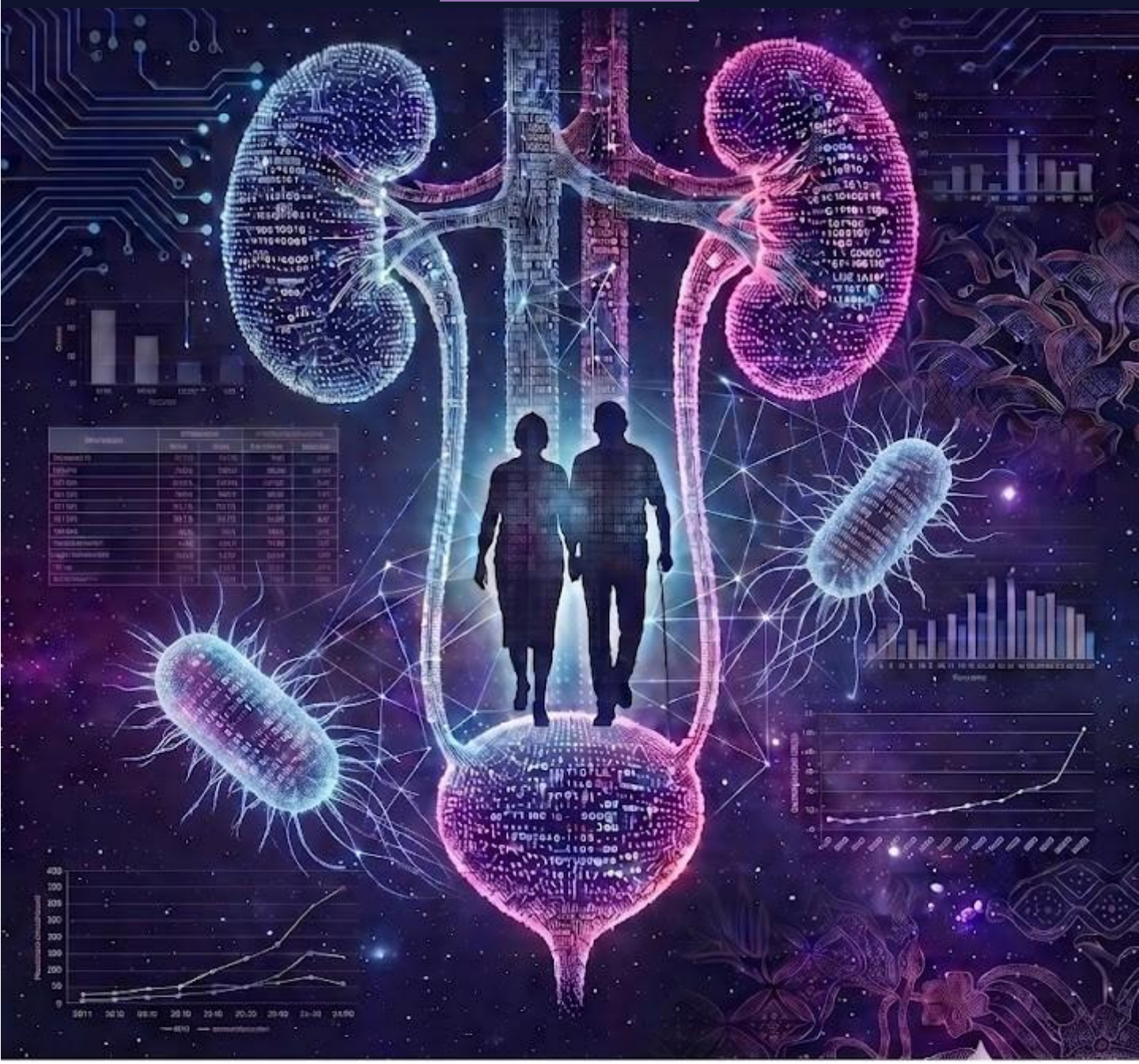
Urinary Tract Infections in Older Persons

A Consensus Statement on Diagnosis and Antimicrobial Stewardship

1st Edition 2026



MyICID
Malaysian Society of Infection Control and Infectious Diseases

MSGM
Malaysian Society Of Geriatric Medicine

Urinary Tract Infections in Older Persons:

A Consensus Statement on Diagnosis and Antimicrobial Stewardship

e-ISBN: 978-629-93274-0-0

First Edition: October 2026

Copyright © 2026

Malaysian Society of Infection Control and Infectious Diseases (MyICID)

All rights reserved.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, whether electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publisher. Applications for permission should be addressed to the Malaysian Society of Infection Control and Infectious Diseases.

Published by

Malaysian Society of Infection Control and Infectious Diseases (MyICID)

C/O Unit Penyakit Berjangkit, Jabatan Perubatan
Hospital Sungai Buloh
Jalan Hospital Sungai Buloh
47000 Sungai Buloh, Selangor, Malaysia

Email: myicid1@gmail.com
Official website: myicid.my

In collaboration with

Malaysian Society of Geriatric Medicine (MSGM)

3A-2, The Place
Jalan PJU 8/5G
Bandar Damansara Perdana
47820 Petaling Jaya, Selangor, Malaysia

Email: secretariat@msgm.com.my
Official website: msgm.com.my

Disclaimer

This Consensus Statement is based on scientific evidence available at the time of development, supplemented by the collective expert opinion and clinical experience of infectious diseases physicians, geriatricians, and pharmacists.

The recommendations provide general, evidence-informed guidance and do not replace individual clinical judgement, institutional policies, clinical guidelines, or regulatory requirements. Healthcare professionals remain responsible for the assessment and management of individual patients, taking into account their clinical circumstances and available diagnostic and microbiological information.

The recommendations may be revised as new evidence emerges and should be interpreted alongside current national and international guidelines and local antimicrobial stewardship policies.

Chief Editors' Preface

Urinary tract infection (UTI) is one of the most frequently encountered infections in older persons and a common reason for antimicrobial prescribing. Yet, few diagnoses illustrate the complexity of clinical decision-making in later life as clearly as suspected UTI. In older persons, the challenge is often not simply how to treat an infection, but first determining whether a true infection is present and whether antimicrobial therapy is warranted. Multimorbidity, cognitive impairment, urinary catheterization and the high prevalence of asymptomatic bacteriuria can complicate clinical assessment and the interpretation of urinary investigations.

It is against this clinical background that this Urinary Tract Infections in Older Persons: A Consensus Statement on Diagnosis and Antimicrobial Stewardship has been developed. This document represents a close multidisciplinary collaboration between Infectious Diseases and Geriatric Medicine, bringing together expertise in infection management and antimicrobial stewardship with an understanding of the physiological, functional and clinical complexities that accompany ageing.

The recommendations are intended to provide healthcare professionals with a practical and evidence-informed framework for the assessment, diagnosis, investigation and antimicrobial management of suspected UTI in older persons. Particular emphasis is placed on differentiating symptomatic UTI from asymptomatic bacteriuria, improving the appropriate use and interpretation of urine investigations, and ensuring that antimicrobial therapy, when indicated, is selected and prescribed judiciously. This document is intended for all healthcare professionals involved in the care of older persons, including medical officers, specialists, geriatricians, infectious diseases physicians, family medicine specialists, nurses, pharmacists and antimicrobial stewardship teams across hospital, primary care and long-term care settings. We hope that it will promote greater consistency in clinical practice while supporting decisions that are evidence-based, proportionate and centred on the individual older person.

At the heart of this recommendation is a simple but important principle: good antimicrobial stewardship begins with good diagnostic stewardship. Knowing when to investigate, when to treat and, equally, when not to do so are all integral to high-quality care. Avoiding unnecessary testing and antibiotics is not therapeutic inaction, but an active step towards protecting older persons from avoidable harm. We hope that these recommendations will support clinicians in navigating one of the most common yet challenging infectious presentations in older persons with greater confidence, clarity and consistency. More importantly, we hope that their adoption will contribute to safer care for older persons, more responsible antimicrobial use and the wider national effort to address antimicrobial resistance.

The development of this consensus recommendation has only been possible through the collective expertise, thoughtful deliberation and commitment of our multidisciplinary working group. We extend our sincere appreciation to all members, reviewers and contributors who have given their time and expertise to this endeavour. It is our privilege, on behalf of the working group, to present this recommendation to our colleagues across the healthcare system. We trust that it will serve not merely as a reference document, but as a practical guide to better clinical judgement, safer prescribing and better outcomes for the older persons entrusted to our care.

Dr Noridah binti Nordin
Consultant Infectious Diseases Physician
Hospital Sultan Ismail Petra, Kelantan

Dr Kejal a/p Hasmukharay
Consultant Geriatrician
Pusat Perubatan Universiti Malaya, Kuala Lumpur

Editorial Committee

(in alphabetical order)

Dr. Alif Adlan Mohd Thabit Infectious Diseases Physician Hospital Selayang	**Dr. Nor Arisah Misnan** Infectious Diseases Physician Hospital Sungai Buloh
Anitha a/p Ramadas Pharmacist Hospital Kuala Lumpur	**Dr. Noridah binti Nordin** Consultant Infectious Diseases Physician Hospital Sultan Ismail Petra
Dr. Anjanna Kukreja Infectious Diseases Physician Universiti Malaya	**Dr. Rahela Ambaras Khan** Pharmacist Hospital Kuala Lumpur
Dr. Azureen binti Azmel Consultant Infectious Diseases Physician Hospital Tengku Ampuan Rahimah	**Dr. Rosmahani binti Mohd Ali** Consultant Geriatrician Hospital Kuala Lumpur
Chew Chia Zin Pharmacist Hospital Kuala Lumpur	**Siti Mallissa binti Mohd Shariff** Pharmacist Hospital Tengku Ampuan Rahimah
Dr. Kejal a/p Hasmukharay Consultant Geriatrician Universiti Malaya	**Dr. Steven Lim Chee Loon** Consultant Infectious Diseases Physician Hospital Raja Permaisuri Bainun
Dr. Lim Kah Chuan Infectious Diseases Physician Hospital Sultan Idris Shah	**Dr. Suvintheran Thangavelu** Infectious Diseases Physician Hospital Columbia Asia Seremban
Dr. Loh Jia Hui Infectious Diseases Physician Hospital Raja Perempuan Zainab II	**Dr. Tan Hui Loo** Geriatrician Hospital Tuanku Ja'afar Seremban
Dr. Yusliza Azreen binti Mohd Yusoff Consultant Geriatrician Hospital Raja Perempuan Zainab II	

External Reviewers

(in alphabetical order)

Dr. Benedict Sim Lim Heng
Consultant Infectious Diseases Physician
Hospital Sungai Buloh

Dr. Edward Chong Kah Chun
Consultant Geriatrician
Sunway Medical Centre

Dato' Dr. Ker Hong Bee
Consultant Infectious Diseases Physician
Hospital Raja Permaisuri Bainun

Dr. Leong Chee Loon
Consultant Infectious Diseases Physician
Hospital Kuala Lumpur

Contents

Copyright i
Disclaimer ii
Chief Editors' Preface iii
Editorial Committee v
External Reviewers vi
Abbreviations ix
Executive Summary x
Chapter 1 Introduction 1
1.1 Distinctive Challenges in Older Persons 1
Chapter 2 Epidemiology of Urinary Tract Infections in Older Persons 4
2.1 Burden of Disease 4
2.2 Health Economic Burden 4
2.3 Microbiology and Antimicrobial Resistance 6
2.4 Impact of UTI in Older Persons 7
Chapter 3 Risk Factors and Clinical Presentations of Urinary Tract Infections in Older Persons 10
3.1 What makes older persons more susceptible to UTI? 10
3.2 How do UTIs present differently in older persons? 16
Chapter 4 Differentiating Asymptomatic Bacteriuria from Urinary Tract Infections 20
4.1 What is the difference between asymptomatic bacteriuria (ABU) and urinary tract infections (UTIs)? 20
4.2 What is the pathophysiology of ABU and its clinical relevance? 21
4.3 What is the prevalence of ABU and UTI in older persons? 23
4.4 Should urine culture be ordered for asymptomatic older persons? 25
4.5 How do we differentiate UTI from ABU in older persons, and why is it important to make this distinction? 25

Chapter 5 Diagnostic Approach to Urinary Tract Infections in Older Persons 28

5.1 What is the recommended best practice for urine specimen collection? 28

5.2 Are urinalysis and urine culture useful in diagnosing UTI in older persons? 30

5.3 Is delirium a reliable predictor of UTI in older persons? 32

5.4 How should we approach older persons with acute delirium? 33

5.5 What is the role of diagnostic imaging in diagnosing UTI in older persons? 35

Chapter 6 Antimicrobial Stewardship Principles 37

6.1 When should antimicrobial therapy be started? 37

6.2 Choosing empirical antimicrobial therapy 38

6.3 When should antimicrobial therapy be de-escalated or stopped in older persons with UTI? 39

6.4 Treatment monitoring 45

Chapter 7 Non-antibiotic Prevention of Urinary Tract Infections in Older Persons 48

7.1 Should topical oestrogen be used to prevent recurrent urinary tract infections in postmenopausal women? 48

7.2 What general behavioural measures reduce the risk of UTIs in older persons? 48

7.3 How should incontinence absorbent products be managed to reduce UTI risk in older persons? 49

7.4 What strategies are recommended to prevent catheter-associated urinary tract infections (CAUTIs) in older persons? 50

7.5 Are cranberry products effective for cystitis prevention in older persons? 51

7.6 Do probiotics play a role in preventing UTIs in older women? 52

7.7 Is D-mannose effective for preventing recurrent UTIs in older persons? 52

7.8 What is the role of methenamine hippurate in non-antibiotic UTI prevention? 53

7.9 Is a urinary alkaliniser recommended as a preventive measure for recurrent urinary tract infection (rUTI) in older persons? 53

7.10 When do you consider long-term antibiotic prophylaxis in recurrent cystitis? 54

7.11 How do you evaluate older persons with recurrent UTI? 55

Abbreviations

Abbreviation	Term
ABU	Asymptomatic bacteriuria
ADLs	Activities of Daily Living
BPH	Benign prostatic hyperplasia
CAUTI	Catheter-Associated UTI
CFU/mL	Colony-forming units per millilitre
CT	Computed tomography
ESBL	Extended-spectrum β-lactamase
GSM	Genitourinary Syndrome of Menopause
MDR	Multidrug-resistant
MSU	Midstream Urine
MyICID	Malaysian Society of Infection Control and Infectious Diseases
MSGM	Malaysian Society of Geriatric Medicine
NAG	National Antimicrobial Guideline
NSAR	National Antibiotic Resistance Surveillance
UTI / UTIs	Urinary tract infection / infections

Executive Summary

Key Clinical Recommendations

01	**Assess before testing.** Order urine investigations only when new urinary symptoms or systemic features raise suspicion of UTI.
02	**Interpret results clinically.** Pyuria, positive dipstick findings or a positive urine culture alone do not establish UTI.
03	**Avoid screening for or treating asymptomatic bacteriuria.** This includes catheterized older persons, except before invasive urological procedures involving mucosal trauma.
04	**Do not routinely attribute delirium to UTI.** Evaluate and manage other potential causes. In the absence of urinary symptoms or systemic signs of infection, bacteriuria alone does not warrant antibiotic treatment.
05	**Treat suspected sepsis promptly.** Initiate appropriate empirical antibiotics while investigating both urinary and non-urinary sources.
06	**Collect specimens correctly.** Obtain midstream urine where feasible. For catheterized patients, sample aseptically from the sampling port or a newly replaced catheter when indicated, never from the drainage bag.
07	**Individualise antibiotics.** Follow the Malaysian National Antimicrobial Guideline, considering severity, susceptibility results, renal function and drug interactions. Use the narrowest effective agent for the shortest effective duration.
08	**Review treatment within 48–72 hours.** Reassess the diagnosis, narrow therapy, switch to oral treatment when appropriate, and stop antibiotics when no longer indicated.
09	**Minimise catheter use.** Use only when indicated, maintain appropriate catheter care, review necessity daily and remove promptly.
10	**Prioritise prevention.** Address hydration, toileting, constipation and continence care. Offer vaginal oestrogen to suitable postmenopausal women with recurrent UTI. Reserve long-term antibiotic prophylaxis for selected patients.

CHAPTER 1

Introduction

The older population experiences a high burden of urinary tract infections (UTIs) and related antimicrobial exposure. The development of this consensus statement aims to balance preventing harm from untreated symptomatic infection against the well-established risks of treating asymptomatic bacteriuria (ABU), particularly in long-term care and hospital settings [1–3]. This duality influences diagnostic standards specific to older persons and serves as the foundation for current antimicrobial stewardship initiatives and the development of this consensus statement.

1.1 Distinctive Challenges in Older Persons

In older persons, UTIs may present with non-specific or systemic symptoms such as loss of appetite, delirium, falls, lethargy, or functional decline rather than classic dysuria or frequency. This complicates clinical decision-making and increases the risk of inappropriate antibiotic use if criteria rely solely on conventional urinary symptoms [1,4,5]. A key clinical challenge is differentiating symptomatic UTI from ABU. While the presence of urinary symptoms or systemic signs of infection in an appropriate clinical context supports a diagnosis of UTI, frailty-related manifestations such as delirium or functional decline are non-specific and should not, in isolation, prompt antibiotic therapy. Careful clinical evaluation is therefore essential to avoid reflexive and inappropriate antibiotic prescribing for bacteriuria in the absence of true infection [2,5,6].

It is also important to acknowledge that frailty may alter the clinical presentation of infections. Hence, we include brief guidance on evaluating delirium, confusion, functional decline, falls, and non-specific malaise as potential infection signals in frail individuals, with clear pathways to determine when to pursue urine culture, imaging, or other diagnostics. This consensus statement incorporates diagnostic stewardship principles to reduce overdiagnosis and overtreatment in this population [1,4,7].

Asymptomatic bacteriuria affects up to 20% of older persons, particularly in women [8]. Incidence may increase up to 50% among those with catheters or institutional living arrangements [8,9]. Treating ABU does not improve outcomes and can cause adverse events, antimicrobial resistance, and *Clostridioides difficile* infection risks [10,11]. Consensus guidelines and population-based observations consistently advocate against routine treatment of ABU in most older persons, including those with frailty, unless specific indications are met (e.g., planned urologic procedures) [5,6,12,13].

Older persons often carry polypharmacy burdens, increasing the likelihood of drug–disease and drug–drug interactions, adverse drug events, and dosing errors. These factors influence antibiotic selection, duration, and monitoring, underscoring the need for stewardship-informed, patient-centred antibiotic prescribing in older populations [5,14,15]. Pharmacokinetic and pharmacodynamic changes with ageing, comorbidities (e.g., chronic

kidney disease, chronic liver disease, chronic heart failure, hypoalbuminemia, malnutrition, obesity), and frailty need to be addressed too.

Managing complex older persons requires coordinated input across disciplines, together with meaningful caregiver involvement. A multidisciplinary approach involving clinicians, nursing staff, pharmacists, geriatricians and caregivers should be adopted when assessing and managing recurrent or suspected UTIs, particularly in residents with dementia, frailty or complex care needs. Leverage stewardship programs and education to reduce ABU overtreatment while ensuring timely management of clinically significant infections [16–18].

