

EDUCATION SERIES

Prevention of Urinary Tract Infections:

Reducing Risk and Protecting Older Adults

Disclaimer

This information is for educational purposes only and is not to be considered as legal or medical advice.

Statement of Funding

This Educational Series is supported by an unrestricted educational grant from GSK.

Introduction

As anyone who has ever experienced a urinary tract infection (UTI) knows, they can be painful, disruptive, and for some people, highly embarrassing. The impact of UTIs goes well beyond the medical condition itself. At the most personal level, many older adults may be hesitant to bring up UTIs with anyone at all, due to stigma, shame or embarrassment. Depending on how UTI symptoms present, the older person may not even be aware of their condition, or ascribe the symptoms to age or other factors.

Often associated with younger women, many older people may not think of UTIs as conditions which apply to them. Some health care providers may not be as attuned to checking for UTIs in older adults despite their prevalence and negative impacts. Government and health policymakers may not keep UTIs, and their associated treatments, front of mind when they are thinking about health care supports – and may be unaware of the economic impacts of the infection or the need for careful antibiotic stewardship.

In short, UTIs are no joke. They are often medically overlooked, poorly managed and personally underreported. UTIs negatively impact physical, psychological, mental and social well-being. And all of these can be improved with education and awareness, policy change, and destigmatization.

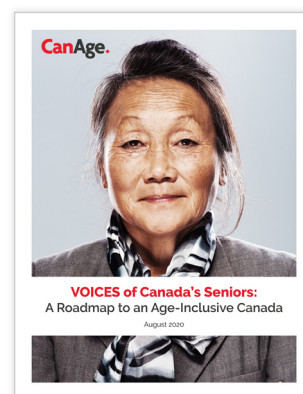
But why is a seniors' advocacy organization focussing on UTIs and incontinence? In short, because UTIs are a growing problem, both in terms of Canada's rapidly aging population in real numbers, and also in terms of impact.

At CanAge, we work tirelessly to educate, empower and mobilize people on the issues that matter most to seniors and their families. As an independent, non-partisan, not-for-profit organization, we believe every Canadian – independent of age – deserves a vibrant, connected, and meaningful life with equitable access to the resources needed to thrive.

As a pan-Canadian organization, CanAge also knows that older Canadians are diverse in their experiences, perspectives, passions, and contexts. As a group, Canadian seniors will represent 23% of the population by 2030. Politically engaged, Canadian seniors are consistently the most active voter group

at the polls, with approximately 72% of seniors indicating that they vote in every election and nearly 80% voting in the last 2 federal elections. The needs of a rapidly aging population must be a key priority for policy-makers.

In 2020, CanAge released its **VOICES of Canada's Seniors: A Roadmap for an Age-Inclusive Canada**. It outlines a way forward for Canada, with 6 Compass Points, 40 Issues and 135 specific evidence-based Recommendations.



The 6 Compass Points of the VOICES Roadmap are:

- V** Violence and Abuse Prevention
- O** Optimal Health and Wellness
- I** Infection Prevention and Disaster Response
- C** Caregiving, Long-Term Care, Home Care and Housing Resources
- E** Economic Security
- S** Social Inclusion



In our UTI 101 series, CanAge explores the effects of incontinence and urinary tract infections amongst each of these 6 Compass Point areas.

V - Violence and Abuse Prevention investigates the links between incontinence, care dependence and elder abuse, neglect and self-neglect.

O - Optimal Health and Wellness digs into issues such as medical under-diagnosis, antibiotic stewardship and co-morbidities and underreporting by individuals due to stigma, embarrassment or conflation of symptomatology.

I - Infection Prevention and Disaster Response explores how long term care IPAC standards intersect with the prevalence, prevention and treatment of UTIs.

C - Caregiving, Long-Term Care, Home Care and Housing Resources delves both how and why avoidable UTIs remain the primary reason for hospital admissions from congregate

care settings and also what we can do to promote urinary health across the housing continuum.

E - Economic Security uncovers both the substantial financial burden UTIs place on the healthcare system as well as the significant cost to an individual for incontinence products and UTI treatments.

S - Social Isolation connects the often tragic and direct links between UTIs on the one hand, and incontinence, loneliness and stigma on the other.

