or increase the frequency of IC. Generally in the NLU TD population, catheterization with a 12 to 14 French catheter is needed 4 to 6 times per day. Less frequent catheterization results in higher bladder-storage volumes and an increased risk of UTI. More frequent catheterizations increase the risk of cross-infection. If the UTIs persist and a consistent catheterization routine (with respect to frequency and technique) and adequate hydration are not possible, a less demanding bladder management technique...
should be considered, such as using a condom catheter with external collection device (ECD) or an indwelling urethral Foley or suprapubic catheter.  

The role of indwelling catheterization

For those with unacceptable infections with CIC or for those who do not have the functional ability to self-catheterize (and do not have access to a caregiver), Foley catheters are first considered as they are easy to insert and care for, and provide exceptional convenience for most individuals. For some, however, urethral erosion or patient preference results in the choice of a suprapubic tube, which is more invasive to insert initially. Also, if a suprapubic tube accidentally falls out without being replaced expeditiously, the tract through the abdominal wall actually closes, necessitating another invasive procedure. In terms of infection risk, the EUA also cautions that indwelling transurethral catheterisation and suprapubic cystostomy are to be avoided because they are risk factors for UTI and have significant long-term complications. On choice of indwelling catheter material, the EUA states that silicone catheters have advantages over latex catheters. Medications to reduce bladder overactivity may also address frequent UTI, with both CIC and indwelling catheterization.

Why are annual evaluations suggested?

The Consortium of Spinal Cord Medicine (CSCM) and the AUA update on urological care in the out-patient NLUTD indicates that best practice is to evaluate the kidneys (upper urinary tract) and bladder (lower urinary tract) in individuals who perform intermittent catheterization. In general, the recommendation is for urodynamic studies (UDS) to be conducted to assess bladder capacity and pressure, bladder and sphincter functioning, and the presence of reflux. Upper urinary tract evaluations include tests that evaluate function (such as nuclear medicine renal scans) and tests that evaluate anatomy (such as ultrasound and computed tomography [CT] scans). Ultrasound scans are frequently used to screen the upper tract because they are not user-dependent, do not have a risk of allergic reactions, do not require bowel prep, and cause much less radiation exposure than a CT scan.

Unfortunately, history, level of injury and signs and symptoms alone are not enough to determine if a person is experiencing high bladder (intravesical) pressures or reflux, which may cause frequent UTI as well as renal complications over time. To evaluate bladder pressures and voiding dynamics, UDS are indicated. UDS may be done with or without video fluoroscopy (video UDS or VUDS). The advantage of video is the ability to simultaneously study function and anatomy, allowing for improved diagnosis of findings, such as vesicoureteral reflux from high pressures, external sphincter dyssynergia and bladder diverticula. UDS should be done during the first year after injury, as well as after any change in bladder management or symptoms.

The lower urinary tract is also assessed by ultrasound to measure residual volumes after voiding or self-catheterization and to highlight any abnormalities of the urinary tract structure, such as thickening of the bladder wall or the presence of diverticula or bladder calculi. Cystoscopy is indicated when a UTI recurs, bladder function has changed, cancer concern arises (e.g., significant haematuria) or if anatomic abnormalities are suggested by imaging. Regular cystoscopy and bladder biopsy are also recommended to screen for malignancy in long-term indwelling catheter users.

If a recurrent UTI develops, the patient needs renal and bladder ultrasound tests and blood work (or have results reviewed from previous tests) to identify significant changes in the structure and function of the urinary tract. Hydration, catheterization technique and hygiene should have already been discussed with the patient; if this is not the case, it is a priority to refer the patient to a home care or a continence clinic to receive this information. If not already done, the patient should also be referred to a urologist or rehabilitation physician.

Are other preventive or adjunctive therapies effective?

Cranberry juice and tablets

It is uncertain if cranberry is effective in preventing UTIs in people with SCI. It is believed that drinking cranberry juice reduces the proliferation of bacteria by acidifying the urine; however there is no agreement on the amount of cranberry juice or tablets required to achieve this effect, or if a single dose or multiple doses are necessary. Routine use of cranberry juice in the concentration required to achieve a clinical effect may be contraindicated in patients prone to obesity or oxalate or uric acid calculi (bladder stones). Cranberry juice is also not recommended in patients on anticoagulation therapy. Although cranberry juice is not for everyone, it is a relatively safe and natural remedy, which might provide symptomatic and therapeutic relief for patients with UTIs or excessive mucus formation and high glomerular filtration rate.

D-mannose

D-mannose is thought to be effective in dislodging E. coli bacteria from the bladder wall and may improve many UTIs caused by this bacterium, including those in individuals with SCI. D-mannose is a naturally occurring sugar that is similar in structure to glucose (a component of table sugar). Because the body metabolizes only small amounts of d-mannose,
and excretes the rest in the urine, it does not interfere with blood-sugar regulation, even in diabetics. D-mannose does not kill any bacteria, but simply helps to displace them. Unfortunately, evidence for the use of d-mannose to treat bacteria in the urine is weak and based on studies in rats which were performed in the 1980s.19

**Vitamin C**

Dietary supplementation with vitamin C is frequently recommended as a way to reduce UTIs by increasing urine acidity; however, there are no clinical studies which demonstrate effectiveness of vitamin C in improving symptoms or UTI incidence.

**Portable bladder scanners**

Portable bladder scanners are a recent development and have been studied as a method of self-monitoring in an attempt to determine self-catheterization frequency.6 Although this approach has promise, it is expensive and has not been demonstrated to reduce the rate of UTIs.6

**Bacterial interference**

With the bacterial interference approach to combating UTI, innocuous bacteria are allowed to colonize the bladder, which in turn, inhibits colonization of the bacteria that cause the symptomatic infection.5 Any antibiotic treatment during colonization would kill off the protective bacteria.

According to the Cochrane Review,7 available data on IC do not provide convincing evidence that any specific technique (sterile or clean), catheter type (coated or uncoated), method (single-use or multiple-use), person (self or other), or strategy is better than any other for all clinical settings.8

Evidence for many of the adjunctive therapies used in UTI prevention is weak. We need more studies to answer these and other questions.

**Acknowledgements:** This report is a project of the Alberta Spinal Cord Injury Initiative, a collaborative effort by Albertans with SCI, service providers, researchers and decision-makers committed to improving the lives of people affected by SCI and similar physical disabilities. We gratefully acknowledge the Government of Alberta who recognized the value of the vision for the Alberta SCI community.

**Special thanks:** Special thanks go to the working group members who spearheaded the development of this paper. They are: Lourain Chittam (Alberta Aids to Daily Living), Teren Clarke (Canadian Paraplegic Association (Alberta)), Guy Coulombe (Canadian Paraplegic Association (Alberta)), Tim Hill (Canadian Paraplegic Association (Alberta)) (project coordinator), Bev Matthiessen (Alberta Committee of Citizens with Disabilities), Katherine Moore (University of Alberta); Raj Parmar (Foothills Medical Centre).

**Competing interests:** None declared.

This paper has been peer-reviewed.

**References**


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