References:

1. Gharbi M, Drysdale JH, Lishman H, Goudie R, Molokhia M, Johnson AP, et al. Antibiotic management of urinary tract infection in elderly patients in primary care and its association with bloodstream infections and all cause mortality: population based cohort study. BMJ. 2019;364:l525.
2. Keller SC, Feldman L, Smith J, Pahwa A, Cosgrove SE, Chida N. The Use of Clinical Decision Support in Reducing Diagnosis of and Treatment of Asymptomatic Bacteriuria. J Hosp Med. 2018;13(6):392–5.
3. Rousham E, Cooper M, Petherick E, Saukko P, Oppenheim B. Overprescribing antibiotics for asymptomatic bacteriuria in older adults: a case series review of admissions in two UK hospitals. Antimicrob Resist Infect Control. 2019;8:71.
4. Balogun SA, Philbrick JT. Delirium, a Symptom of UTI in the Elderly: Fact or Fable? A Systematic Review. Can Geriatr J. 2014;17(1):22–6.
5. Daniel M, Keller S, Mozafarihashjin M, Pahwa A, Soong C. An Implementation Guide to Reducing Overtreatment of Asymptomatic Bacteriuria. JAMA Intern Med. 2018;178(2):271–6.
6. Ackermann RJ, Monroe PW. Bacteremic urinary tract infection in older people. J Am Geriatr Soc. 1996;44(8):927–33.
7. Lozano-Vicario L, Garcia-Hermoso A, Cedeno-Veloz BA, Fernandez-Irigoyen J, Santamaria E, Romero-Ortuno R, et al. Biomarkers of delirium risk in older adults: a systematic review and meta-analysis. Front Aging Neurosci. 2023;15:1174644.
8. Kim KH, Yang HJ. Asymptomatic Bacteriuria in Older Adults – Diagnosis, Management, and Future Directions: A Narrative Review. Urogenit Tract Infect. 2025;20(2):58–66.
9. Jackson AA, Lai PSM, Alias AM, Atiya N, Ramdzan SN, Abdul Malik TF, et al. Pitfalls in diagnosis and management of suspected urinary tract infection in an urban tropical primary care setting. J Infect Dev Ctries. 2019;13(3):219–26.
10. Everitt KA, Baldwin M, Tinker N, Stuhr K, Morris DS, Veillette JJ. Outcomes associated with asymptomatic bacteriuria management in elderly patients hospitalized with a ground-level fall. Antimicrob Steward Healthc Epidemiol. 2025;5(1):e72.
11. Koves B, Cai T, Veeratterapillay R, Pickard R, Seisen T, Lam TB, et al. Benefits and Harms of Treatment of Asymptomatic Bacteriuria: A Systematic Review and Meta-analysis by the European Association of Urology Urological Infection Guidelines Panel. Eur Urol. 2017;72(6):865–8.
12. Anger J, Lee U, Ackerman AL, Chou R, Chughtai B, Clemens JQ, et al. Recurrent Uncomplicated Urinary Tract Infections in Women: AUA/CUA/SUFU Guideline. J Urol. 2019;202(2):282–9.
13. Rotjanapan P, Dosa D, Thomas KS. Potentially inappropriate treatment of urinary tract infections in two Rhode Island nursing homes. Arch Intern Med. 2011;171(5):438–43.
14. Akhtar A, Ahmad Hassali MA, Zainal H, Ali I, Khan AH. A Cross-Sectional Assessment of Urinary Tract Infections Among Geriatric Patients: Prevalence, Medication Regimen Complexity, and Factors Associated With Treatment Outcomes. Front Public Health. 2021;9:657199.

15. Petty LA, Vaughn VM, Flanders SA, Malani AN, Conlon A, Kaye KS, et al. Risk Factors and Outcomes Associated With Treatment of Asymptomatic Bacteriuria in Hospitalized Patients. JAMA Intern Med. 2019;179(11):1519–27.
16. Kuzma A, Critchlow E, Koelper N, Agrawal S, Dutcher L, Arya L. Symptom Documentation Before Antibiotics for Recurrent Urinary Tract Infections. Urogynecology (Phila). 2025;31(4):369–76.
17. Hartman EAR, Groen WG, Heltveit-Olsen SR, Lindbaek M, Hoye S, Sundvall PD, et al. Multifaceted antibiotic stewardship intervention using a participatory-action-research approach to improve antibiotic prescribing for urinary tract infections in frail elderly (ImpresU): study protocol for a European qualitative study followed by a pragmatic cluster randomised controlled trial. BMJ Open. 2021;11(10):e052552.
18. Forster J, Schulze P, Burger C, Krone M, Vogel U, Surat G. Combined Training Intervention Targeting Medical and Nursing Staff Reduces Ciprofloxacin Use and Events of Urinary Tract Infection. Adv Urol. 2022;2022:2474242.

CHAPTER 2

Epidemiology of Urinary Tract Infections in Older Persons

2.1 Burden of Disease

Urinary tract infections (UTIs) are among the most common bacterial infections in older persons and contribute substantially to morbidity and healthcare utilisation. Globally, UTIs account for over 400 million cases annually, with adults aged ≥65 years contributing disproportionately to UTI-related hospitalisations, complications, and mortality. Between 1990 and 2019, the global incidence and disability-adjusted life years attributable to UTIs increased significantly, largely reflecting population ageing [1–3].

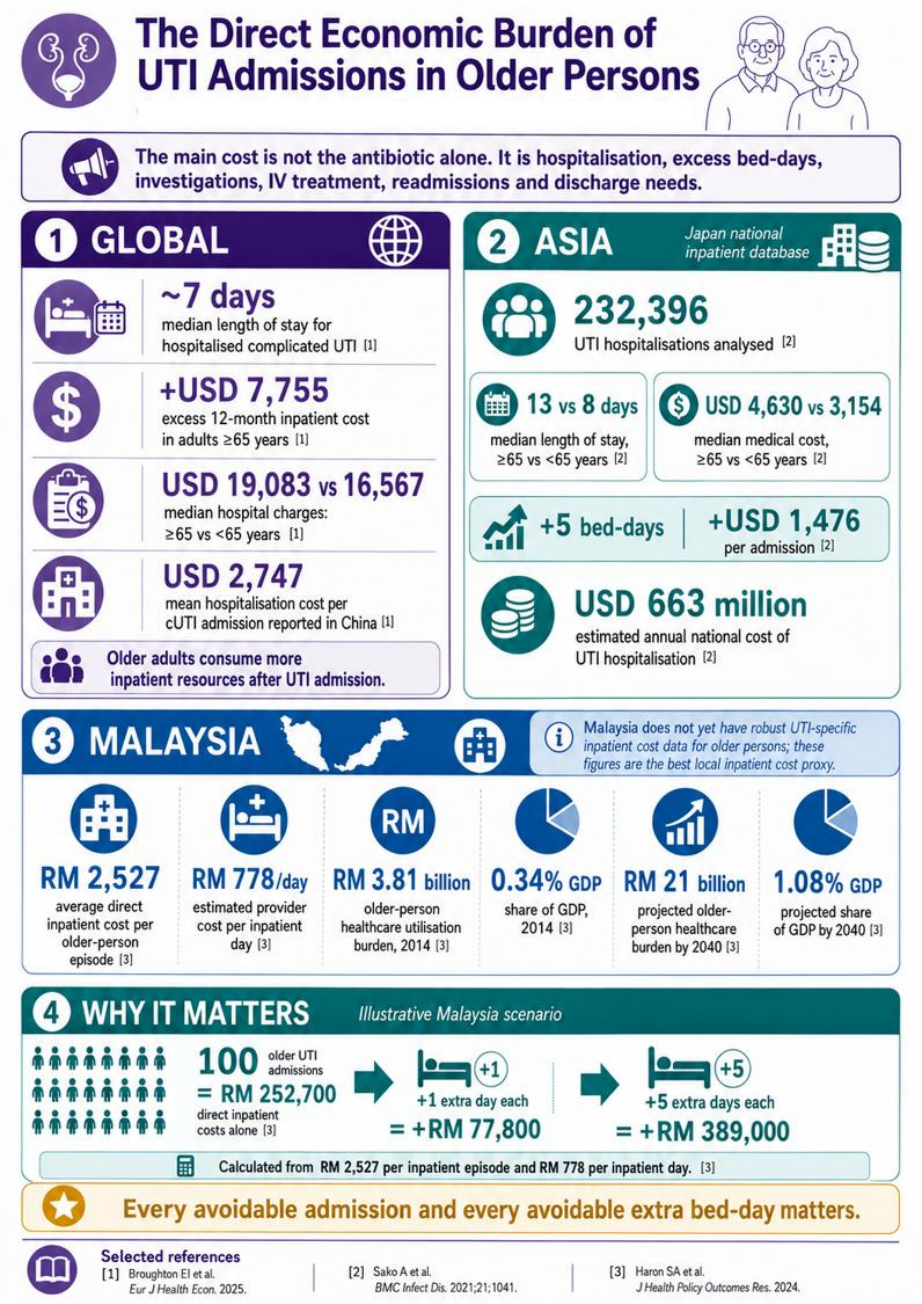
The Asia-Pacific region, which hosts over 60% of the world's older population, has experienced a marked rise in UTI burden among older persons. Regional analyses indicate higher UTI-related morbidity and mortality in older age groups, particularly in settings with increasing antimicrobial resistance and high healthcare utilisation among ageing populations [1,3,4].

In Malaysia, UTIs are consistently reported as one of the most common bacterial infections among older persons in both inpatient and outpatient settings. Hospital-based studies and national surveillance data indicate that UTIs are a frequent cause of admission among older patients and contribute substantially to antimicrobial prescribing, length of hospital stay, and healthcare costs [5–7]. While population-level prevalence data specific to older Malaysians remain limited, available local studies highlight significant variation in diagnostic and treatment practices, underscoring the need for standardised, context-specific guidance [6,8–9].

2.2 Health Economic Burden

Older persons admitted with UTI incur substantial direct healthcare costs, driven mainly by hospitalisation, excess bed-days, investigations, intravenous treatment and discharge-related care rather than antibiotic costs alone [10,11]. International and Asian data show that older persons with UTI have longer hospital stays and higher inpatient costs than younger patients [5,10]. In Malaysia, although UTI-specific costing data remain limited, rising ageing-related healthcare expenditure highlights the importance of preventing avoidable UTI admissions and reducing unnecessary inpatient bed-days [12,13].

Figure 2.1: The Direct Economic Burden of UTI Admissions in Older Persons



2.3 Microbiology and Antimicrobial Resistance

Microbiology of UTI in Older Persons

Escherichia coli remains the predominant uropathogen in older persons across community and healthcare settings [14–18]. Other commonly isolated Gram-negative organisms include *Klebsiella pneumoniae, Proteus mirabilis,* and other members of the Enterobacterales family [14,19]. Gram-positive organisms, particularly *Enterococcus* sp., are encountered more frequently among hospitalised patients, residents of long-term care facilities, and individuals with indwelling urinary catheters [20]. Less commonly, *Pseudomonas aeruginosa* and other non-fermenting Gram-negative bacilli are isolated, particularly in patients with recurrent UTIs, urinary tract abnormalities, recent instrumentation, or repeated healthcare exposure [19,20].

Antimicrobial Resistance

Antimicrobial resistance among uropathogens is an increasing challenge in the management of UTIs in older persons. Increasing age, recurrent antibiotic exposure, prior hospitalisation, residence in long-term care facilities, urinary catheterization, and structural urinary tract abnormalities all increase the likelihood of infection caused by extended-spectrum β-lactamase (ESBL)-producing Enterobacterales and other multidrug-resistant (MDR) organisms [21–23].

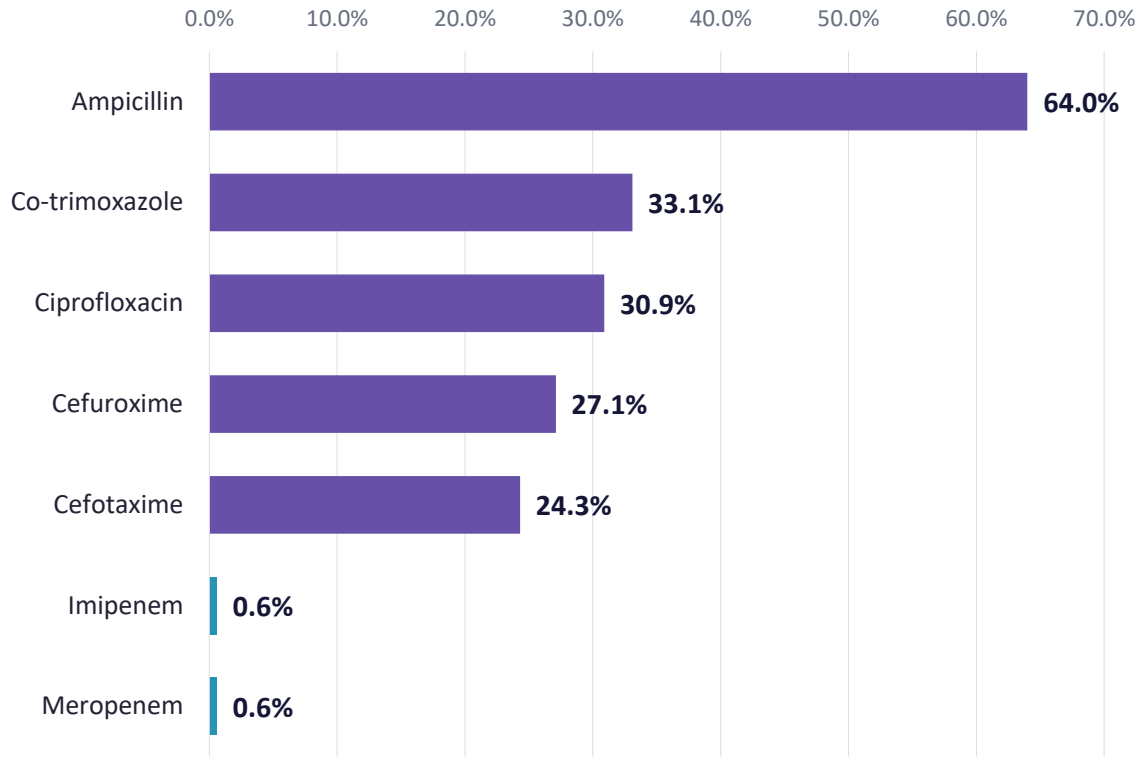
The Malaysian National Antibiotic Resistance Surveillance (NSAR) provides the most comprehensive national data on antimicrobial susceptibility patterns of urinary isolates [16]. However, these laboratory-based surveillance data are not restricted to clinically confirmed symptomatic UTIs and may include isolates from asymptomatic bacteriuria, catheter-associated bacteriuria, and other urine cultures submitted during routine clinical care. Consequently, the reported resistance rates should be interpreted as surveillance data on urinary isolates rather than resistance rates among symptomatic UTIs alone [16].

Despite this limitation, NSAR provides valuable information to guide empirical antimicrobial therapy in Malaysia. In the latest national registry data, resistance among urinary *E. coli* isolates remained high for several commonly used antibiotics, including ampicillin (64.0%), co-trimoxazole (33.1%), ciprofloxacin (30.9%), cefuroxime (27.1%), and cefotaxime (24.3%), whereas resistance to carbapenems remained low, with both imipenem and meropenem resistance reported at 0.6% respectively [16].

Community surveillance has generally demonstrated lower antimicrobial resistance rates than those observed among hospital isolates. Nevertheless, ESBL-producing Enterobacterales and carbapenem-resistant organisms have also been identified in community settings, highlighting that antimicrobial resistance is no longer confined to hospitals. The detection of resistant organisms among patients presenting from the community may, in part, reflect previous healthcare and antimicrobial exposures, including prior colonization or infection with an ESBL-producing or multidrug-resistant organism, recent antimicrobial therapy, recent hospitalisation, residence in a long-term care facility,

recurrent urinary tract infection, recent urological instrumentation, or the presence of indwelling urinary devices. These factors should therefore be considered when assessing the likelihood of resistant uropathogens and selecting empirical antimicrobial therapy [16].

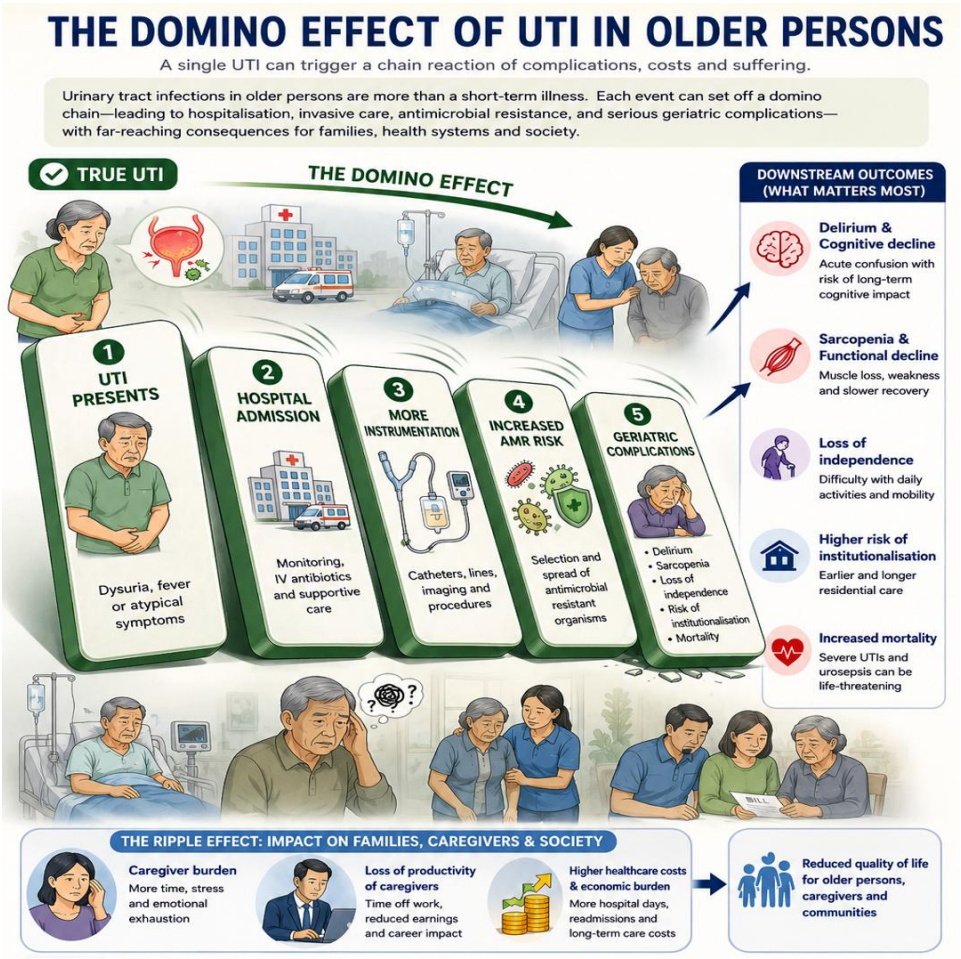
Figure 2.2: Antimicrobial Resistance Among Urinary *Escherichia coli* Isolates: National Antibiotic Resistance Surveillance Report 2025



2.4 Impact of UTI in Older Persons

A UTI in an older person may begin as a localised infection, but its consequences can extend well beyond the urinary tract. In vulnerable older persons, the ensuing cascade may include hospitalisation, instrumentation, antimicrobial exposure, complications of acute illness, functional decline and deconditioning, loss of independence, and increasing caregiver burden. Delirium may occur during an acute illness, including infection, but not all older persons with UTI develop delirium, and delirium alone should not be regarded as evidence of UTI without compatible urinary or systemic features. Conversely, misattributing delirium or other non-specific symptoms to UTI, or treating asymptomatic bacteriuria unnecessarily, may initiate a parallel cascade of avoidable antimicrobial exposure, adverse drug effects, antimicrobial resistance, recurrent healthcare utilisation and caregiver burden [5,6,8,10–13,24,25].