CanAge is committed to the health and well-being of all Canadians as we age. We hope that this series will help to shift minds, policies and treatments options for UTIs and incontinence.

It's time to take this issue on seriously. We hope that this paper, this series and our additional knowledge tools will help to put us on the path to well-being and confidence in aging.

Executive Summary

This paper will showcase prevention strategies for recurrent UTIs. UTIs are common and uncomfortable infections that occur when bacteria enters the urethra leading to an infection along the urinary tract.

For many, UTIs may become recurrent, meaning that two infections occur within the span of six months. Strategies including behavioural, dietary, medicinal and non pharmaceutical approaches are discussed. Some of these techniques include: antibiotic prophylaxis, cranberry products, exercise, and estrogen. Specific approaches for populations who are disproportionately affected by infections, such as post-menopausal women and those who are catheterized, are also discussed. More research into the impacts of these prevention strategies, specifically in older adult populations is needed. In highlighting these techniques, we can better manage and improve the health and quality of life of those who suffer from recurrent UTIs.

This paper provides an overview of many UTI prevention strategies. It is the second report in a series of papers that will explore different aspects of UTIs and incontinence, including: **Urinary Tract Infections 101: Improving Well-Being with Knowledge and Supports**, **Treatment Challenges: Urinary Tract Infections, Older Adults and Antibiotic Resistance** and **Urinary Incontinence: The Impact on the Well-being of Older Adults**.

For further information on these topics, please refer to the individual papers in the series.

Importance of Prevention

Urinary tract infections (UTI) significantly impact older adults. UTIs are the second most common infection among older adults after respiratory infections.¹ As previously identified in our [Urinary Tract Infections 101: Improving Well-Being with Knowledge & Supports](#) paper, there are significant challenges in identifying UTIs in older adult populations. More typical UTI symptoms seen in younger people with uncomplicated infections may not be present in older individuals, making the diagnostic process challenging. Older adults who are catheterized may also present symptoms differently, leading to further challenges in identifying these infections.¹ Some symptoms that may appear can also be attributed to other illnesses, changes in medication, or dehydration.² Aside from issues in identifying and diagnosing UTIs, the severity and long-lasting impact of infections must be considered. Sepsis, a deadly spread of infection throughout the body, can occur when UTIs are undetected. This condition can have persistent effects on individuals and is extremely costly to the healthcare system.³

More typical UTI symptoms seen in younger people with uncomplicated infections may not be present in older individuals, making the diagnostic process challenging.

The American College of Preventive Medicine defines preventive medicine as “[...] a medical specialty recognized by the American Board of Medical Specialties (ABMS), which focuses on the health of individuals and communities. The goal of preventive medicine is to promote health and well-being and prevent disease, disability and death.”⁴ Preventive medicine can be cost- and life-saving.

As seen through the COVID-19 pandemic, taking preventive measures, such as behaviours to prevent transmission of the virus or large-scale vaccination campaigns, can help to reduce the severity and long term impact of disease. Older adults, specifically women, are at heightened risk for recurrent UTI (defined as two or more UTIs in a six-month period). “In 2007, UTI recurrence accounted for 10.5 million outpatient consultations and 2–3 million emergency department visits in the USA alone”(750).⁵ Some risk factors for recurrent UTI include: a history of UTIs, diabetes, cognitive impairment, disability, frailty, urinary incontinence, and neurogenic bladder.⁶ ^{7,8} Some of these conditions occur more frequently in older populations.⁶ This paper will highlight strategies to prevent recurrent UTIs. In focusing on the prevention of UTIs, we can better manage and improve the health and quality of life of older adults.

Prevention Strategies

Behavioural Changes

There are a variety of behavioural changes to diet, lifestyle, and exercise that can help to maintain a healthy bladder. Some changes do not necessarily apply directly to UTI prevention, but they do contribute to bladder health, in itself a vital part of overall health. Healthy bladder habits can limit opportunities for infection and raise individual and collective awareness about the importance of bladder health and seeking medical help if an issue does arise.⁹