Figure 2.3: The Domino Effect of UTI in Older Persons



References:

1. Zeng Z, Zhan J, Zhang K, Chen H, Cheng S. Global, regional, and national burden of urinary tract infections from 1990 to 2019: an analysis of the global burden of disease study 2019. World J Urol. 2022;40(3):755–63.
2. Global Burden of Disease Collaborative N. Global Burden of Disease Study 2019 (GBD 2019) Results. Seattle, United States: Institute for Health Metrics and Evaluation (IHME); 2020.
3. United Nations DoE, Social Affairs PD. World Population Prospects 2022: Summary of Results. New York: United Nations; 2022.
4. Sulis G, Sayood S, Gandra S. Antimicrobial resistance in low- and middle-income countries: current status and future directions. Expert Rev Anti Infect Ther. 2022;20(2):147–60.
5. Akhtar A, Ahmad Hassali MA, Zainal H, Ali I, Khan AH. A Cross-Sectional Assessment of Urinary Tract Infections Among Geriatric Patients: Prevalence, Medication Regimen Complexity, and Factors Associated With Treatment Outcomes. Front Public Health. 2021;9:657199.
6. Gharbi M, Drysdale JH, Lishman H, Goudie R, Molokhia M, Johnson AP, et al. Antibiotic management of urinary tract infection in elderly patients in primary care and its association with bloodstream infections and all cause mortality: population based cohort study. BMJ. 2019;364:l525.

7. Daniel M, Keller S, Mozafarihashjin M, Pahwa A, Soong C. An Implementation Guide to Reducing Overtreatment of Asymptomatic Bacteriuria. JAMA Intern Med. 2018;178(2):271–6.
8. Jackson AA, Lai PSM, Alias AM, Atiya N, Ramdzan SN, Abdul Malik TF, et al. Pitfalls in diagnosis and management of suspected urinary tract infection in an urban tropical primary care setting. J Infect Dev Ctries. 2019;13(3):219–26.
9. Kim KH, Yang HJ. Asymptomatic Bacteriuria in Older Adults – Diagnosis, Management, and Future Directions: A Narrative Review. Urogenit Tract Infect. 2025;20(2):58–66.
10. Broughton E, Colosia A, Bektas M, Kuper K, Kotb R. Assessing the economic burden of complicated urinary tract infection: A systematic literature review. Eur J Health Econ. 2025.
11. Sako A, Yasunaga H, Matsui H, Fushimi K, Yanai H, Gu Y, et al. Hospitalization for urinary tract infections in Japan, 2010-2015: a retrospective study using a national inpatient database. BMC Infect Dis. 2021;21(1):1048.
12. Haron SA KR, Orhun NM, Nur AM, Aljunid SM, Shafie AA. Economic burden of healthcare utilisation by older persons living in the community in Malaysia. J Health Policy Outcomes Res. 2024.
13. Ministry of Health Malaysia. Annual Report 2024: Infection Prevention & Control and Antimicrobial Resistance Containment Programme. Malaysia: Ministry of Health Malaysia; 2025.
14. Rowe TA, Juthani-Mehta M. Diagnosis and management of urinary tract infection in older adults. Infect Dis Clin North Am. 2014;28(1):75–89.
15. Rowe TA, Juthani-Mehta M. Urinary tract infection in older adults. Aging health. 2013;9(5):519-528.
16. Institute for Medical Research. National Antibiotic Resistance Surveillance Report 2025. Kuala Lumpur: National Institutes of Health, Ministry of Health Malaysia; 2025.
17. Cortes-Penfield NW, Trautner BW, Jump RLP. Urinary Tract Infection and Asymptomatic Bacteriuria in Older Adults. Infect Dis Clin North Am. 2017;31(4):673–88.
18. Pandita AK, Raina D, Arora T, Ohri P. Evaluation of urinary tract infections in geriatric patients attending a tertiary care hospital. Panacea Journal of Medical Sciences. 2020;10(2):90–5.
19. Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. Nat Rev Microbiol. 2015;13(5):269–84.
20. Genao L, Buhr GT. Urinary Tract Infections in Older Adults Residing in Long-Term Care Facilities. Ann Longterm Care. 2012;20(4):33–8.
21. Artero A, Esparcia A, Alberola J, Madrazo M, Nogueira JM, Eiros JM. Prospective cohort study of risk factors for extended-spectrum ß-lactamase-producing Escherichia coli urinary tract infections in elderly patients admitted to hospital. Int J Clin Pract. 2017 Sep;71(9). doi: 10.1111/ijcp.13001. Epub 2017 Sep 5. PMID: 28873266.
22. Karlovic K, Nikolic J, Arapovic J. Ceftriaxone treatment of complicated urinary tract infections as a risk factor for enterococcal re-infection and prolonged hospitalization: A 6-year retrospective study. Bosn J Basic Med Sci. 2018;18(4):361–6.
23. Delpech G, Allende NG, Lissarrague S, Sparo M. Antimicrobial Resistance of Uropathogenic Escherichia coli from Elderly Patients at a General Hospital, Argentina. The Open Infectious Diseases Journal. 2018;10:79–87.
24. Lui SMT, Carr F, Gibson W. Diagnosis of urinary tract infections in the hospitalized older adult population in Alberta. Plos One. 2024;19(6).
25. Jung J, Moon SM, Kim DY, Kim SH, Lee WJ, Heo ST, et al. Appropriateness of antibiotic use for patients with asymptomatic bacteriuria or urinary tract infection with positive urine culture: a retrospective observational multi-centre study in Korea. J Hosp Infect. 2023;140:79–86.

CHAPTER 3

Risk Factors and Clinical Presentations of Urinary Tract Infections in Older Persons

Case vignette

Mr. A, an 82-year-old man, resident of a nursing home, with background history of:

- Stroke with limited mobility (wheelchair-bound)
- Requires assistance with basic activities of daily living
- Long-term indwelling urinary catheter for chronic urinary retention due to benign prostatic hyperplasia

Nursing staff noticed:

- Acute confusion (disorientated to place and person)
- Low-grade fever (37.8 °C)
- Reduced appetite

What makes older persons more susceptible to UTIs?

How do UTIs present differently in older persons?

3.1 What makes older persons more susceptible to UTI?

Urinary tract infections (UTIs) in older persons are usually **multifactorial**, due to a complex interplay of [1–4]:

- age-related physiological changes
- functional and environmental factors
- co-existing medical conditions (systemic illnesses, local urinary tract abnormalities)
- urinary catheter use
- medications associated with an increased risk of UTI

Understanding these contributing elements is crucial for effective prevention, diagnosis, and management.

3.1.1 Age-Related Physiological Changes

Ageing is associated with altered immune functions, urinary tract system physiology and hormonal mechanisms. However, not all of these are inevitable or clinically significant consequences of normal ageing.

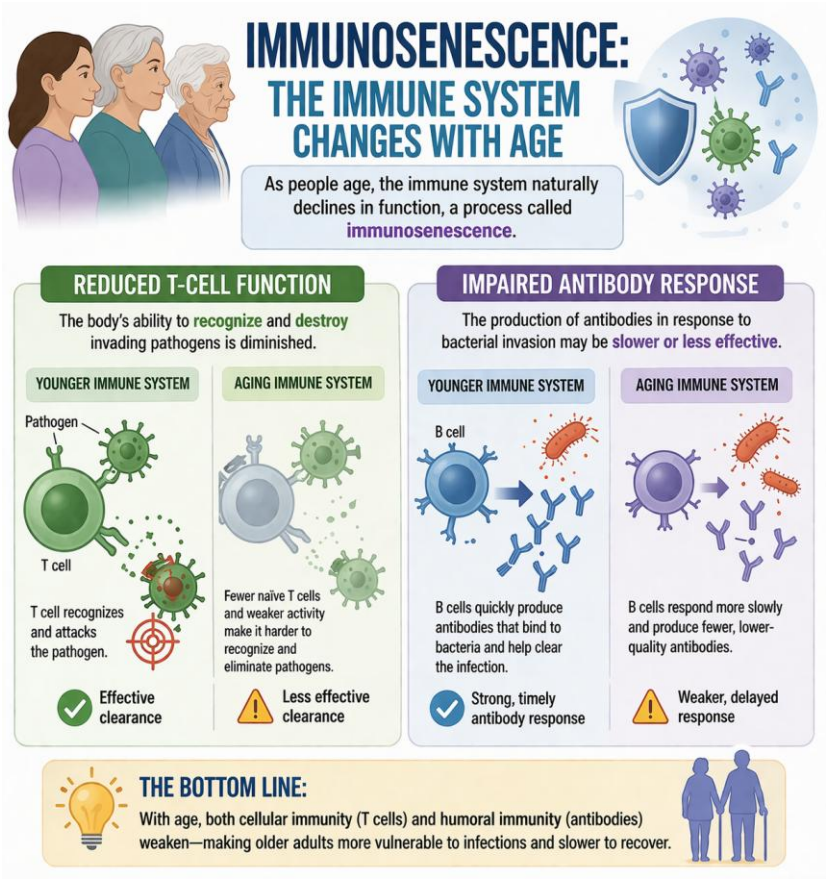
Immunosenescence

As people age, the immune system naturally declines in function, a process called immunosenescence [1,2].

- **Reduced T-cell Function:** The body's ability to recognize and destroy invading pathogens is diminished.
- **Impaired Antibody Response:** The production of antibodies in response to bacterial invasion may be slower or less effective.

As a result, older persons with UTI have changes in systemic inflammatory responses. Hence, the clinical presentation of UTI can be variable and may also present atypically, for example, lack of fever [1,2].

Figure 3.1: Immunosenescence in Older Persons [1,2]



Changes in the Urinary Tract

Age-associated structural and functional changes in the urinary tract create an environment more conducive to bacterial growth and colonization [1,2].

Figure 3.2: Age-Related Changes in the Urinary Tract in Older Persons

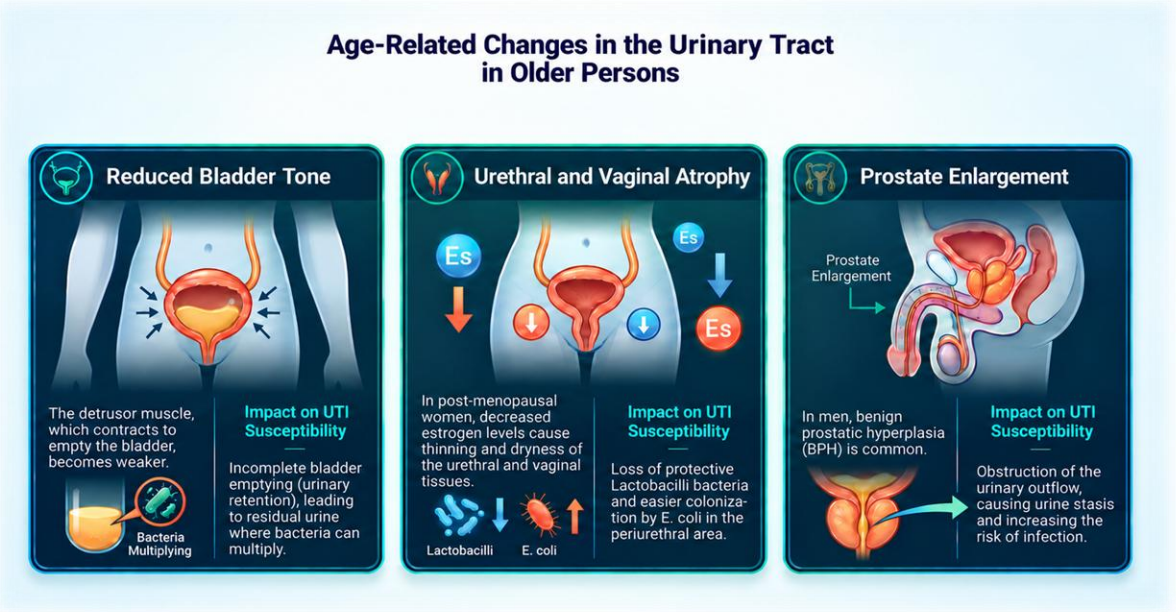


Table 3.1: Age-Related Changes in the Urinary Tract in Older Persons

Factor	Description	Impact on UTI Susceptibility
Reduced Bladder Tone	The bladder may develop impaired contractility with increased post-void residual volume.	Incomplete bladder emptying (urinary retention), leading to urine stasis with a greater likelihood of bacterial persistence.
Urethral and Vaginal Atrophy (leading to genitourinary syndrome of menopause)	In post-menopausal women, decreased oestrogen levels cause thinning and dryness of the urethral and vaginal tissues, as well as changes in the vaginal microbiome.	Loss of protective *Lactobacilli* bacteria and easier colonization by *E. coli* in the periurethral area.
Prostate Enlargement	Benign prostatic hyperplasia (BPH) and bladder outlet obstruction become more prevalent with increasing age in men.	Obstruction of the urinary outflow, causing urine stasis and increasing susceptibility to UTI.

3.1.2 Functional and Environmental Factors

Increased susceptibility to bacteriuria and symptomatic UTI in older persons may be contributed by functional impairment, reduced mobility, dependence on caregivers and the care environment [3].

Immobility and Incontinence

Reduced mobility, whether due to frailty or illness, may contribute to UTI [3]:

- **Difficulty with Hygiene:** Reliance on caregivers for toileting and personal hygiene may increase the risk of perineal contamination or even delayed toileting.
- **Constipation:** Constipation or faecal impaction may contribute to bladder dysfunction, urinary retention with impaired emptying, especially in frail or neurologically impaired older persons.
- **Incontinence (urinary, faecal):** This is associated with UTI due to various factors, including perineal contamination, dependence on toileting, and use of absorbent pads.

Institutionalization

Residents in long-term care facilities and nursing homes often have higher rates of UTIs due to increased use of invasive devices, and dependency on caregivers for toileting and hygiene [3,5].

3.1.3 Co-existing Medical Conditions

Chronic diseases become more prevalent in older persons. Some medical conditions may predispose them to UTIs due to their effect on immune function, bladder emptying or alteration to urogenital anatomy or mucosal defence [1,2].

Diabetes Mellitus

Poorly controlled blood sugar levels can lead to:

- **Glucosuria:** Excess glucose in the urine provides a rich nutrient source for bacterial growth. It is essential to differentiate glycosuria due to uncontrolled diabetes from SGLT-2 inhibitor induced glycosuria, as failing to properly identify the underlying cause of the glycosuria leads to dangerous diagnostic errors, inappropriate drug discontinuation, or overlooked severe metabolic decline.
- **Impaired Immunity:** Diabetes itself can suppress the immune system.
- **Autonomic neuropathy**: Urinary retention

Neurological Conditions

Conditions that affect nerve function can impair bladder control and sensation.

- **Stroke, Parkinson's disease, spinal diseases:** These can cause neurogenic bladder dysfunction, leading to severe urinary incontinence or chronic retention. In addition, urinary symptoms are under-reported among those with cognitive impairment.
- For those with **dementia**, bladder dysfunction may be neurogenic, functional or due to impaired cognition itself. This may result in poor recognition of urinary symptoms, inability to communicate needs or locate toilets.
- The use of anticholinergic medications to manage these conditions can exacerbate urinary retention by blocking the receptors needed for the bladder to contract and empty. The detrusor muscle of the bladder depends on **muscarinic (M3) receptors** to contract. When these receptors are blocked, the bladder is unable to contract effectively, leading to retention.

Local Urinary Tract Abnormalities

- Examples: BPH, urethral strictures, urolithiasis, pelvic organ prolapse, malignancies

3.1.4 Urinary Catheter Use

Long-term use of urinary catheters is one of the most important risk factors for UTIs, often leading to asymptomatic bacteriuria that may progress to symptomatic infection [5,6].

- Catheters introduce bacteria directly into the bladder by bypassing natural urethral defence.
- They provide a surface for bacteria to form biofilms (structured, cooperative community of microorganisms that attaches to a surface and encases itself in a self-produced, gel-like matrix of extracellular polymeric substances - often called "slime"), which are resistant to antibiotics and the body's immune response.
- The risk increases with:
  - Duration of catheterization (bacteriuria develops in about 10% per catheter-day) Based on US CDC data, the daily risk of bacteriuria with catheterization is 3% to 10%, approaching 100% after 30 days, which is considered the delineation between short and long-term catheterization
  - Unnecessary catheterization in the absence of a clear clinical indication, or inappropriate catheterization practices.
  - Breaks in closed system
  - Catheter manipulation and poor catheter care

Hence, the most effective preventive measure would be to avoid unnecessary catheterization and remove catheters as soon as they are no longer indicated.

3.1.5 Medications associated with an increased risk of UTI

Table 3.2: Medications Associated with an Increased Risk of UTI [4]

Medications	Description	Impact on UTI Susceptibility
SGLT2 inhibitors	Sodium–glucose cotransporter 2 inhibitors, including canagliflozin, dapagliflozin and empagliflozin, increase urinary glucose excretion.	Glycosuria may increase glucose availability in the urinary and genital tract, potentially facilitating microbial growth and colonization.
Immunosuppressive agents	Includes glucocorticoids, azathioprine, cyclosporine, sirolimus and mycophenolate mofetil. These agents suppress local and systemic immune responses.	Impaired host immune defence may increase susceptibility to bacterial colonization and urinary tract infection.
Anticholinergic and bladder-relaxing medications	Includes antimuscarinic agents, antihistamines, antiparkinsonian agents, β-adrenergic agonists, calcium channel blockers, opioids and sedatives. These medications may affect bladder contractility or normal micturition.	Impaired bladder emptying may result in urinary retention and stasis, facilitating bacterial persistence and colonization.
Medications associated with voiding dysfunction	Benzodiazepines, opioids, calcium channel blockers and NSAIDs may contribute to detrusor dysfunction, altered voiding reflexes or impaired neural control of micturition in susceptible individuals.	Delayed or incomplete bladder emptying may promote urinary stasis and increase the likelihood of bacterial persistence.
Medications associated with urinary stone formation or altered urinary chemistry	Includes sulphonamides, ciprofloxacin, ampicillin, antacids, calcium, vitamin D and/or vitamin C, loop diuretics (e.g., furosemide), carbonic anhydrase inhibitors (e.g., acetazolamide) and xanthine oxidase inhibitors (e.g., allopurinol). Some drugs or metabolites may alter urinary pH or precipitate in the urinary tract.	Crystallization and urinary stone formation may lead to obstruction, urinary stasis or surfaces that facilitate bacterial persistence, potentially increasing the risk of UTI.

In conclusion, the comprehensive management of UTIs in older persons must therefore address not only the acute infection but also the underlying predisposing factors like those discussed above. Understanding the full scope of risk factors is a critical step in providing appropriate care.

3.2 How do UTIs present differently in older persons?

UTI symptoms in older persons may be less prominent and challenging to elicit. Additionally, non-specific symptoms (e.g. delirium, functional decline etc.) can be more common and easily missed or misattributed to other conditions [1,2].

Understanding these atypical presentations is crucial for prompt diagnosis and effective management. Accurate recognition is important to ensure timely treatment of true infection, while avoiding inappropriate antimicrobial treatment for non-specific symptoms or ABU.

3.2.1 Atypical Clinical Features of UTI in Older Persons

The characteristic signs of a UTI (such as painful urination or frequent urges) are frequently absent in older persons. Instead, the infection often manifests as vague, systemic, or neurological symptoms [1,2].

Acute Mental Status Change (Delirium)

Acute confusion or delirium is one of the most recognized but non-specific symptoms of infection in older persons [1,7].