While in the bathroom, it is important to sit in a comfortable position so that muscles can be properly engaged. A person must allow enough time for muscles to relax and to permit the bladder to fully empty. Intentionally holding in urine for long periods of time can foster bacterial growth in the bladder.¹⁰ This is especially important for aging populations as bladder muscles and function can decline or change over time.^{6,7} In older adults, constipation can sometimes also be associated with the inability to fully empty the bladder, so bowel health and regularity should be considered. It is also suggested that women urinate after sexual intercourse to prevent UTI.^{7,9} Proper hand washing and sanitation protocols are also effective in preventing UTIs, especially in the long-term care and healthcare settings.¹¹ According to the Harvard Medical School, wearing loose fitting pants as well as wiping from front to back after urination may also help to prevent UTIs (although there is not strong evidence to support these claims).⁷

Urinary incontinence (UI) is a common bladder-related issue. Some types of UI are more directly linked to UTI. For example, a UI that involves being unable to completely empty the bladder can lead to residual urine, a risk factor for UTIs. Exercises to strengthen pelvic floor muscles can help with incontinence in men and women. Lower activity levels were associated with voiding issues, while long term, more moderate exercise was determined to be an effective tool for managing incontinence. Some high impact sports may create changes to pelvic floor muscles functionality. With more strength, better bladder muscle control can be utilized during activities, such as sneezing or coughing, where leakage regularly occurs. In combination with suppression strategies, the exercises have been proven to limit frequency and urgency of urination.¹⁰

Healthy bladder habits can limit opportunities for infection and raise individual and collective awareness about the importance of bladder health and seeking medical help if an issue does arise.

Cigarette smoking also puts people at higher risk for incontinence. While some evidence shows that taking Vitamin D can help to strengthen bladder muscle function and voiding.¹⁰

Again, although some of the behavioural changes may not directly prevent UTIs, they can help to promote a healthy bladder. However, more evidence on the efficacy of these behaviours for older adult populations is required.

Dietary Interventions

Fluid Intake

There are certain foods and drinks that can irritate the bladder and interact with muscle control. It is suggested that histamines, some fizzy drinks, alcohol, and caffeine should all be avoided as they can promote higher urgency and frequency to urinate.¹⁰ In one study, drinking more than 1.5 litres of fluid helped to reduce UTI by nearly 50% in premenopausal women.¹² Fluid intake can affect incontinence, and there is a fine balance between consuming too little fluid, which may make urine very concentrated and can promote infection, and drinking too much fluid which may increase bladder pressure, urgency, and frequency of urination.^{10,12}

Cranberry Products

One of the most commonly acclaimed preventive measures against UTIs is cranberry products (available in pill or juice form). It is believed that cranberry proanthocyanidins (PAC) may work to prevent bacteria from adhering to the bladder.^{1, 10, 13, 14, 15, 16, 17} Although there may be some anecdotal evidence, there have been mixed clinical results proving the efficacy of cranberry products against urinary tract infections, especially in older adult populations.^{1, 8, 10, 13, 14, 15, 16, 17} In a 2014 study, it was determined that cranberry juice may be effective in reducing the rates of recurrent UTI for the high risk patients living in long term care (LTC) homes.^{13, 15, 17} However, another study demonstrated that there was no significant difference in infection rates between older adult women living in nursing homes given cranberry capsules and those given a placebo.^{13, 17} An additional study conducted

Although there may be some anecdotal evidence, there have been mixed clinical results proving the efficacy of cranberry products against urinary tract infections, especially in older adult populations.

in 2016 showed that cranberry products may be effective in recurrent UTI prevention, however this study was primarily conducted on younger participants.¹⁶ Further understanding of the impact on older adults is required. The dosages and duration of treatment varied across these studies. Current evidence suggests that cranberry products are not effective in preventing UTI in patients with neurogenic bladder.^{14, 16} Cranberry products are not believed to be harmful and may lead to increased hydration, which can be beneficial in UTI prevention.¹⁸ It is clear that further research to develop a better understanding of the dosage amount, duration, and efficacy in older adult populations is still required before cranberry products can become a clinical recommendation for the prevention of UTIs.^{1, 8, 13, 14, 15, 16, 17}

Chinese Herbal Medicine (CHM)

Chinese herbal medicine has shown some signs of reducing the risk for recurrent UTI. One study showed that Chinese herbal medicine, coupled with antibiotics, were more effective than antibiotics alone. More clinical and older adult-specific research is required to determine how effective CHM may be in preventing UTIs.¹⁷