- **Delirium / Acute Confusion:** A sudden change in attention, awareness and cognition. In older persons, particularly those with underlying dementia, delirium may be a prominent presenting feature of infection. However, delirium alone is not specific to UTI and should prompt assessment for urinary and non-urinary infections and non-infectious causes, including comparison with baseline cognition and function.

Functional and Behavioural Changes

A deterioration in overall well-being and daily function is a common warning sign of infection [1,2].

- **Falls:** New or increased frequency of falls.
- **Functional Decline:** A rapid decrease in the ability to perform Activities of Daily Living (ADLs).
- **Malaise, Anorexia, Fatigue:** Generalized feeling of being unwell, loss of appetite, and profound tiredness.
- **Behavioural Change:** Increased agitation, combativeness, or withdrawal.

Vague Urinary Symptoms

While classic symptoms may be absent, some non-specific changes to the urine may be noticed by the patient or caregivers.

- **Cloudy or foul-smelling urine:** These findings are common, especially in patients on long-term urinary catheters, but they are not specific to UTI and can be present with simple dehydration or asymptomatic bacteriuria [1]. They should not trigger urine testing or antibiotics on their own. Moreover, the appearance, colour, or smell of urine can be affected by certain food intake, supplements or medications [8,9]. Hence, it is not necessarily a sign of UTI.

3.2.2 Warning: Non-Specific Symptoms

It is important to recognize that many of the atypical symptoms listed above are common in older persons, and can be caused by numerous conditions other than a UTI.

Therefore, according to current guidelines, symptoms such as delirium, falls, or cloudy urine alone, are not diagnostic of UTI in older persons, unless accompanied by more localized genitourinary signs or severe systemic illness (e.g., fever, sepsis) [1,2].

If empirical antibiotics are initiated, comprehensive assessments, including assessment of alternative causes (infective and non-infective), should be done simultaneously. Empirical antibiotics should be discontinued if an alternative diagnosis is more likely.

For further details, refer to ***Chapter 5: Diagnostic Approach to Urinary Tract Infections in Older Persons*** and ***Chapter 6: Antimicrobial Stewardship Principles***.

In conclusion, signs and symptoms of pre-existing comorbidities can make the diagnosis of UTI in older persons difficult as the clinical assessment becomes challenging. Existing conditions in an older person such as impaired hearing, cognitive impairment and complex multimorbidities make communication and the reporting or recognition of symptoms by caregivers challenging, thereby complicating diagnosis [1,2,7].

A structured approach incorporating clinical assessment, functional evaluation, and environmental considerations is essential for the diagnosis and management of UTI, with the goal of improving the quality of life of older persons.

Figure 3.3: Atypical Clinical Features of UTI in Older Persons

UTI in Older Persons

Atypical presentation • Think beyond the usual symptoms

UTI symptoms in older persons may be less prominent and challenging to elicit.

Non-specific symptoms (e.g. delirium, functional decline) can be more common and easily missed or misattributed to other conditions.[1,2]



Why it matters?

Understanding these atypical presentations is crucial for prompt diagnosis and effective management. Accurate recognition ensures timely treatment of true infection, while avoiding inappropriate antimicrobial treatment for non-specific symptoms or ABU.

3.2.1 Atypical Clinical Features of UTI in Older Persons

The characteristic signs of a UTI (such as painful urination or frequent urges) are frequently absent in older persons. Instead, the infection often manifests as vague, systemic or neurological symptoms[1,2].

1. Acute Mental Status Change (Delirium)



- Acute confusion or delirium is one of the most recognized but non-specific symptoms of infection in older persons[1,7].

Key point:
Delirium / acute confusion = sudden change in attention, awareness and cognition. In older persons, especially those with dementia, it may be a prominent feature of infection. However, delirium alone is not specific to UTI and should prompt assessment for urinary and non-urinary infections and non-infectious causes, including comparison with baseline cognition and function.

2. Functional and Behavioural Changes



Falls
New or increased frequency of falls.

Functional Decline
Rapid decrease in the ability to perform Activities of Daily Living (ADLs).

Malaise, Anorexia, Fatigue
Generalized feeling of being unwell, loss of appetite, and profound tiredness.

Behavioural Change
Increased agitation, combativeness, or withdrawal.

3. Vague Urinary Symptoms

While classic symptoms may be absent, some non-specific changes to the urine may be noticed by the patient or caregivers.



Cloudy or foul-smelling urine:

- Common, especially in patients on long-term urinary catheters, but not specific to UTI.
- Can be present with simple dehydration or asymptomatic bacteriuria[1].
- Should not trigger urine testing or antibiotics on their own.
- Appearance, colour or smell of urine can be affected by certain foods, supplements or medications[8,9].

Hence, it is not necessarily a sign of UTI.

3.2.2 Warning: Non-Specific Symptoms

Many of the atypical symptoms listed above are **common** in older persons, and can be caused by numerous conditions other than a UTI.

Therefore, according to current guidelines, symptoms such as delirium, falls or cloudy urine alone, are not diagnostic of UTI in older persons, unless accompanied by more localized genitourinary signs or severe systemic illness (e.g., fever, sepsis)[1,2].

If empirical antibiotics are initiated, comprehensive assessments, including assessment of alternative causes (infective and non-infective), should be done simultaneously. Empirical antibiotics should be discontinued if an alternative diagnosis is more likely.

For further details, refer to Chapter 5: Diagnostic Approach to Urinary Tract Infections in Older Persons and Chapter 6: Antimicrobial Stewardship Principles.



Look deeper, Treat wiser

References: [1,2,7,8,9]

References

1. Mody L, Juthani-Mehta M. Urinary tract infections in older women: a clinical review. JAMA. 2014;311(8):844-854.
2. Rowe TA, Juthani-Mehta M. Urinary tract infection in older adults. Aging Health. 2013;9(5):519-528.
3. Caljouw MAA, den Elzen WPJ, Cools HJM, Gussekloo J. Predictive factors of urinary tract infections among the oldest old in the general population. BMC Med. 2011;9:57.
4. Dobrek L. Lower urinary tract disorders as adverse drug reactions—A literature review. Pharmaceuticals (Basel). 2023 Jul 20;16(7):1031. doi:10.3390/ph16071031.
5. Nicolle LE. Urinary tract infections in long-term-care facilities. Infect Control Hosp Epidemiol. 2001;22(3):167-175.
6. Saint S, Chenoweth CE. Biofilms and catheter-associated urinary tract infections. Infect Dis Clin North Am. 2003;17(2):411-432.
7. Dutta C, Pasha K, Paul S, Abbas MS, Nassar ST, Tasha T, et al. Urinary tract infection induced delirium in elderly patients: a systematic review. Cureus. 2022;14(12):e32333.
8. Jump RL, Crnich CJ, Nace DA. Cloudy, foul-smelling urine not a criteria for diagnosis of urinary tract infection in older adults. J Am Med Dir Assoc. 2016 Aug;17(8):754. doi:10.1016/j.jamda.2016.04.009.
9. Skrajnowska D, Bobrowska-Korczak B. The effects of diet, dietary supplements, drugs and exercise on physical, diagnostic values of urine characteristics. Nutrients. 2024 Sep 17;16(18):3141. doi:10.3390/nu16183141.

CHAPTER 4

Differentiating Asymptomatic Bacteriuria from Urinary Tract Infections

Case vignette

Mr Ali, an 84-year-old man, was seen in a primary care clinic for his routine biannual follow-up for his comorbidity care for hypertension, gout and dyslipidaemia. He complained of occasionally passing cloudy urine but denied any other symptoms such as fever, pain or dysuria. Urinalysis showed pyuria and urine culture grew ≥10^5 CFU/mL of *E. coli*. He was otherwise well, and his blood test results were unremarkable.

Does he have a urinary tract infection?

4.1 What is the difference between asymptomatic bacteriuria (ABU) and urinary tract infections (UTIs)?

Urinary tract infection (UTI)

Defined as an infection of the urinary system and may involve the lower or upper urinary tracts. A symptomatic UTI generally requires the presence of urinary tract–specific symptoms, such as acute dysuria, suprapubic pain, flank pain, or new changes in urine character (e.g., cloudy or turbid urine, visible haematuria, or unusual/foul odour), together with significant bacteriuria, typically defined as a quantitative urine culture of ≥10^5 colony-forming units/mL (CFU/mL) of a single bacterial species in one urine specimen [1–2].

Asymptomatic bacteriuria (ABU)

Defined as the presence of ≥10^5 colony-forming units (CFU)/mL of the same bacterial species in two consecutive urine specimens for women, or one for men, in the absence of symptoms specifically attributable to a UTI [1–2].

Asymptomatic pyuria

Defined as the presence of white blood cells or leucocytes in the urine without accompanying urinary tract–specific symptoms and, by itself, does not indicate urinary tract infection or the need for antimicrobial therapy [1–2].

ABU is common in older persons and, in most circumstances, is not associated with adverse outcomes and does not require antibiotic treatment. Multiple studies and guidelines support that pyuria or bacteriuria alone does not equate to infection [1–4]. Distinguishing infection from colonization is essential to prevent unnecessary antibiotic use and adverse events.

4.2 What is the pathophysiology of ABU and its clinical relevance?

The pathophysiology of ABU is not yet fully understood but is essentially a complex interplay between host vulnerability, neurological decline, and bacterial adaptation. Theoretically, it is a state of equilibrium: the host provides a stable environment due to impaired voiding and a reduced immune response, while the bacteria adapt to coexist with the host without triggering significant inflammation or symptomatic infection.

Host Vulnerability and Anatomical Factors

In older persons, particularly those residing in long-term care facilities, ABU may be driven by age-related structural and functional changes of the urinary tract that impair the normal clearance of bacteria.

- **Voiding Dysfunction:** Conditions such as benign prostatic hyperplasia (BPH), pelvic floor dysfunction, and neurogenic bladder secondary to neurological disorders can result in incomplete bladder emptying and increased post-void residual urine. Urinary stasis promotes bacterial colonization and persistence, and may increase the risk of subsequent symptomatic UTI.
- **Anatomical and Instrumentation-Related Factors:** Structural abnormalities of the urinary tract and the presence of urinary catheters, stents, or other urological devices, provide surfaces and pathways that facilitate bacterial adherence, biofilm formation, and persistent colonization.
- **Metabolic and Hormonal Changes:** Declining oestrogen levels after menopause lead to genitourinary changes collectively referred to as Genitourinary Syndrome of Menopause (GSM). Vaginal and periurethral atrophy, alterations in the genitourinary microbiota, and reduced local mucosal defences may facilitate colonization by uropathogens. In addition, comorbidities such as poorly controlled diabetes mellitus may impair host immune function and further increase susceptibility to bacterial colonization of the urinary tract.

Immunological Tolerance

A key physiological reason why ABU remains asymptomatic is the attenuation of the host inflammatory response to urinary tract colonization.

- **Genetic Factors:** Individuals with ABU often exhibit reduced expression of Toll-like receptor 4 (TLR4) or carry specific TLR4 gene polymorphisms. TLR4 is a key component of the innate immune system that recognizes bacterial pathogens and initiates inflammatory responses. Reduced TLR4 expression or altered receptor function may attenuate the host inflammatory response to urinary tract colonization, allowing bacteria to persist in the urinary tract without causing symptoms [5].
- **Diminished Innate Response:** In the absence of a strong innate immune trigger, the inflammatory cascade associated with symptomatic UTI is not activated. Consequently, patients do not develop the typical manifestations of UTI, such as dysuria, urinary urgency, frequency, suprapubic discomfort, or fever, despite the presence of bacteria in the urine.

Microbial Adaptation and Attenuation

The bacteria themselves undergo adaptations that enable long-term survival in the bladder:

- **Attenuated Virulence:** Bacterial strains associated with long-term asymptomatic colonization, particularly *Escherichia coli*, often exhibit reduced virulence compared with strains causing symptomatic UTI. These organisms are less likely to invade tissues or elicit a strong inflammatory response.
- **Genetic Adaptation:** During prolonged residence in the urinary tract, bacteria may acquire mutations or lose virulence-associated genes involved in adhesion, invasion, and immune activation. This adaptation favors coexistence with the host and reduces the likelihood of triggering symptoms that could lead to bacterial clearance.
- **Stable Ecological Niche:** Although antibiotic treatment may temporarily eradicate bacteriuria, recolonization is common because the underlying host factors remain unchanged. Low-virulence organisms may provide colonization resistance by occupying ecological niches, competing for nutrients and attachment sites, and inhibiting the growth of more pathogenic uropathogens. Thus, asymptomatic colonization is not necessarily harmful, and eradication of bacteriuria may disrupt a relatively stable microbial community without providing sustained clinical benefit.

Clinical Confounders in older persons

The pathophysiology is further complicated by age-related changes that mask or mimic symptoms:

- **Bladder Capacity:** Age-associated lower urinary tract changes, including reduced bladder capacity, detrusor overactivity, and nocturia, may cause urinary frequency even in the absence of infection.
- **Hydration Status:** Low fluid intake may result in concentrated, foul-smelling urine, which can be mistaken for symptomatic urinary tract infection despite the absence of infection-related symptoms. Concentrated urine may also cause bladder irritation and urinary urgency or frequency, further mimicking urinary tract infection.

In the vast majority of cases, withholding antibiotic treatment for ABU is the preferred clinical approach. This strategy preserves the existing urinary microbiota, minimises unnecessary exposure to antibiotics, reduces the risk of antimicrobial resistance, and avoids adverse drug events.

4.3 What is the prevalence of ABU and UTI in older persons?

Prevalence of ABU in older persons

In contrast to UTI, ABU is more common in older persons, with prevalence increasing with age in both men and women. In younger premenopausal women, the estimated prevalence of ABU is 1–5%, rising to 6–16% in women aged >65 years [1–2,4,6–7]. Among community-dwelling women aged >80 years, the prevalence approaches 20% [8]. In long-term care facilities, estimates are even higher, ranging from 25–50% in women [9].

In healthy young men, ABU is uncommon, with a reported prevalence of <1% [2,4,10]. Among community-dwelling men aged >65 years, the prevalence increases to approximately 5–10% [7–8]. In older men residing in long-term care facilities, the prevalence approaches that observed in women, ranging from 15–35% [9]. The prevalence of ABU increases further in the presence of comorbidities.

Urinary catheterization predisposes both men and women to ABU. The daily risk of acquiring bacteriuria with an indwelling urinary catheter is approximately 3–7%, and virtually all patients with chronic indwelling catheters develop bacteriuria due to biofilm formation [11]. Following catheter removal, a proportion of bacteriuria episodes resolve spontaneously.

The high prevalence of ABU among older persons contributes to the frequent misdiagnosis of UTI and inappropriate antibiotic prescribing, particularly in those presenting with non-specific symptoms.

Table 4.1: Estimated Prevalence of ABU Across Different Populations

Populations	Women	Men
Young healthy adults	1–5%	<1%
Community-dwelling older persons (>65 years)	6–16%	5–10%
Residents in long-term care facilities	25–50%	15–35%
Chronic indwelling urinary catheters	Nearly 100%	Nearly 100%

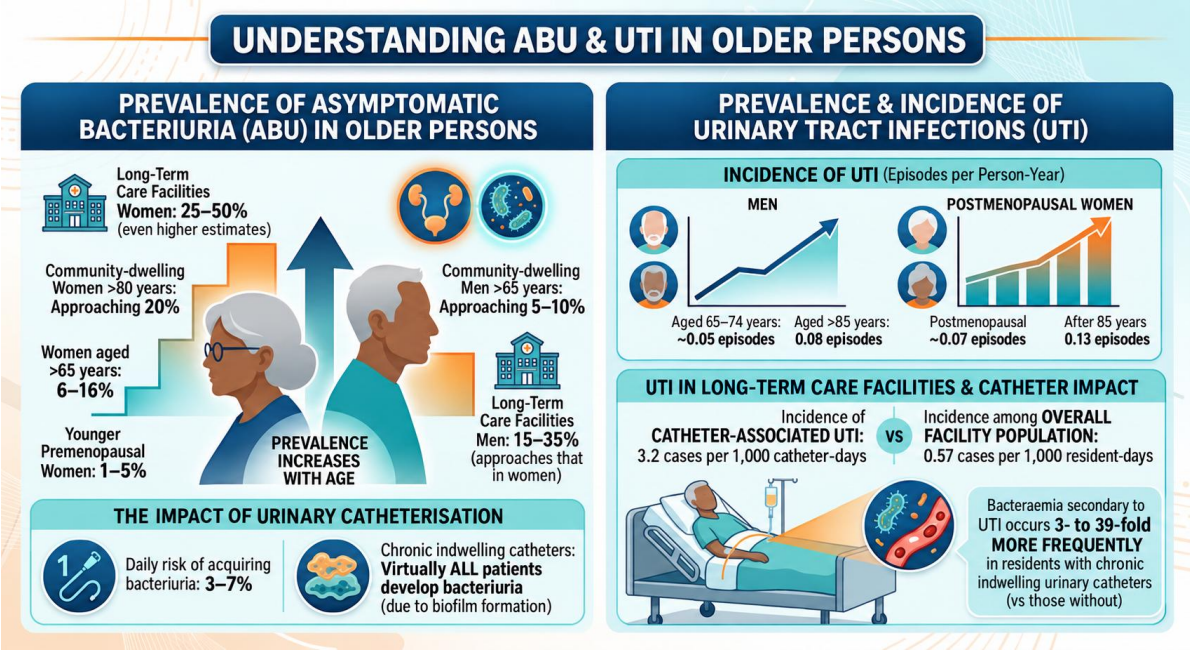
Prevalence of UTI in older persons

Among both community-dwelling and institutionalized older persons, the incidence of UTI increases with advancing age and differs by sex. In men, the incidence increases from approximately 0.05 episodes per person-year among those aged 65–74 years to 0.08 episodes per person-year in those aged >85 years [12–13]. In postmenopausal women, the incidence is approximately 0.07 episodes per person-year, increasing to 0.13 episodes per person-year after 85 years of age [13–14].

UTIs are among the most common healthcare-associated infections in long-term care facilities. A systematic review and meta-analysis found that UTIs accounted for approximately 39% of reported healthcare-associated infections in these settings [15].

UTIs are substantially more common in patients with chronic indwelling urinary catheters. In one long-term care facility, the incidence of catheter-associated UTI was 3.2 cases per 1,000 catheter-days, compared with 0.57 cases per 1,000 resident-days among the overall facility population. Furthermore, bacteremia secondary to UTI has been reported to occur 3- to 39-fold more frequently in residents with chronic indwelling urinary catheters than in those without catheters [9,16].

Figure 4.1: Epidemiology of Asymptomatic Bacteriuria and Urinary Tract Infection in Older Persons



Case vignette

Mrs Wong, a 64-year-old woman, was brought to the Emergency Department following a motor vehicle accident resulting in traumatic brain injury. She was intubated and planned for admission to the Neuro ICU in preparation for craniotomy. A urine culture was obtained during insertion of a urinary catheter in the Emergency Department following cerebral resuscitation and subsequently grew *E. coli*. There were no reported urinary symptoms prior to the trauma.

4.4 Should urine culture be ordered for asymptomatic older persons?

Current guidelines do not recommend screening for bacteriuria in asymptomatic older persons, including those who are community-dwelling, institutionalized, or have an indwelling urinary catheter. Randomized and observational studies have shown no reduction in mortality or symptomatic UTI with treatment of ABU. Therefore, screening for ABU is associated with unnecessary antibiotic use, increasing the risk of adverse effects and antimicrobial resistance.

Screening is indicated only prior to invasive urological procedures involving mucosal bleeding, such as transurethral resection of the prostate (TURP), where treatment is recommended before the procedure [2]. Routine follow-up urine cultures are not required.