Other Interventions

Catheterization

Catheterization accounts for anywhere from 20-30% of all healthcare-related infections.¹⁹ Catheters are often utilized by older adult populations in settings such as hospitals or congregate care facilities, where residents and patients are already at heightened risk for infection because of factors related to age, frailty, cognition, and health.^{19, 20} Although catheters are a necessary tool to assist with voiding, there are mechanisms that can be used to reduce the rate of catheter-associated urinary tract infections (CAUTIs). The most effective preventive measure is to limit the length of time a catheter is used. A systematic review identified that measures such as proper hand hygiene, reduced catheter use (when possible), shortening the duration of catheter dwelling, infection surveillance and better staff training may reduce CAUTIs.²⁰ Because CAUTIs pose such a severe risk in

Although catheters are a necessary tool to assist with voiding, there are mechanisms that can be used to reduce the rate of catheter-associated urinary tract infections (CAUTIs). The most effective preventive measure is to limit the length of time a catheter is used.

healthcare settings, better training and practices around hand hygiene, sanitation practices for staff, family and patients as well as more robust infection prevention programs and protocols can also prevent infection.^{11, 13, 20} Lastly, more informed decision making around catheter usage and education around catheter insertion would help to manage high CAUTI rates.¹³ A study showed that an 85% decrease in the number of CAUTIs was present when catheter guidelines, and measures aimed at early catheter removal and hand hygiene compliance, were implemented at a hospital.¹¹ Smaller catheters (in length and size), and effectively secured catheters, which decrease urethral trauma and limit movement, may also help to prevent CAUTIs.²⁰ There is inconclusive evidence that suggests that coating catheters in antibiotics, probiotics or antiseptics may reduce UTI risk.^{20, 21} Further research into the efficacy of coated catheters is required.

Antibiotic prophylaxis

In populations who frequently have complicated, recurrent UTIs, the prophylactic use of antibiotics can be effective in managing infections. In appropriate situations, antibiotics are necessary and best practice to treat confirmed cases (via urinalysis) of a UTI.^{13, 17, 22, 23, 24} This is particularly evident in post menopausal women with recurrent infections.²⁴ However, given the rising rates of antibiotic resistance, we must evaluate antibiotic use as a preventive technique. An over-reliance on antibiotics can lead to a variety of complications including larger scale issues such as diarrhea, changing Lactobacillus levels in the vagina, and antibiotic resistance.^{2, 21, 25} It is understood that antibacterial resistance is strongest within the first month after taking antibiotics; however, it can last for up to one year.²³ For individuals with recurrent infections who are misdiagnosed or over-prescribed antibiotics, this challenge is even more serious. “In the USA and Canada, approximately 10–25% of uncomplicated UTI isolates are resistant to TMP–SMX (Trimethoprim–sulfamethoxazole)”(644).²² The overuse of antibiotics can also make it difficult to fight off secondary infections, such as yeast infection or gastrointestinal infections.²² The dangers of this global public health crisis will be discussed in more detail in our UTI – Treatment report in this series.

Methenamine

Methenamine is used to prevent or control recurrent UTIs which can be caused by certain types of bacteria. Other antibiotics are used to treat active infections, but methenamine is used to stop the growth of bacteria in urine. It has an ingredient which makes the urine more acidic, which kills the bacteria in the urinary tract.²⁶ The notable benefits of the medication, in comparison to many other antibiotics, is that it has not been associated with antibiotic resistance and has fewer negative side effects, such as drug-on-drug interactions.²⁵ For older adults, who may take multiple medications or have other health conditions, these side effects may have significant impact. One study showed that the use of methenamine for UTI prevention was effective in older adult populations and prolonged the length of time between recurrent infections by nearly nine months, including for those with differing kidney function. Further understanding of the efficacy of methenamine for residents of LTC is required, although research to date showing methenamine as a preventive tool against UTI is promising.²⁵

D-Mannose

There is some evidence that D-Mannose, a sugar similar to glucose, may be effective in helping to prevent UTIs. In one study, six months after a UTI, those that took D-Mannose had reduced risks of recurrent infection. Further understanding of using D-Mannose with antibiotics as well as non-antibiotic treatment is required.¹⁷

Vaccines and Immunostimulants

Animal studies have shown promising results for the creation of a vaccine that can prevent recurrent UTIs. One vaccine may target E. Coli bacteria, which account for 80% of uncomplicated UTIs. However, the development of this vaccine is complicated because of the many E. Coli strains that exist.²² OM-89, an E. Coli based vaccine that is taken orally, has shown to reduce the number of recurrent UTIs.²³ Uromune, Strovac and other novel vaccines are also being investigated to better understand their efficacy in UTI prevention.¹⁷ More research and large-scale, clinical trials (outside of animal testing) are

required to determine the effectiveness of vaccines in helping older adults manage complicated UTIs.^{17, 22}

Older Women and Recurrent UTI

Older, post-menopausal women are at a heightened risk for developing UTIs and recurrent infections. Half of all women will experience a UTI in their life and it is estimated that 10-15% of women above 60 will experience a recurrent UTI.²¹ The increased risk of infection may be attributed to hormonal, bacterial, anatomical and/or functional changes that occur both during and after menopause.^{8, 21} As a result of the high prevalence of UTI in post-menopausal women, some of the prevention strategies addressed will be focused on women's health and UTI prevention, specifically the use of probiotics and estrogen.

Half of all women will experience a UTI in their life and it is estimated that 10-15% of women above 60 will experience a recurrent UTI.

Probiotic

A promising preventive intervention against recurrent UTIs is the use of probiotics. Probiotics are live microorganisms that can provide health benefits to the body. Probiotics have a variety of functions including being anti-microbial, antioxidant, anti-diarrheal, anti-lipidemic, and anti-cancerous and have been used successfully to aid in gastrointestinal and digestive issues.^{21, 27} When we have infections, the body's natural protection of bacterial flora (the microorganisms in the body) can be disrupted. This makes our body's immune system weak which can make fighting infections difficult and make us more susceptible to further infection. When we take probiotics, the introduction of these microorganisms helps rebuild the diminished flora, therefore boosting the immune response.²¹ Lactobacilli are some of the most commonly used probiotic strains, and also happen to be "[...] the most commonly identified genus of bacteria in the human vaginal microbiota"(1).²⁷ It is responsible for maintaining a healthy vaginal ecosystem; low levels of Lactobacilli can actually increase risk of UTI.^{21, 27} Not all strains of Lactobacillus will be useful in the prevention of UTIs, but because of its active role in healthy women, it is hypothesized that probiotics can be utilized to improve or prevent UTIs.^{17, 21, 27}

Probiotics show promise in preventing UTIs without some of the consequences of other strategies, such as antibiotic resistance, although research gaps remain. There have been some studies showing the efficacy of probiotic use in helping to prevent UTIs in pre-menopausal women. One small study of probiotics used with post-menopausal women showed that UTI were not eliminated but rather the probiotic helped to reduce the number of recurrences as well as stop the development of antimicrobial resistance.²¹ Other studies have shown that Lactobacillus species are different in women around the world and should be considered when developing probiotics to treat a variety of infections.²¹ There are also mixed results on the efficacy of taking a probiotic orally or through topical cream, although most evidence proves that creams are more effective.^{1,17,21,27} However, using oral tablets may help to control and maintain E. Coli bacteria, which is the cause of most UTIs.¹⁷ In a study of postmenopausal women, antibiotic resistance was also significantly lower when using oral probiotic compared to groups taking antibiotics.¹⁷ The different strains of Lactobacilli, variable populations tested (including age and race), the mechanism of delivery (tablet versus cream), length of treatment and quantity of probiotic are some areas of research that require further exploration in order to determine probiotic efficacy.^{1,17,21,27} Although it seems like there are potential benefits to using probiotics to prevent recurrent UTIs, larger clinical, in vivo studies, with a focus on older adult populations are still required before probiotics can be deemed as a clinical recommendation for UTI prevention.

In a study of postmenopausal women, antibiotic resistance was also significantly lower when using oral probiotic compared to groups taking antibiotics.