For further information, please refer to the National Antimicrobial Guideline (NAG) at the link below:

National Antimicrobial Guideline 2024 – Urinary Tract Infections, Ministry of Health Malaysia

4.5 How do we differentiate UTI from ABU in older persons, and why is it important to make this distinction?

Differentiating symptomatic UTI from ABU in older persons is particularly challenging, especially among those residing in long-term care facilities. This is because older persons are less likely to present with classic localized genitourinary symptoms, and infections are often assessed in the context of non-specific presentations such as delirium, weakness, or functional decline.

The distinction is further complicated by the lack of standardized diagnostic criteria across epidemiological studies. Variability in definitions of UTI contributes to inconsistent reporting of incidence and prevalence, making it difficult to compare studies and increasing the risk of misclassification between UTI and ABU.

UTI remains one of the most common indications for antibiotic prescribing among older persons, particularly in long-term care settings. However, antimicrobial use in this population is frequently inappropriate, with up to 75% of antimicrobial use in long-term care facilities reported to be unnecessary or inappropriate. Inappropriate UTI-related prescribing is often driven by the misinterpretation of ABU or non-specific symptoms as evidence of infection [17–18].

Older persons are frequently treated with antibiotics based on positive urinalysis or urine culture and non-specific symptoms, such as acute delirium. Yet, studies have found no clear association between positive urine culture results and UTI in residents with fever [19], or between bacteriuria and symptoms such as malaise, anorexia, or fatigue [20].

One of the essential steps to avoid overdiagnosis of UTI is to adopt diagnostic stewardship, including judicious ordering of urinalysis and urine culture only when there is a high clinical suspicion of UTI.

References

1. Rowe TA, Juthani-Mehta M. Urinary tract infection in older adults. Aging health. 2013 Oct;9(5):519-528. doi: 10.2217/ahe.13.38. PMID: 24391677; PMCID: PMC3878051.
2. Nicolle LE, Bradley S, Colgan R, Rice JC, Schaeffer A, Hooton TM; Infectious Diseases Society of America; American Society of Nephrology; American Geriatric Society. Infectious Diseases Society of America guidelines for the diagnosis and treatment of asymptomatic bacteriuria in adults. Clin Infect Dis. 2005 Mar 1;40(5):643-54. doi: 10.1086/427507. Epub 2005 Feb 4. Erratum in: Clin Infect Dis. 2005 May 15;40(10):1556. PMID: 15714408.
3. Beveridge LA, Davey PG, Phillips G, McMurdo ME. Optimal management of urinary tract infections in older people. Clin Interv Aging. 2011;6:173-80. doi: 10.2147/CIA.S13423. Epub 2011 Jun 22. PMID: 21753872; PMCID: PMC3131987.
4. Nicolle LE, Gupta K, Bradley SF, Colgan R, DeMuri GP, Drekonja D, Eckert LO, Geerlings SE, Köves B, Hooton TM, Juthani-Mehta M, Knight SL, Saint S, Schaeffer AJ, Trautner B, Wullt B, Siemieniuk R. Clinical Practice Guideline for the Management of Asymptomatic Bacteriuria: 2019 Update by the Infectious Diseases Society of America. Clin Infect Dis. 2019 May 2;68(10):1611-1615. doi: 10.1093/cid/ciz021. PMID: 31506700.
5. Song J, Abraham SN. TLR-mediated immune responses in the urinary tract. Curr Opin Microbiol. 2008 Feb;11(1):66-73. doi: 10.1016/j.mib.2007.12.001. Epub 2008 Feb 1. PMID: 18243043; PMCID: PMC2775047.
6. Juthani-Mehta M. Asymptomatic bacteriuria and urinary tract infection in older adults. Clin Geriatr Med. 2007 Aug;23(3):585-94, vii. doi: 10.1016/j.cger.2007.03.001. PMID: 17631235.
7. Nicolle LE. Asymptomatic bacteriuria in the elderly. Infect Dis Clin North Am. 1997 Sep;11(3):647-62. doi: 10.1016/s0891-5520(05)70378-0. PMID: 9378928.
8. Rodhe N, Mölstad S, Englund L, Svärdsudd K. Asymptomatic bacteriuria in a population of elderly residents living in a community setting: prevalence, characteristics and associated factors. Fam Pract. 2006 Jun;23(3):303-7. doi: 10.1093/fampra/cml007. Epub 2006 Apr 4. PMID: 16595541.
9. Nicolle LE; SHEA Long-Term-Care-Committee. Urinary tract infections in long-term-care facilities. Infect Control Hosp Epidemiol. 2001 Mar;22(3):167-75. doi: 10.1086/501886. PMID: 11310697.
10. Nicolle LE. Asymptomatic bacteriuria: when to screen and when to treat. Infect Dis Clin North Am. 2003 Jun;17(2):367-94. doi: 10.1016/s0891-5520(03)00008-4. PMID: 12848475.
11. Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA; Healthcare Infection Control Practices Advisory Committee. Guideline for prevention of catheter-associated urinary tract infections 2009. Infect Control Hosp Epidemiol. 2010 Apr;31(4):319-26. doi: 10.1086/651091. PMID: 20156062.
12. Griebling TL. Urologic diseases in america project: trends in resource use for urinary tract infections in men. J Urol. 2005;173(4):1288–1294. doi: 10.1097/01.ju.0000155595.98120.8e.
13. Caljouw MA, Den Elzen WP, Cools HJ, Gussekloo J. Predictive factors of urinary tract infections among the oldest old in the general population. A population-based prospective follow-up study. BMC Med. 2011;9:57. doi: 10.1186/1741-7015-9-57.

14. Jackson SL, Boyko EJ, Scholes D, Abraham L, Gupta K, Fihn SD. Predictors of urinary tract infection after menopause: a prospective study. Am J Med. 2004;117(12):903–911. doi: 10.1016/j.amjmed.2004.07.045.

15. Bennett N, Tanamas SK, James R, Ierano C, Malloy MJ, Watson E, Sluggett JK, Dunt D, Thursky K, Worth LJ. Healthcare-associated infections in long-term care facilities: a systematic review and meta-analysis of point prevalence studies. BMJ Public Health. 2024 May 27;2(1):e000504. doi: 10.1136/bmjph-2023-000504. PMID: 40018192; PMCID: PMC11816188.

16. Smith PW, Nicolle LE. The Chronic Indwelling Catheter and Urinary Infection in Long-Term–Care Facility Residents. Infection Control & Hospital Epidemiology. 2001;22(5):316–21. doi:10.1086/501908

17. Morrill HJ, Caffrey AR, Jump RL, Dosa D, LaPlante KL. Antimicrobial Stewardship in Long-Term Care Facilities: A Call to Action. J Am Med Dir Assoc. 2016 Feb;17(2):183.e1-16. doi: 10.1016/j.jamda.2015.11.013. Epub 2016 Jan 6. PMID: 26778488; PMCID: PMC6348872.

18. D'Agata E, Loeb MB, Mitchell SL. Challenges in assessing nursing home residents with advanced dementia for suspected urinary tract infections. J Am Geriatr Soc. 2013 Jan;61(1):62-6. doi: 10.1111/jgs.12070. PMID: 23311553; PMCID: PMC3545416.

19. Orr PH, Nicolle LE, Duckworth H, Brunka J, Kennedy J, Murray D, Harding GK. Febrile urinary infection in the institutionalized elderly. Am J Med. 1996 Jan;100(1):71-7. doi: 10.1016/s0002-9343(96)90014-5. PMID: 8579090.

20. Boscia JA, Kobasa WD, Abrutyn E, Levison ME, Kaplan AM, Kaye D. Lack of association between bacteriuria and symptoms in the elderly. Am J Med. 1986 Dec;81(6):979-82. doi: 10.1016/0002-9343(86)90391-8. PMID: 3799658.

CHAPTER 5

Diagnostic Approach to Urinary Tract Infections in Older Persons

Case vignette

An 82-year-old nursing home resident presents with acute delirium but no urinary symptoms such as dysuria, frequency, suprapubic pain, or flank pain. She is afebrile and haemodynamically stable. Urinalysis shows 2+ leukocyte esterase and positive nitrites, and urine culture subsequently grows ESBL-producing *E. coli*.

Does she have a urinary tract infection?

5.1 What is the recommended best practice for urine specimen collection?

Urine specimen collection is important because the accuracy of laboratory results depends largely on how the sample is obtained. Proper collection minimises contamination from external sources and ensures that the results accurately reflect the patient's urinary tract, allowing reliable diagnosis of UTI in conjunction with clinical features.

Midstream Urine (MSU) Sampling

The goal of MSU is to flush out colonizing bacteria from the distal urethra and reduce contamination, so that the sample more accurately reflects the microbial environment of the bladder.

- **Pass the initial urine for 'a second or two':** Begin voiding into the toilet for 2–3 seconds (at least to remove the initial 15-30 mL of urine) before positioning the sterile container into the stream. This helps minimise contamination, although evidence supporting a specific duration or volume of urine to discard is limited.
- **No Antiseptics:** Use only plain water or saline-soaked gauze for periurethral cleansing. Antiseptic wipes (like alcohol or chlorhexidine) should be avoided as they can inhibit bacterial growth in the culture, leading to false negatives. Please refer to and follow local laboratory protocols for perineal cleansing, if available.
- **The "Mid-Stream" Capture:** Collect approximately 10–20 mL of urine without stopping the flow, then remove the container and finish voiding into the toilet. Please refer to local laboratory protocol for urine sample volume for urine culture.

Older persons often face mobility or cognitive challenges that make standard MSU difficult.

- **Assisted Collection:** If the patient is cognitively impaired or has dexterity challenges, a carer or clinician should assist with positioning, separation of the labia, where appropriate, or stabilisation of the collection container while maintaining aseptic technique during urine collection.
- **Role of "In-and-Out" (Straight) Catheters:** In-and-out catheterization should not be performed solely to obtain urine specimens when a patient can otherwise provide an adequate urine sample or when there is no clinical indication for urine testing. Unless the patient cannot void spontaneously or has significant retention, avoid invasive sampling to reduce the risk of introducing a new infection.
- **Non-Invasive Alternatives:** For incontinent patients without catheters, "clean-catch" can sometimes be achieved by using a specialized urine collection container in the commode.

Catheter Sampling

Sampling from an indwelling catheter is high-risk for contamination because of intraluminal biofilms.

- **Never Sample from the Bag:** Urine in the drainage bag is stagnant and colonized. It should never be used for culture.
- **The "Fresh Catheter" Rule:** If a catheter has been in place for a prolonged period, the most accurate practice for diagnosing a Catheter-Associated UTI (CAUTI) is to replace the catheter, where appropriate, and obtain the sample from a newly inserted one (or via a fresh straight-catheterization). This ensures you are culturing the bladder urine, not the biofilm on the previous catheter.
- **Aseptic Port Access (if a urine sampling port available):** It is recommended that urine samples be obtained from the designated needleless sampling port. The port should be scrubbed with 70% isopropyl alcohol for at least 15 seconds and allowed to dry. Please refer to local infection control protocol for further details.
- **Clamping (Optional):** If the tubing is empty, the drainage tube may be briefly clamped below the sampling port to allow urine to collect and facilitate urine sampling. Catheter clamping should only be performed when appropriate and in accordance with local hospital policy, if available.

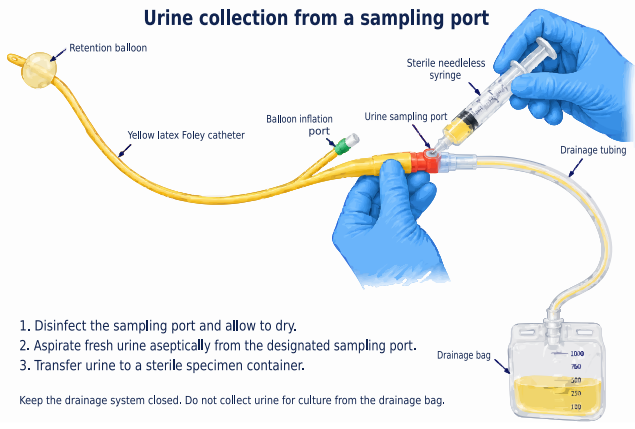


Figure 5.1: Urine Specimen Collection from the Sampling Port of a Closed Urinary Drainage System

Post-Collection Urine Sample Handling

- **The 1-Hour Window:** Ideally, the sample should reach the lab as soon as possible.
- **Refrigeration:** If processing is delayed, the urine sample should be refrigerated at 2–8°C. This helps to prevent bacterial multiplication and minimise changes that could affect urinalysis and urine culture results.
- **Sample preservation:** If refrigeration is not possible, follow the local laboratory protocol for appropriate urine sample preservation.

5.2 Are urinalysis and urine culture useful in diagnosing UTI in older persons?

UTI in older persons is primarily a clinical diagnosis, with urinalysis and urine culture serving as supportive rather than definitive diagnostic tools. In the absence of clinical features suggestive of UTI, abnormal urinalysis or a positive urine culture alone should not prompt antibiotic treatment.

Urinalysis (dipstick / microscopy):

Pyuria (≥10 WBCs/HPF or positive leukocyte esterase) is sensitive but non-specific. Its absence makes UTI less likely, but its presence alone does not confirm infection. Nitrite positivity suggests nitrate-reducing organisms such as *E. coli* and *Klebsiella*, but does not distinguish ABU from UTI. Bacteriuria on urinalysis is meaningful only when considered alongside the clinical presentation. Haematuria is non-specific, while a high number of squamous epithelial cells suggests contamination from the distal urethra or perineal area and may reduce the reliability of the urine culture result. Therefore, positive urine dipstick findings alone can be misleading in older persons and should not be used to diagnose UTI without supporting clinical features.

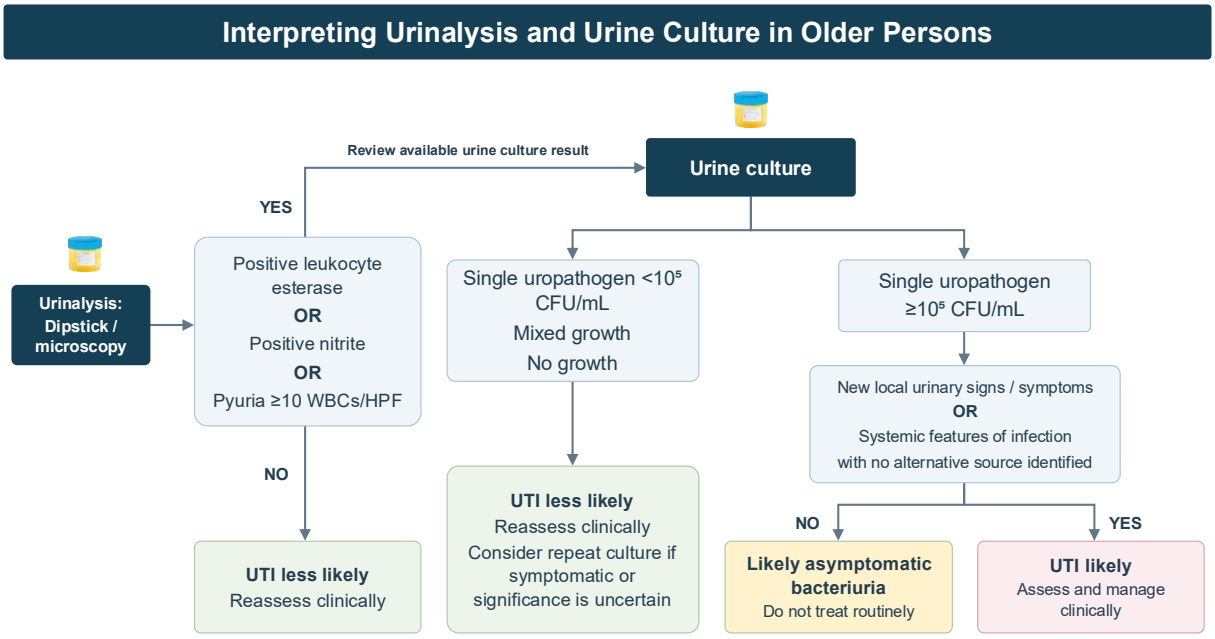
Urine culture:

Growth of uropathogens in a urine culture may represent either infection or colonization. Traditionally, ≥10^5 CFU/mL is considered significant bacteriuria, although lower thresholds (≥10^3–10^4 CFU/mL) may be clinically relevant in symptomatic patients. Heavy growth of a single uropathogen supports significant bacteriuria but does not necessarily indicate symptomatic UTI. Mixed growth may indicate contamination but can also occur with long-term catheterization or underlying urinary tract abnormalities and should therefore be interpreted in the clinical context. The high prevalence of ABU reduces the positive predictive value of urine culture for diagnosing UTI in older persons. A positive urine culture without clinical features of infection most likely represents ABU.

Table 5.1: Interpretation of Urinalysis and Urine Culture Findings in Older Persons

Test	Latest Evidence-Based Interpretation
Leukocyte Esterase	High sensitivity but low specificity. A negative test may help to rule out UTI, but a positive test is common in ABU and does not confirm infection.
Nitrites	Specifically produced by nitrate-reducing bacteria like *E. coli* and *Klebsiella* sp., but not specific for infection.
Pyuria (WBCs)	Sensitive but non-specific. If there are no WBCs in the urine, a UTI is unlikely. However, WBCs without symptoms may indicate ABU.
Urine Culture	Supports the diagnosis and guides antimicrobial treatment when symptomatic UTI is suspected. A positive urine culture with ≥10^5 CFU/mL in the absence of compatible symptoms may indicate ABU rather than UTI.

Figure 5.2: Interpreting Urinalysis and Urine Culture in Older Persons



Note:
- This algorithm applies when urine investigations have already been performed.
- Urine testing should be performed only when UTI is clinically suspected.
- In patients with sepsis or haemodynamic instability, initiate urgent assessment and treatment without waiting for urine results.

5.3 Is delirium a reliable predictor of UTI in older persons?

Delirium alone, in the absence of localizing urinary symptoms or systemic signs of infection, does not reliably indicate a UTI.

Delirium is a non-specific clinical syndrome with multiple potential causes, including medications (e.g. sedatives, anticholinergics, opioids), dehydration, hypoxia, hypoglycaemia, electrolyte disturbances, constipation, urinary retention, hunger, thirst, fatigue, uncontrolled pain, and various infections. Therefore, it has low specificity as a predictor of UTI in older persons.

Association does not equal causation

UTI and delirium can co-occur in older persons. A systematic review reported that among patients with delirium, the prevalence of UTI ranged from 25.9% to 32%, compared with 13% among those without delirium. Conversely, delirium was present in 30%–35% of patients with UTI, compared with 7.7%–8% among those without UTI [1]. However, this association does not necessarily imply causation.

In fact, no randomized controlled trials have evaluated this association. Although a small number of observational studies have examined the relationship between UTI and delirium, significant methodological limitations—including poor case definitions of both UTI and delirium and inadequate control of confounding factors—are likely to contribute to biased results [2].

Overdiagnosis due to asymptomatic bacteriuria

Despite this, delirium is widely regarded as an atypical presentation of UTI in older persons and often prompts routine evaluation for UTI whenever delirium occurs. This frequently includes urine cultures, which commonly yield positive results due to the high prevalence of ABU in older persons, particularly among residents of long-term care facilities. The association between delirium and UTI may therefore be overestimated, as bacteriuria detected in older persons presenting with confusion may reflect pre-existing ABU rather than true symptomatic UTI [3].