Estrogen

There is strong evidence to suggest that estrogen may be a viable safeguard against urinary tract infections for post-menopausal women. It is believed that one of the roles of this hormone is to maintain low vaginal acidity levels (pH).^{1,17} In pre-menopausal women, estrogen helps to promote the growth of Lactobacilli and can be used in the early stages of menopause to help manage symptoms. As women experience menopause, estrogen levels decrease, leading to changes in vaginal bacteria (such as the absence of Lactobacilli, the flora that help to maintain vaginal health) and increasing pH levels. This may provide increased opportunity for infection and explain why older adult women so often experience recurrent urinary tract infections.^{1,13,17} Menopause may also create

functional changes within the bladder, such as increased incontinence, which can also put individuals at heightened risk for infection.¹³

Studies have shown that estrogen applied locally via creams, rings, or tablets is effective at reducing UTIs, while taking the hormone orally is futile.^{1,13,17} In one study with post-menopausal women, using intravaginal estrogen cream helped increase Lactobacilli in participants. Initially levels of Lactobacilli were not present in any lab cultures, but after one month of treatment, appeared in 61% of participants.¹⁷ Further understanding of the significance of using estrogen to help manage UTIs amongst residents of long-term care facilities is still required. Additionally, more research into the most effective dosages as well as the use of estrogen either in conjunction or as a substitute for antibiotics is necessary. The use of estrogen in post-menopausal women may increase their risk for stress urinary incontinence and may cause some irritation.¹⁷ To learn more about incontinence, please read our [Urinary Incontinence: The Impact on the Well-being of Older Adults](#) paper.

As women experience menopause, estrogen levels decrease, leading to changes in vaginal bacteria (such as the absence of Lactobacilli, the flora that help to maintain vaginal health) and increasing pH levels. This may provide increased opportunity for infection and explain why older adult women so often experience recurrent urinary tract infections.

Innovation and Technology in Testing

Diaper Inlay

The functional challenges of incontinence as well as cognitive impairment can make it difficult to properly collect sterile urine samples to test for UTIs. This can also become a time-consuming process for nurses, physicians or other care staff who may need to assist with or supervise urine collection. Individuals who are incontinent and wear briefs are at heightened risk for UTIs.²⁸ Incontinence also tends to be higher in populations with low physical functionality and cognitive impairment.⁶ Catheterization in this population is common, which can also increase risk for UTIs. Many challenges also arise in urine collection in catheterized individuals.

A rapid and sterile method of urine collection has been developed through a diaper inlay that is placed in briefs.²⁸ “The developed diaper inlay was capable of collecting, isolating, analyzing samples and retaining results” in less than 8 hours”(717).²⁸ This technology can help nursing

and care homes retrieve urine samples in a safe and timely manner, preventing infection from going unnoticed, misdiagnosed or becoming severe. Because this population of older adults who may have cognitive impairments as well as issues with catheterization and incontinence are most susceptible to UTI, it is imperative that accurate and reliable diagnostic testing for infection occurs.

Conclusion

Urinary tract infections are serious ailments that affect older adults. This paper highlights some behavioural, medical, and non-pharmaceutical remedies that have been used to improve bladder health. It is clear that there is a gap in research and more studies including older adults living in the community and in institutions are required. A better understanding of prevention techniques and how they impact older adults can improve health outcomes and the quality of life for those who suffer from UTIs.

References

1. Rowe, Theresa A., and Manisha Juthani-Mehta. "Urinary Tract Infection in Older Adults." *Aging Health* 9, no. 5 (2013): 519-28. <https://doi.org/10.2217/ahe.13.38>
2. "Management of Urinary Tract Infections (UTIs) in Non-catheterized Long-Term Care Home Residents" Public Health Ontario, n.d., <https://www.publichealthontario.ca/-/media/documents/u/2016/uti-ltch-management.pdf?la=en>
3. "Home." Canadian Sepsis Foundation. Accessed May 30, 2021, <https://canadiansepsisfoundation.ca/>
4. "What is Preventive Medicine?", American College of Preventive Medicine, Accessed May 30, 2021, <https://www.acpm.org/about-acpm/what-is-preventive-medicine/>
5. Sihra, Néha, Anna Goodman, Rhana Zakri, Arun Sahai, and Sachin Malde. "Nonantibiotic Prevention and Management of Recurrent Urinary Tract Infection." *Nature Reviews Urology* 15, no. 12 (December 2018): 750–76. <https://doi.org/10.1038/s41585-018-0106-x>.
6. Storme, Oscar, José Tirán Saucedo, Arturo Garcia-Mora, Manuel Dehesa-Dávila, and Kurt G. Naber. "Risk Factors and Predisposing Conditions for Urinary Tract Infection." *Therapeutic Advances in Urology* 11 (2019): <https://doi.org/10.1177/1756287218814382>
7. "When urinary tract infections keep coming back", Harvard Health Publishing Harvard Medical School, September 17, 2019, <https://www.health.harvard.edu/bladder-and-bowel/when-urinary-tract-infections-keep-coming-back>
8. Mody, Lona, and Manisha Juthani-Mehta. "Urinary Tract Infections in Older Women: A Clinical Review." *JAMA* 311, no. 8 (February 26, 2014): 844. <https://doi.org/10.1001/jama.2014.303>.
9. Lukacz, E. S., C. Sampsel, M. Gray, S. MacDiarmid, M. Rosenberg, P. Ellsworth, and M. H. Palmer. "A Healthy Bladder: A Consensus Statement: Consensus Statement - a Healthy Bladder." *International Journal of Clinical Practice* 65, no. 10 (October 2011): 1026–36. <https://doi.org/10.1111/j.1742-1241.2011.02763.x>.
10. Burgio, K. L., D. K. Newman, M. T. Rosenberg, and C. Sampsel. "Impact of Behaviour and Lifestyle on Bladder Health." *International Journal of Clinical Practice* 67, no. 6 (June 2013): 495–504. <https://doi.org/10.1111/ijcp.12143>.
11. "Evidence of hand hygiene as the building block for infection prevention and control", WHO Global Infection Prevention and Control Unit - World Health Organization, Accessed May 30, 2021, <https://apps.who.int/iris/bitstream/handle/10665/330079/WHO-HIS-SDS-2017.7-eng.pdf>
12. Plüddemann, Annette. "Can Drinking More Water Prevent Urinary Tract Infections? The Evidence Says Yes." *BMJ Evidence-Based Medicine* 24, no. 5 (October 2019): 191–92. <https://doi.org/10.1136/bmjebm-2018-111143>.
13. Ashraf, Muhammad S., Swati Gaur, Oluma Y. Bushen, Teena Chopra, Philip Chung, Kalin Clifford, Elizabeth Hames, et al. "Diagnosis, Treatment, and Prevention of Urinary Tract Infections in Post-Acute and Long-Term Care Settings: A Consensus Statement From AMDA's Infection Advisory Subcommittee." *Journal of the American Medical Directors Association* 21, no. 1 (January 2020): 12-24.e2. <https://doi.org/10.1016/j.jamda.2019.11.004>.
14. Jepson, Ruth G., and Jonathan C. Craig. "A Systematic Review of the Evidence for Cranberries and Blueberries in UTI Prevention." *Molecular Nutrition & Food Research* 51, no. 6 (June 2007): 738–45. <https://doi.org/10.1002/mnfr.200600275>.