Consequently, clinicians who routinely investigate delirium for UTI may frequently identify bacteriuria and erroneously attribute delirium to UTI, leading to unnecessary antimicrobial treatment while delaying recognition and management of the true underlying cause of delirium.

5.4 How should we approach older persons with acute delirium?

In older persons presenting with acute delirium, clinicians should first undertake a comprehensive evaluation for all plausible causes, including common infections such as pneumonia and skin and soft tissue infections.

Routine or reflex urine testing in older persons with delirium is discouraged, as abnormal urine findings may lead to premature diagnostic closure and misattribution of delirium to UTI. This may delay recognition and treatment of the true underlying cause and potentially result in adverse outcomes. Urine investigations should be considered when there are localising urinary symptoms or signs, or systemic features suggestive of infection, such as fever or elevated inflammatory markers, while other potential causes of delirium are being assessed.

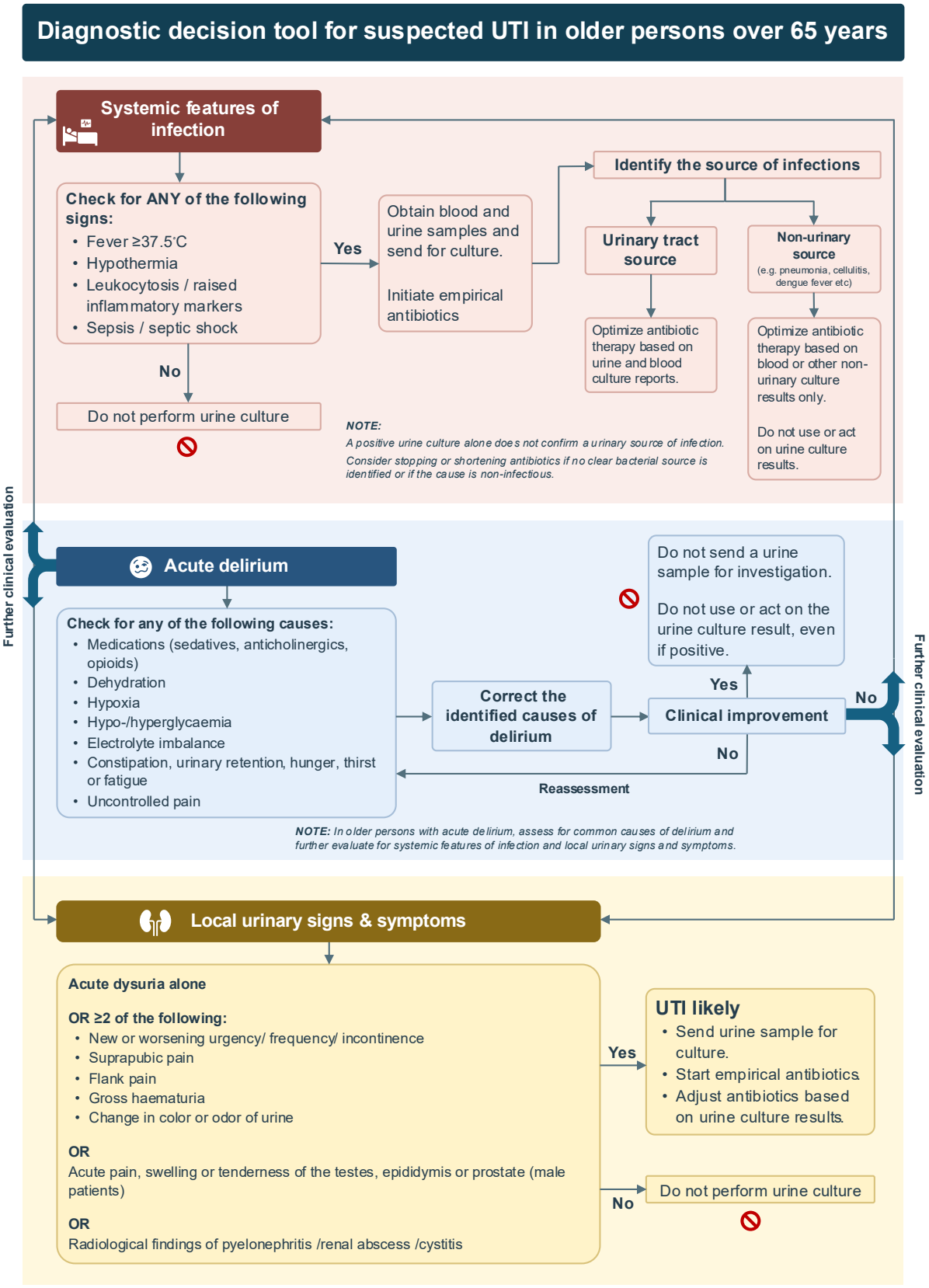
Antimicrobial stewardship considerations

If a positive urine culture is identified in the absence of an alternative cause of delirium and there is clinical evidence of sepsis, it may be reasonable to treat for presumed UTI while continuing further evaluation.

Clinicians should remain mindful of the risks of antibiotic overuse, particularly multidrug-resistant organisms and *Clostridioides difficile* infection, and should de-escalate or discontinue therapy promptly once an alternative diagnosis is established or clinical improvement occurs.

Importantly, in the context of sepsis from a non-urinary source, positive urine culture results alone should not prompt changes to ongoing therapy in a clinically improving patient, even if susceptibility testing suggests resistance to the current agent.

Figure 5.3: Diagnostic Decision Tool for Suspected UTI in Older Persons over 65 years



5.5 What is the role of diagnostic imaging in diagnosing UTI in older persons?

Imaging is not routinely indicated for the diagnosis of uncomplicated UTI in older persons. It should be considered when there are features suggesting a complicated or upper urinary tract infection, including recurrent infection, poor response to appropriate antimicrobial therapy, suspected urinary obstruction or structural abnormality, urolithiasis, pyelonephritis, or systemic features suggestive of sepsis, such as fever, rigors, or haemodynamic instability.

Common imaging modalities include renal ultrasonography and computed tomography (CT), selected according to the clinical scenario. The primary role of imaging is to identify underlying structural or obstructive abnormalities rather than to confirm infection, and its use should be based on clinical judgement.

Table 5.2: Quick Reference for Asymptomatic Bacteriuria and UTI Diagnosis in Older Persons

Topic	Key Points	Rationale / Notes
ABU Prevalence: Community-Dwelling	Young women: 1–5% Women >65: 6–16% Women >80: ~20% Young men: <1% Men >65: 5–10%	Increases with age; explains high background bacteriuria
ABU Prevalence: Long-Term Care	Women: 25–50% Men: 15–35%	High colonization; catheter use further increases risk
Catheter-Associated ABU	3–7% per day; chronic indwelling catheters ~100%	Biofilm formation → persistent bacteriuria
Screening Recommendations	Do not screen routinely Exception: prior to urologic procedures with mucosal bleeding	Treating ABU does not improve outcomes; increases antibiotic harm
UTI Diagnosis	Symptoms + bacteriuria ± pyuria/nitrites Culture ≥10^5 CFU/mL significant; lower counts may be significant if symptomatic	Avoid treating lab results without compatible symptoms
Urinalysis Interpretation	Pyuria: sensitive, not specific Nitrites: Specific for nitrate-reducing bacteria but do not distinguish bacteriuria from UTI	Do not test routinely without clinical suspicion of UTI. Urinalysis does not replace clinical diagnosis

Topic	Key Points	Rationale / Notes
Delirium & UTI	Delirium alone is not a reliable predictor Investigate urine only if localizing urinary symptoms or systemic infection signs	Reflex testing leads to overtreatment; consider all delirium causes
Imaging	Only for recurrent/complicated UTI, obstruction, stones, structural abnormalities, or sepsis	Identifies underlying cause, not infection itself

References

1. Balogun SA, Philbrick JT. Delirium, a Symptom of UTI in the Elderly: Fact or Fable? A Systematic Review. Can Geriatr J. 2014;17(1):22–6.
2. Mayne S, Bowden A, Sundvall PD, Gunnarsson R. The scientific evidence for a potential link between confusion and urinary tract infection in the elderly is still confusing - a systematic literature review. BMC Geriatr. 2019 Feb 4;19(1):32. doi: 10.1186/s12877-019-1049-7. PMID: 30717706; PMCID: PMC6360770.
3. Nace DA, Drinka PJ, Crnich CJ. Clinical uncertainties in the approach to long term care residents with possible urinary tract infection. *J Am Med Dir Assoc*. 2014;15(2):133–39.

CHAPTER 6

Antimicrobial Stewardship Principles

Antimicrobial stewardship is essential in older persons because of the high prevalence of asymptomatic bacteriuria (ABU), polypharmacy, multimorbidity, frailty, complex care needs, and increased risks of antimicrobial resistance and drug-related adverse events.

Case vignette

Mdm L is a 78-year-old woman with hypertension, ischemic heart disease, osteoarthritis and poorly controlled type 2 diabetes mellitus (HbA1c 9.3%). Over the preceding 48 hours, she had a persistent temperature of 37.3–37.4°C and dysuria. She subsequently became increasingly lethargic and confused, with poor oral intake, prompting her family to bring her to the hospital.

In the ED, Mdm L was febrile (38.5°C), tachycardic (105 bpm), and hypotensive (100/60 mmHg). Laboratory investigations showed leukocytosis (WBC 16.0 x 10^9/L) and elevated CRP (120 mg/L). Urinalysis showed leukocyte esterase +++, nitrites +, blood ++. Urine and blood cultures were collected.

She was admitted, received intravenous fluids and was treated empirically with IV amoxicillin/clavulanate.

On day 2 of admission, the urine culture grew *Escherichia coli* (>10^5 CFU/mL).

- The *E. coli* was sensitive to ceftriaxone, trimethoprim-sulfamethoxazole, ciprofloxacin, and amoxicillin/clavulanate.
- Blood cultures were negative.

Given Mdm L's favourable clinical trajectory and the conclusive urine culture result, outline your optimal antibiotic strategy.

6.1 When should antimicrobial therapy be started?

Antimicrobial therapy should be reserved for patients with clinical features consistent with symptomatic UTI (e.g. dysuria, urinary frequency/urgency, suprapubic pain, flank pain or costovertebral angle tenderness), or systemic signs (e.g. fever, urosepsis, or haemodynamic instability). Routine treatment based solely on bacteriuria, pyuria, or changes in mental status (such as delirium) without urinary symptoms is not recommended in older persons [1].

The presence of isolated bacteriuria (asymptomatic bacteriuria, ABU) should not prompt antibiotic treatment unless there is a clear indication (e.g. prior to urological procedures breaching the mucosa) [1].

Treat if [1–4]:

- Localizing urinary symptoms:
  - Dysuria
  - Urinary frequency or urgency
  - Suprapubic pain
  - Flank pain or costovertebral angle tenderness
- OR systemic features suggestive of infection:
  - Fever* or hypothermia
  - New or worsening delirium with no alternative explanation, *plus* objective systemic or genitourinary findings
  - Sepsis or urosepsis

*Fever in older persons is defined as a single oral temperature >37.8°C, or rectal temperatures >37.5°C, or persistent temperature >37.2°C or an elevation in body temperature of more than 1.1°C above the baseline [7].

Do not treat if [1–4]:

- Asymptomatic bacteriuria (ABU), including:
  - Incidental positive urine culture
  - Pyuria alone
  - Cloudy or foul-smelling urine in the absence of symptoms
- Chronic stable lower urinary tract symptoms (e.g. long-standing urgency, incontinence)

In delirious older persons who are unable to report urinary symptoms, the diagnosis of UTI should be based on objective systemic or genitourinary findings rather than urine results alone, with concurrent evaluation to exclude alternative causes.

6.2 Choosing empirical antimicrobial therapy

Once a diagnosis of UTI is established, antimicrobial therapy should be guided by the clinical classification and severity of infection. For recommended empirical antimicrobial choices, dosing and duration of therapy, please refer to the latest Malaysian National Antimicrobial Guideline (NAG) at the link below:

National Antimicrobial Guideline 2024 – Urinary Tract Infections, Ministry of Health Malaysia

6.2.1 Antimicrobial Stewardship Principles

- Avoid the routine empirical use of fluoroquinolones and carbapenems. Their use should be reserved for patients with severe or complicated infection, or a high risk of resistant organisms, guided by previous microbiological results, recent antimicrobial exposure and local susceptibility patterns [5–6].
- Review empirical antibiotics at 48–72 hours based on clinical response and microbiological results [6].
- De-escalate to the narrowest effective agent once susceptibilities are known [6].

6.2.2 Special considerations in older persons

- Assess renal function and adjust antibiotic doses accordingly, considering age-related changes in renal function [5].
- Review concurrent medications and consider the increased risk of drug–drug interactions and antibiotic-related adverse effects, including delirium, QT prolongation and nephrotoxicity [5].
- Use the shortest effective antibiotic duration based on the site and severity of infection, clinical response and adequacy of source control. Prolonged courses should be reserved for specific indications requiring extended treatment, such as deep-seated infection or inadequate source control.

6.3 When should antimicrobial therapy be de-escalated or stopped in older persons with UTI?

Antimicrobial de-escalation and timely discontinuation are essential components of antimicrobial stewardship in older persons with UTI. Older persons frequently receive empirical broad-spectrum antimicrobials due to atypical clinical presentations, diagnostic uncertainty and concern for severe infection.

However, prolonged or unnecessary antimicrobial exposure in this population is associated with increased risks of *Clostridioides difficile* infection, antimicrobial resistance, adverse drug reactions, drug–drug interactions and prolonged hospitalization [8].

Antimicrobial therapy should therefore be regarded as a dynamic intervention that requires structured reassessment rather than a fixed course once initiated.

Timing of Review

All older persons started on antimicrobials for suspected or confirmed UTI should undergo formal treatment review within 48–72 hours of initiation. This timepoint allows sufficient clinical response and availability of microbiological data to support decisions on de-escalation or discontinuation [9].

6.3.1 When to De-escalate Antimicrobial Therapy

Antimicrobial de-escalation refers to narrowing the antimicrobial spectrum, reducing treatment intensity or switching from intravenous to oral therapy while maintaining clinical effectiveness.

Clinically Based De-escalation

Consistent with current guidance for UTI management in frail or comorbid older persons, antimicrobial de-escalation should be considered in clinically stable patients with improving or resolved urinary symptoms and no evidence of persistent fever, haemodynamic instability, severe sepsis, or complicated infection requiring prolonged broad-spectrum therapy. In the absence of clinical improvement, reassessment of the diagnosis is recommended rather than automatic escalation of antimicrobial treatment [10].

Microbiologically Guided De-escalation

Once urine culture and susceptibility results are available, antimicrobial therapy should be narrowed to the most targeted effective agent. Broad-spectrum empirical agents including carbapenems or antipseudomonal β-lactams should be discontinued when narrower options are suitable and the patient is clinically stable [11]. Culture-directed de-escalation has been shown to reduce antimicrobial exposure without compromising clinical outcomes [12].

Intravenous-to-Oral De-escalation

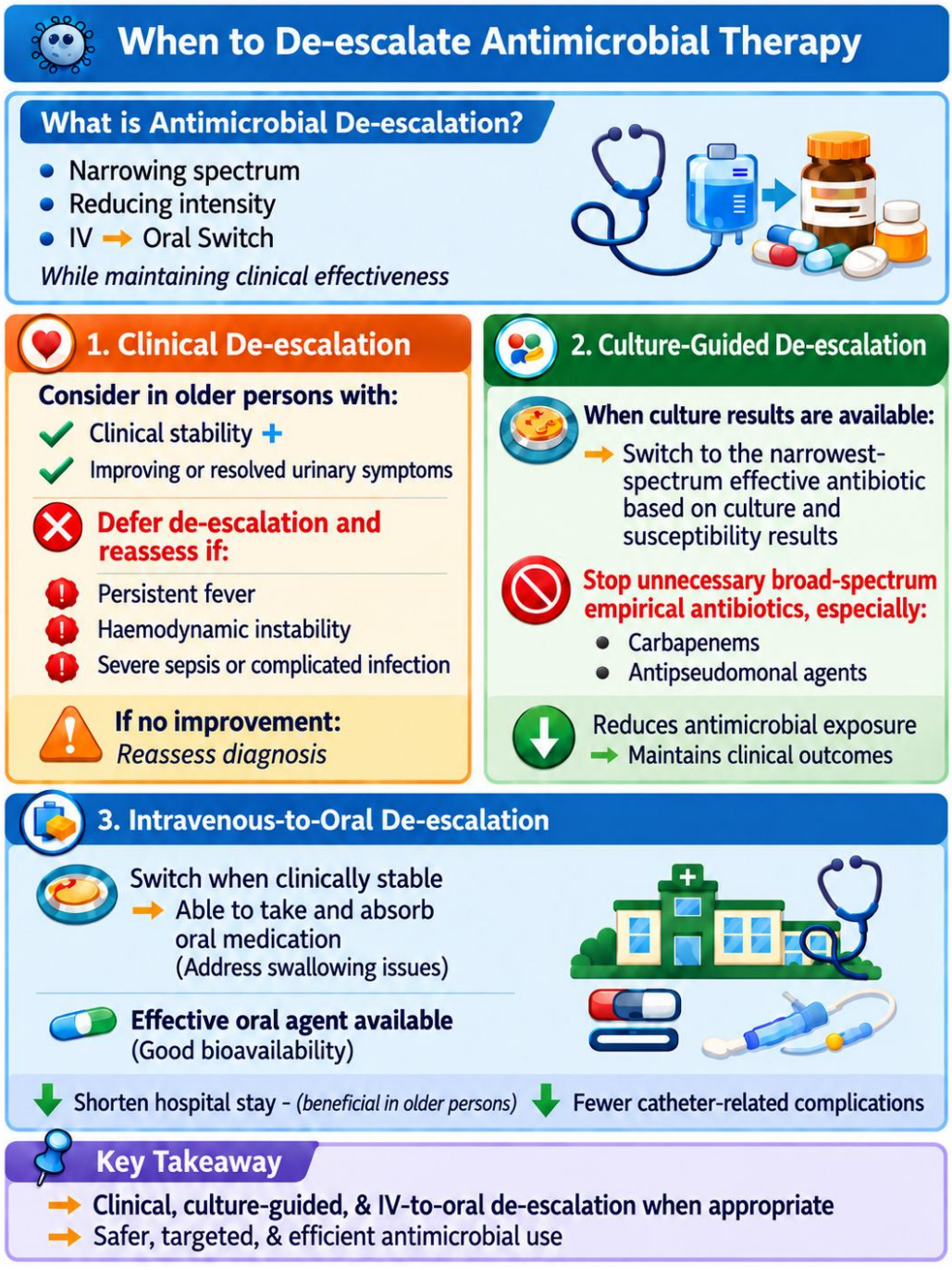
Transition from intravenous to oral antimicrobial therapy should be considered once clinical stability has been achieved, oral intake is adequate, swallowing difficulties have been addressed, and an effective oral agent is available.

The oral agent should have reliable absorption and achieve adequate concentrations at the site of infection.

Examples of agents with good oral bioavailability include fluoroquinolones, trimethoprim/sulfamethoxazole, linezolid, metronidazole and doxycycline; selection should be guided by the infection site, microbiological susceptibility and patient-specific factors.

Early intravenous-to-oral switch may reduce the length of hospital stay and catheter-related complications, particularly in older persons [13].

Figure 6.1: When to De-escalate Antimicrobial Therapy [10–13]



6.3.2 When to Stop Antimicrobial Therapy

Antimicrobials should be discontinued when continued therapy is unlikely to provide additional clinical benefit, particularly once diagnostic reassessment indicates no ongoing infection or treatment response has been achieved [9,14].