References

15. Caljouw, Monique A. A., Wilbert B. Hout, Hein Putter, Wilco P. Achterberg, Herman J. M. Cools, and Jacobijn Gussekloo. "Effectiveness of Cranberry Capsules to Prevent Urinary Tract Infections in Vulnerable Older Persons: A Double-Blind Randomized Placebo-Controlled Trial in Long-Term Care Facilities." *Journal of the American Geriatrics Society* 62, no. 1 (January 2014): 103–10. <https://doi.org/10.1111/jgs.12593>.
16. Singh, Iqbal, Lokesh Kumar Gautam, and Iqbal R. Kaur. "Effect of Oral Cranberry Extract (Standardized Proanthocyanidin-A) in Patients with Recurrent UTI by Pathogenic E. Coli: a Randomized Placebo-Controlled Clinical Research Study." *International Urology and Nephrology* 48, no. 9 (2016): 1379–86. <https://doi.org/10.1007/s11255-016-1342-8>.
17. Sihra, Néha, Anna Goodman, Rhana Zakri, Arun Sahai, and Sachin Malde. "Nonantibiotic Prevention and Management of Recurrent Urinary Tract Infection." *Nature Reviews Urology* 15, no. 12 (December 2018): 750–76. <https://doi.org/10.1038/s41585-018-0106-x>.
18. Rowe, Theresa. "Epidemiology & Prevention of UTI." National Center for Emerging and Zoonotic Infectious Diseases, CDC, July 17, 2018. <https://www.cdc.gov/nhsn/pdfs/training/2018/lta/epidemiology-prevention-uti-508.pdf>
19. Al-Hameed, Fahad M., Gulam R. Ahmed, Asim A. AlSaedi, Muhammad J. Bhutta, Faisal F. Al-Hameed, and Majid M. AlShamrani. "Applying Preventive Measures Leading to Significant Reduction of Catheter-Associated Urinary Tract Infections in Adult Intensive Care Unit." *Saudi Medical Journal* 39, no. 1 (January 2018): 97–102. <https://doi.org/10.15537/smj.2018.1.20999>.
20. Meddings, Jennifer, Sanjay Saint, Sarah L Krein, Elissa Gaies, Heidi Reichert, Andrew Hickner, Sara McNamara, Jason D Mann, and Lona Mody. "Systematic Review of Interventions to Reduce Urinary Tract Infection in Nursing Home Residents." *Journal of Hospital Medicine* 12, no. 5 (May 1, 2017): 356–68. <https://doi.org/10.12788/jhm.2724>.
21. Gupta, Varsha, Deepika Nag, and Pratibha Garg. "Recurrent Urinary Tract Infections in Women: How Promising Is the Use of Probiotics?" *Indian Journal of Medical Microbiology* 35, no. 3 (July 2017): 347–54. https://doi.org/10.4103/ijmm.IJMM_16_292.
22. Brumbaugh, Ariel R, and Harry LT Mobley. "Preventing Urinary Tract Infection: Progress toward an Effective Escherichia Coli Vaccine." *Expert Review of Vaccines* 11, no. 6 (June 2012): 663–76. <https://doi.org/10.1586/erv.12.36>.
23. Rodriguez-Mañas, Leocadio. "Urinary Tract Infections in the Elderly: A Review of Disease Characteristics and Current Treatment Options." *Drugs in Context* 9 (July 8, 2020): 1–8. <https://doi.org/10.7573/dic.2020-4-13>.
24. Ahmed, Haroon, Freya Davies, Nick Francis, Daniel Farewell, Christopher Butler, and Shantini Paranjothy. "Long-Term Antibiotics for Prevention of Recurrent Urinary Tract Infection in Older Adults: Systematic Review and Meta-Analysis of Randomised Trials." *BMJ Open* 7, no. 5 (2017). <https://doi.org/10.1136/bmjopen-2016-015233>.
25. Snellings, Marina S., Sunny A. Linnebur, Scott M. Pearson, Jeff I. Wallace, Joseph J. Saseen, and Danielle R. Fixen. "Effectiveness of Methenamine for UTI Prevention in Older Adults." *Annals of Pharmacotherapy* 54, no. 4 (April 2020): 359–63. <https://doi.org/10.1177/1060028019886308>.
26. Finkel, Richard, Michelle Alexia Clark, and Luigi X. Cubeddu. *Pharmacology*. 4th ed. Lippincott's Illustrated Reviews. Philadelphia: Lippincott Williams & Wilkins, 2009.

References

27. Vagios, Stylianos, Helai Hesham, and Caroline Mitchell. "Understanding the Potential of Lactobacilli in Recurrent UTI Prevention." *Microbial Pathogenesis* 148 (November 2020): 104544. <https://doi.org/10.1016/j.micpath.2020.104544>.
28. Karlsen, Haakon, Tao Dong, and Zhenhe Suo. "A Diaper Pad for Diaper-Based Urine Collection and Colorimetric Screening of Urinary Biomarkers." *Annals of Biomedical Engineering* 46, no. 5 (May 2018): 717–25. <https://doi.org/10.1007/s10439-018-1996-8>.






Authors

This CanAge report was written by the CanAge Policy & Research Team.



Authored by CanAge.
September 2021

Stay Connected with CanAge

- 1** Visit our website
CanAge.ca
- 2** Become a FREE CanAge member
Visit CanAge.ca/join for your 1 year free membership!
- 3** Follow us on social media
 -  @CanAgeSeniors
 -  @CanAgeSeniors
 -  CanAgeSeniors
 -  CanAge
 -  CanAge