Culture-Negative UTI

Antimicrobials should be discontinued when there are no positive urine cultures and there are no localising urinary symptoms or systemic signs of infection. In older persons, nonspecific symptoms such as delirium, weakness and syncope are common and may be associated with non-infective causes [8]. A comprehensive assessment should also be conducted to identify causes of delirium other than infection.

Asymptomatic Bacteriuria

Antimicrobials should be discontinued when bacteriuria is present in the absence of urinary symptoms or systemic infection and current assessment supports ABU rather than symptomatic UTI. ABU is highly prevalent among older persons and does not warrant antimicrobial treatment except in specific circumstances such as prior to urological procedures with mucosal breach [8,13]. Empirical antimicrobials initiated for non-specific symptoms such as confusion or falls should be stopped once asymptomatic bacteriuria is identified [8,15].

Alternative Diagnosis Identified

Antimicrobials should be discontinued when subsequent assessment suggests that symptoms are attributed to non-infectious conditions including delirium of metabolic or neurological origin, dehydration or medication adverse effects, and especially if there is lack of clinical improvement. Failure to recognise alternative diagnoses contributes significantly to antimicrobial overuse in older persons [10].

Figure 6.2: When to Stop Antimicrobial Therapy [8–10,13–15]

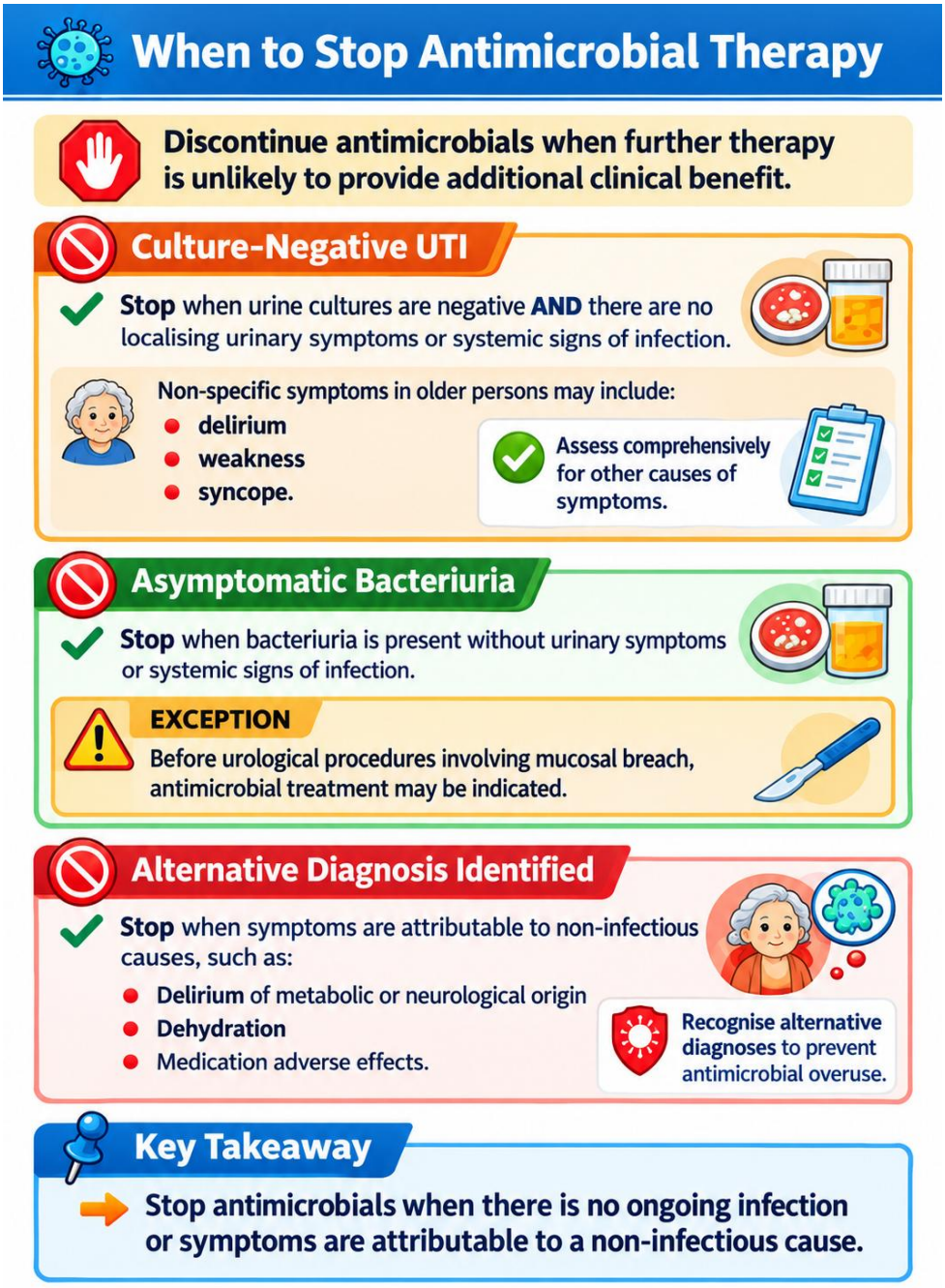
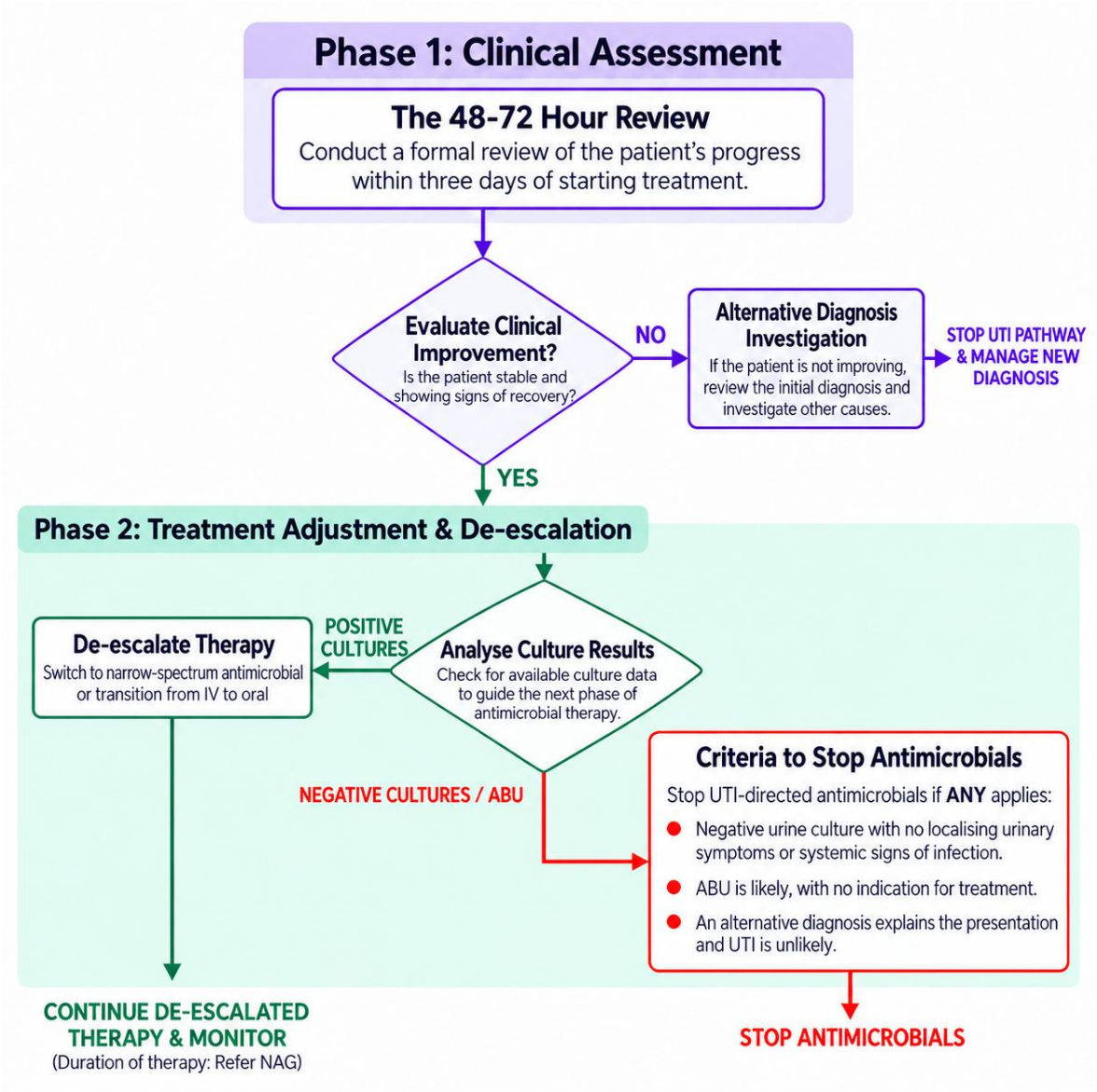


Figure 6.3: Clinical Decision Pathway for UTI Management in Older Persons



6.4 Treatment monitoring

Older persons are at higher risk of adverse drug events due to age-related physiological changes, comorbidities, and polypharmacy. The American Geriatrics Society Beers Criteria identify antimicrobials that warrant caution because of risks such as neurotoxicity, delirium, and renal impairment. Careful antibiotic selection and appropriate monitoring are therefore essential. The table below summarizes commonly prescribed antimicrobials for UTIs in older persons, focusing on key adverse effects and drug interactions.

Table 6.1: Commonly Prescribed Antimicrobials for UTIs: Adverse Effects and Monitoring [16,17]

Drug	Key Adverse Effects	Key Drug Interactions	Monitoring
Ciprofloxacin	CNS toxicity (confusion, delirium, seizures), QT prolongation, tendinopathy/rupture, dysglycaemia, peripheral neuropathy	↑ QT risk with antiarrhythmics (e.g., amiodarone); ↑ levels with theophylline; ↑ INR with warfarin; ↑ tendon rupture risk with corticosteroids	Monitor mental status, glucose, QT risk; use with caution in patients at risk of delirium; caution if on steroids
Nitrofurantoin	Pulmonary toxicity (acute pneumonitis, chronic fibrosis), hepatotoxicity, peripheral neuropathy	Minimal CYP interactions; additive neuropathy risk with other neurotoxic drugs	Monitor for cough, dyspnoea; avoid if CrCl <30 mL/min; caution with long-term use
Trimethoprim/ sulfamethoxazole	Hyperkalemia, acute kidney injury, hypersensitivity reactions (rash, including SJS), bone marrow suppression	↑ K^+ with ACEi/ARB/ARNI, spironolactone; ↑ INR with warfarin; ↑ phenytoin level	Monitor K^+ and creatinine within 3–5 days, especially in CKD, frailty; monitor INR; avoid with other K^+-raising drugs if possible
Amoxicillin/ clavulanate	GI upset (diarrhoea), hepatotoxicity, hypersensitivity reactions (rash)	↑ INR with warfarin; ↑ rash risk with allopurinol; ↑ nephrotoxicity risk with other nephrotoxic drugs (e.g., NSAIDs)	Monitor LFTs if prolonged therapy; watch for diarrhoea/C. diff
Ampicillin/ sulbactam	Hypersensitivity reactions (rash), diarrhoea, hepatotoxicity (rare), hypernatraemia (sodium load)	↑ INR with warfarin; ↑ rash risk with allopurinol ↑ nephrotoxicity risk with other nephrotoxic drugs (e.g., NSAIDs)	Monitor for rash; renal function; LFTs if prolonged therapy; monitor mental status in renal impairment

Drug	Key Adverse Effects	Key Drug Interactions	Monitoring
Piperacillin/ tazobactam	Hypernatraemia (sodium load), thrombocytopenia, *C. difficile* infection	↑ AKI risk with vancomycin; ↑ nephrotoxicity risk with other nephrotoxic drugs (e.g., NSAIDs/ACEi/diuretics)	Monitor renal function; check Na^+/K^+; monitor mental status; FBC if prolonged therapy
Cephalexin	GI upset (diarrhoea)	Possible ↑ INR with warfarin	Monitor for hypersensitivity, diarrhoea
Cefepime	Neurotoxicity (encephalopathy, confusion, myoclonus, seizures—especially in renal impairment), *C. difficile* infection	↑ neurotoxicity with other CNS-active drugs; ↑ nephrotoxicity risk with other nephrotoxic drugs (e.g., aminoglycosides)	Adjust dose for renal function; monitor mental status closely; high suspicion if new confusion develops
Aminoglycosides (e.g., gentamicin)	Nephrotoxicity, ototoxicity (hearing loss, vestibular toxicity)	↑ ototoxicity with loop diuretics; ↑nephrotoxicity with vancomycin/ NSAIDs/ ACEi	Monitor renal function closely; generally avoid if safer options exist; perform therapeutic drug monitoring (TDM) for dose adjustments
Carbapenems (e.g., meropenem, imipenem, ertapenem)	Neurotoxicity (confusion, delirium, seizures—higher with imipenem), nausea/diarrhoea, *C. difficile* infection	↓ valproate levels → seizure risk; ↑ CNS toxicity with other neuroactive drugs	Monitor mental status and watch for seizure; avoid/monitor TDM with valproate; adjust dose for renal function

References

1. Nicolle LE, Gupta K, Bradley SF, Colgan R, DeMuri GP, Drekonja D, et al. Clinical practice guideline for the management of asymptomatic bacteriuria: 2019 update by the Infectious Diseases Society of America. *Clin Infect Dis.* 2019;68(10):e83–e110.
2. European Association of Urology. EAU guidelines on urological infections. Arnhem (NL): European Association of Urology; 2024. Available from: https://uroweb.org/guidelines/urological-infections
3. Dellit TH, Owens RC, McGowan JE Jr, Gerding DN, Weinstein RA, Burke JP, et al. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. *Clin Infect Dis.* 2007;44(2):159–177.
4. Rowe TA, Juthani-Mehta M. Urinary tract infection in older adults. Aging health. 2013 Oct;9(5):10.2217/ahe.13.38. doi: 10.2217/ahe.13.38. PMID: 24391677; PMCID: PMC3878051.

5. Ministry of Health Malaysia. National Antimicrobial Guideline 2024. Urinary Tract Infections. Putrajaya: Ministry of Health Malaysia; 2024. Available from https://pharmacy.moh.gov.my/en/documents/national-antimicrobial-guideline-nag-2024-4th-edition.html
6. Trautner BW, Cortés-Penfield N, Gupta K, Hirsch EB, Horstman M, Moran GJ, et al. Clinical practice guideline for the management and treatment of complicated urinary tract infections. Infectious Diseases Society of America; 2025. Available from: https://www.idsociety.org/practice-guideline/complicated-urinary-tract-infections/
7. Margot Gosney, Adam Harper, Simon Conroy. Oxford Desk Reference Geriatric Medicine. 1st edition. Oxford: Oxford University Press;2012. Page 248
8. Kim KH, Yang HJ. Asymptomatic Bacteriuria in Older Adults – Diagnosis, Management, and Future Directions: A Narrative Review. Urogenit Tract Infect. 2025;20(2):58-66. https://euti.org/journal/view.php?doi=10.14777/uti.2550002001
9. Nelson Z, Aslan AT, Beahm NP, et al. Guidelines for the Prevention, Diagnosis, and Management of Urinary Tract Infections in Pediatrics and Adults: A WikiGuidelines Group Consensus Statement. *JAMA Netw Open.* 2024;7(11):e2444495. doi:10.1001/jamanetworkopen.2024.44495 https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2825634#google_vignette
10. Bausch K, Stangl FP, Prieto J, Bonkat G, Kranz J. Urinary Infection Management in Frail or Comorbid Older Individuals. Eur Urol Focus. 2024 Sep;10(5):731-733. doi: 10.1016/j.euf.2024.08.007. Epub 2024 Aug 31. PMID: 39217017. DOI: 10.1016/j.euf.2024.08.007
11. Abuelshayeb L, Abu-Farha R, Hammour KA, Zawiah M. Carbapenem De-escalation in urinary tract infections: prevalence and outcomes among hospitalized patients. BMC Infect Dis. 2025 Apr 18;25(1):562. doi: 10.1186/s12879-025-10962-y. PMID: 40251544; PMCID: PMC12008935. DOI: 10.1186/s12879-025-10962-y
12. Hartman EAR, van de Pol AC, Heltveit-Olsen SR, Lindbæk M, Høye S, Lithén SS, Sundvall PD, Sundvall S, Arnljots ES, Gunnarsson R, Kowalczyk A, Godycki-Cwirko M, Platteel TN, Groen WG, Monnier AA, Zuithoff NP, Verheij TJM, Hertogh CMPM. Effect of a multifaceted antibiotic stewardship intervention to improve antibiotic prescribing for suspected urinary tract infections in frail older adults (ImpresU): pragmatic cluster randomised controlled trial in four European countries. BMJ. 2023 Feb 22;380:e072319. doi: 10.1136/bmj-2022-072319. PMID: 36813284; PMCID: PMC9943914.
13. Bonkat G., Kranz J., et al. EAU Guidelines on Urological Infections. *ISBN 978-94-92671-32-5.* European Association of Urology, 2026. Available from: https://uroweb.org/guidelines/urological-infections
14. Arnold SH, Nygaard Jensen J, Bjerrum L, Siersma V, Winther Bang C, Brostrøm Kousgaard M, Holm A. Effectiveness of a tailored intervention to reduce antibiotics for urinary tract infections in nursing home residents: a cluster, randomised controlled trial. Lancet Infect Dis. 2021 Nov;21(11):1549-1556. doi: 10.1016/S1473-3099(21)00001-3. Epub 2021 Jul 22. PMID: 34303417.
15. Monje A, Escolà-Vergé L, Rivera A, Herrera S, Plaza A, Duch-Llorach P, Pomar V, Roch N, Rouras L, López-Contreras J, Ramos JR. Targeting Overtreatment of Asymptomatic Bacteriuria in the Emergency Department: Results from a Quasi-Experimental Clinical Pharmacist-Led Program Based on Education and Audit. Antibiotics (Basel). 2025 Dec 14;14(12):1261. doi: 10.3390/antibiotics14121261. PMID: 41463763; PMCID: PMC12729950.
16. 2023 American Geriatrics Society Beers Criteria® Update Expert Panel. American Geriatrics Society 2023 updated AGS Beers Criteria® for potentially inappropriate medication use in older adults. J Am Geriatric Soc. 2023; 71(7): 2052-2081. doi:10.1111/jgs.18372
17. Lexicomp. Lexicomp Online [database online]. Hudson (OH): Lexicomp Inc.; 2026 [cited 2026 Apr 8]. Available from: https://www.wolterskluwer.com/en/solutions/lexicomp

CHAPTER 7

Non-antibiotic Prevention of Urinary Tract Infections in Older Persons

7.1 Should topical oestrogen be used to prevent recurrent urinary tract infections in postmenopausal women?

Topical (vaginal) oestrogen therapy is recommended for the prevention of recurrent urinary tract infections (rUTIs) in postmenopausal women, including the older person. Oral oestrogen therapy is not effective and should not be used for this indication.

Rationale and Evidence Summary:

Postmenopausal oestrogen deficiency leads to genitourinary syndrome of menopause, characterized by vaginal and urethral epithelial atrophy, elevation of vaginal pH, and loss of protective *Lactobacillus* species. These changes facilitate colonization by uropathogenic *Enterobacteriaceae*. Topical oestrogen therapy restores the vaginal epithelium, reduces vaginal pH (typically from approximately 5.5 to 3.8), and promotes recolonization with *Lactobacillus* species, resulting in reduced vaginal carriage of uropathogens.

Multiple clinical studies and international guidelines, including the 2025 European Association of Urology (EAU) guidelines [1], support its efficacy, with reported reductions in UTI recurrence from 5.9 to 0.5 episodes per patient-year [2]. Effective regimens generally include an initial loading phase followed by maintenance dosing, such as intravaginal oestrogen cream applied two to three times weekly. Systemic absorption is minimal; and vaginal oestrogen is generally well tolerated. Local adverse effects such as vaginal irritation and minor bleeding may occur. Treatment should be individualised, particularly in women with a history of oestrogen-dependent malignancy or unexplained vaginal bleeding.

7.2 What general behavioural measures reduce the risk of UTIs in older persons?

All older persons, particularly those residing in long-term care facilities, should be supported to maintain adequate hydration, appropriate perineal hygiene, regular bladder emptying, and bowel opening. In patients with urinary or faecal incontinence, a structured continence management plan is essential. These measures should be individualised according to clinical circumstances, as evidence for their specific effectiveness in preventing UTI is limited.

Rationale and Evidence Summary:

Dehydration is a modifiable risk factor for UTIs in older persons. Increased fluid intake promotes urine flow, reduces urinary stasis, and facilitates mechanical flushing of bacteria from the bladder. However, evidence that increased fluid intake specifically prevents UTI in older persons is limited. Adequate daily fluid intake, commonly around 1.5 L/day where clinically appropriate, should be encouraged and individualised according to the patient's clinical needs [3–5]. In institutional settings, this requires active support, including scheduled fluid rounds, offering preferred beverages, and assisting patients who are unable to drink independently, alongside educational interventions [6].

In addition, proper perineal hygiene reduces periurethral faecal contamination (wiping from front to back after defecation, post-coital voiding, avoiding douching, and wearing non-occlusive underwear), while regular voiding minimises urinary retention and bladder overdistension. Although these practices are appropriate components of routine hygiene and bladder care, their effectiveness in preventing UTI in older persons is not well established.

Furthermore, constipation and faecal impaction may affect lower urinary tract function through mechanical pressure on the bladder and bladder outlet, and may contribute to incomplete bladder emptying or urinary retention. Maintaining regular bowel function is therefore appropriate as part of good general care in older persons [7]. For patients with limited mobility, easy access to a commode or assisted toileting is critical.

7.3 How should incontinence absorbent products be managed to reduce UTI risk in older persons?

The use of absorbent products may be associated with an increased risk of UTI [8]. Management should prioritize immediate removal of faecal contamination, rather than solely relying on fixed-time pad-changing schedules for urine.

Rationale and Evidence Summary:

Prolonged exposure to moisture and bacteria within absorbent products creates an environment conducive to uropathogen proliferation and migration, increasing the risk of ascending infection. It also contributes to moisture-associated skin damage, including incontinence-associated dermatitis (IAD), which compromises the skin barrier and significantly increases susceptibility to secondary infection [9].

Pads contaminated with faeces should be changed promptly. Faecal contamination may contribute to the risk of ascending urinary tract infection, particularly with enteric organisms such as *Escherichia coli*. Regular changing and appropriate perineal hygiene are therefore advised.

For urinary incontinence, pads should be checked regularly (e.g. every 2–4 hours) and changed when wet or soiled. The frequency of changing should be individualised according

to the degree of wetness or soiling and the patient's needs. Infrequent changing of pads has been suggested as a potential risk factor for UTI, as prolonged exposure to urine and faecal contamination may contribute to perineal bacterial colonization and potentially increase the risk of ascending infection [10]. However, direct evidence linking pad-changing frequency to UTI prevention in older persons remains limited.

Hygienic care plays an important role; this includes the use of appropriate absorbent products to minimise prolonged exposure to urine and faeces, gentle perineal cleansing with mild cleansers, routine application of moisture-barrier creams to protect skin integrity, and regular reassessment for scheduled or prompted toileting programs, where appropriate, to reduce unnecessary pad dependency [9].

7.4 What strategies are recommended to prevent catheter-associated urinary tract infections (CAUTIs) in older persons?

Indwelling urinary catheters represent the single most significant risk factor for UTI and must be managed with strict adherence to the following evidence-based prevention strategies.

Rationale and Evidence Summary:

The most effective CAUTI prevention strategy is the avoidance of unnecessary catheterization. Indwelling urinary catheters (IDC) should be used only for appropriate clinical indications, such as acute urinary retention, accurate urine output monitoring in critically ill patients, or specific perioperative needs, and should never be used solely for the management of incontinence.

When catheterization is required, insertion must be performed by trained personnel using aseptic technique and sterile equipment. A closed drainage system must be maintained at all times, with prompt replacement of the entire system if sterility is compromised. The collection bag should remain below bladder level and must not contact the floor. Daily review of catheter necessity is essential, with removal as soon as the indication no longer exists, including early postoperative removal where feasible [11–12]. Routine daily hygiene of the meatal area during bathing is appropriate; however, antiseptic cleansing of the periurethral area while the catheter remains in place has not been shown to reduce CAUTI risk and is not recommended according to CDC guidelines [11].

Based on the available literature, while there are some limited studies showing a benefit of intermittent catheterization (IC) or suprapubic catheterization over urethral catheterization for CAUTI rates, there is insufficient evidence to recommend those approaches routinely [1]. In a systematic review of patients undergoing gynaecological surgery, indwelling catheters were associated with higher rates of symptomatic UTIs compared to IC [1].

In another systematic review investigating urinary catheterization management in older persons with hip fractures, a significant reduction in UTIs was demonstrated with IC compared with IDC at hospital admission [13]. However, other embedded trial evaluations find

no significant differences in UTI rates when comparing IC and IDC [13]. A prospective cohort study of nursing home residents found that residents with a suprapubic catheter had fewer CAUTIs and were hospitalized less but were more likely to be colonized with multidrug-resistant organisms [1].

Hydrophilic-coated catheters have been found to be beneficial for reducing CAUTI rates, but neither silver-alloy-impregnated catheters nor nitrofurazone-infused catheters show the same level of routine benefit [1].

When long-term indwelling urinary catheterization is required, a 100% silicone catheter is preferred over a latex catheter because it is associated with lower bacterial colonization [14], reduced encrustation, improved biocompatibility, and fewer catheter-related complications. However, evidence for a significant reduction in CAUTI remains limited [15]. Silicone catheters have a smoother and less porous surface than latex catheters, which may reduce bacterial adherence and biofilm formation [14]. They are also associated with lower rates of encrustation and are better suited for prolonged catheterization. Appropriate catheter indication, minimising catheter duration, and adherence to catheter-care best practices remain the most important measures for preventing CAUTI.

7.5 Are cranberry products effective for cystitis prevention in older persons?

Cranberry products are NOT recommended as an acute cystitis treatment for UTIs in older persons, but they may be considered as an option for prophylaxis in women with recurrent cystitis.

Rationale and Evidence Summary:

Cranberry products are proposed to prevent UTIs by inhibiting *E. coli* adherence to uroepithelial cells through A-type proanthocyanidins. Current evidence supporting or opposing the use of cranberry products for managing acute cystitis remains insufficient [1,16].

A Cochrane systematic review and meta-analysis in 2012 found that when compared with placebo, water, or no treatment, cranberry products did not significantly reduce the occurrence of symptomatic cystitis overall or in women with recurrent cystitis [17]. However, 6 subsequent pooled meta-analyses concluded that consumption of cranberry-containing products may protect against cystitis in selected populations [1].

Highly standardized cranberry extract with a defined soluble proanthocyanidin (PAC) content [23], formulated in phospholipids and containing high-dose PACs, appears effective in preventing recurrent cystitis [1,3]. However, optimal dosing and treatment duration remain unclear [1].

7.6 Do probiotics play a role in preventing UTIs in older women?

Certain probiotic strains may be considered for UTI prevention in older women, but evidence is strain-specific and remains insufficient to recommend probiotics routinely for prevention of recurrent UTI.

Rationale and Evidence Summary:

The proposed mechanism of probiotics is the restoration of a *Lactobacillus*-dominant urogenital microbiota, which inhibits colonization by uropathogens. Among studied preparations, *Lactobacillus rhamnosus* GR-1 and *Lactobacillus reuteri* RC-14 appear most promising. Other commonly used strains, such as *Lactobacillus rhamnosus* GG, have not demonstrated benefit.

A double-blind, placebo-controlled study showed that vaginal probiotics, either alone or combined with oral probiotics, significantly reduced the incidence and recurrence of symptomatic UTIs compared to placebo or oral probiotics alone. While some studies suggest reduced recurrence rates, overall evidence remains variable, and larger, well-designed trials are required before probiotics can be routinely recommended [1,3].

7.7 Is D-mannose effective for preventing recurrent UTIs in older persons?

Current evidence is insufficient to make a recommendation for or against the use of D-mannose for UTI prevention.

Rationale and Evidence Summary:

D-mannose is theorized to prevent bacterial adhesion by acting as a competitive inhibitor of the FimH adhesin on *E. coli* pili. While some guidelines suggest potential benefit in reducing recurrent UTIs, the quality of available evidence is limited, and recommendations vary between professional bodies. As such, D-mannose cannot be routinely recommended at this time [1,3].

7.8 What is the role of methenamine hippurate in non-antibiotic UTI prevention?

Methenamine hippurate may be considered as a non-antibiotic antiseptic option for recurrent UTI prophylaxis in women without urinary tract abnormalities.

Rationale and Evidence Summary:

Methenamine is hydrolyzed in acidic urine to formaldehyde, which exerts bacteriostatic activity against certain uropathogens [22]. Because it acts as a chemical agent rather than a conventional systemic antibiotic, it significantly reduces selective pressure for antibiotic resistance, supporting antimicrobial stewardship, though low-level bacterial adaptation can occasionally occur [22]. Evidence supports its tolerability and efficacy as an alternative to antibiotic prophylaxis in certain patients, particularly women with recurrent cystitis episodes without urinary tract abnormalities [1,3]. However, long-term safety data remain limited [3]. Furthermore, renal function must be evaluated prior to initiation, as the drug relies on adequate urinary excretion to achieve therapeutic concentrations and should be used with caution or avoided in patients with significant renal impairment.

7.9 Is a urinary alkaliniser recommended as a preventive measure for recurrent urinary tract infection (rUTI) in older persons?

No. Urinary alkalinisers should not be used as a long-term preventive strategy for recurrent UTI in older persons. They may be used for short-term symptomatic relief of dysuria during an acute UTI but have not been shown to reduce the risk of UTI recurrence.

Rationale and Evidence Summary:

Current evidence does not support urinary alkalinisation as an effective method for preventing recurrent UTI [18]. Long-term use may increase the risk of sodium overload, fluid retention, electrolyte disturbances, and metabolic alkalosis, particularly in older persons with hypertension, heart failure, or chronic kidney disease [19–20]. In addition, urinary alkalinisation may reduce the efficacy of methenamine hippurate, which requires acidic urine for antibacterial activity [18].

7.10 When do you consider long-term antibiotic prophylaxis in recurrent cystitis?

Long-term antibiotic prophylaxis is reserved for selected cases where behavioural modifications, personal hygiene optimizations, and non-antimicrobial measures have failed or are clinically inappropriate.

Rationale and Evidence Summary:

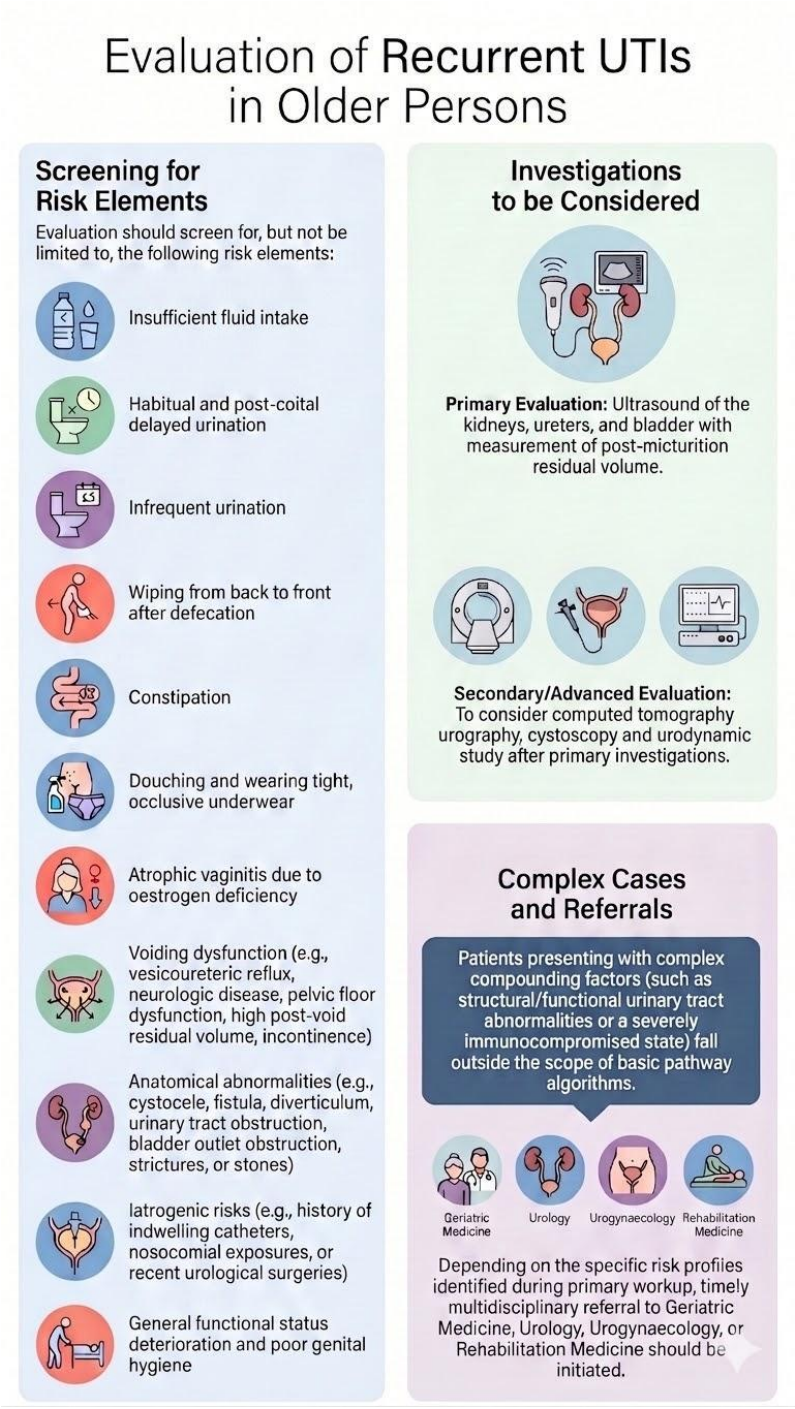
The decision to initiate long-term antibiotic prophylaxis requires balancing symptom burden reduction against the principles of antimicrobial stewardship. While continuous antibiotic prophylaxis is highly effective (reducing recurrence by up to 95%), it carries significant risks of collateral damage. Long-term suppression disrupts the vaginal and faecal microbiome, predisposing patients to vaginal candidiasis, adverse events, and colonization by multidrug-resistant organisms.

Therefore, long-term antibiotic prophylaxis may be considered in carefully selected patients with recurrent cystitis where non-antibiotic strategies are ineffective or inappropriate, following discussion on benefits and harm. Patients must be counselled regarding possible side effects and selection pressure for resistant pathogens. There is no consensus about the optimal duration of continuous antimicrobial prophylaxis, with studies reporting treatment duration of three to twelve months. If prophylaxis is started, it must be reviewed every 6 months to assess continued necessity and monitor for adverse events in accordance with international guidelines [1,3,21].

7.11 How do you evaluate older persons with recurrent UTI?

Assess thoroughly for underlying modifiable, anatomical, or functional risk factors, and conduct targeted imaging or specialist referral when complicating factors are suspected.

Figure 7.1: Evaluation of Recurrent UTI in Older Persons



References

1. Bonkat G, Bartoletti R, Bruyère F, Cai T, Geerlings SE, Köves B, et al. EAU guidelines on urological infections. Arnhem, The Netherlands: European Association of Urology; 2025.
2. Raz R, Stamm WE. A controlled trial of intravaginal estriol in postmenopausal women with recurrent urinary tract infections. *N Engl J Med*. 1993;329(11):753-6.
3. Anger J, Lee U, Ackerman AL, Chou R, Chughtai B, Clemens JQ, et al. Recurrent uncomplicated urinary tract infections in women: AUA/CUA/SUFU guideline. *J Urol*. 2019;202(2):282-289. (Confirmed 2022, Amended 2025).
4. Hooton TM, Vecchio M, Iroz A, Tack I, Dornic Q, Seksek I, et al. Effect of increased daily water intake in premenopausal women with recurrent urinary tract infections: a randomized clinical trial. *JAMA Intern Med*. 2018;178(11):1509-1515.
5. Wynn J, Homewood D, Tse V, Fong E, Roberts MJ, Chung E, et al. What to do about recurrent urinary tract infections: a review of evidence behind emerging therapies. *Aust J Gen Pract*. 2024;53(5):265–73.
6. Lumsden L, Hyner GC. Effects of an educational intervention on the rate of recurrent urinary tract infections in selected female outpatients. *J Community Health Nurs*. 1985;2(1):9-19.
7. Halter JB, Ouslander JG, Tinetti ME, Studenski S, High KP, Asthana S, editors. Hazzard's Geriatric Medicine and Gerontology. 6th ed. New York: McGraw-Hill Medical; 2009.
8. Omli R, Skotnes LH, Romild U, Bakke A, Mykletun A, Kuhry E. Pad per day usage, urinary incontinence and urinary tract infections in nursing home residents. *Age Ageing*. 2010;39(5):549–554.
9. Kottner J, Dissemond J. Incontinence-Associated Dermatitis in Older Adults: A Critical Review of Risk Factors, Prevention and Management. *Drugs Aging*. 2025;42(8):745-754. doi:10.1007/s40266-025-01227-z
10. Sugimura T, et al. Association Between the Frequency of Disposable Diaper Changing and Urinary Tract Infection in Infants. *Clin Pediatr (Phila)*. 2009;48(1):18-20.
11. Centers for Disease Control and Prevention. Catheter-associated urinary tract infections (CAUTI): summary of recommendations [Internet]. Atlanta: CDC; [cited 2026 Jun 7]. Available from: https://www.cdc.gov/infection-control/hcp/cauti/summary-of-recommendations.html
12. Ashraf MS, Gaur S, Bushen OY, Chopra T, Chung P, Clifford K, 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. J Am Med Dir Assoc 2020;21(1):12-24.e2. doi: 10.1016/j.jamda.2019.11.004.
13. Cacciatore S, Ferrara MC, Iuorio MS, Dall'Olio L, Bellelli F, Elmi D, et al. Urinary catheterization management in older adults with hip fracture: a systematic review. J Am Med Dir Assoc 2025;26(2):105410. doi: 10.1016/j.jamda.2024.105410.
14. Aurangzeb, Abrar, M., Wattoo, N. A., Anwar, M., Ashraf, F., Liaqat, K., Idrees, R., Mahnoor, A., & Muneeb, M. (2024). Comparison of Latex and Silicon Indwelling Catheter in Terms of Rate of Bacterial Colonization in Males with Acute Urinary Retention at 5th Day of Catheterization. *Journal of Ayub Medical College, Abbottabad : JAMC, 36(3), 548–550.* https://doi.org/10.55519/JAMC-03-13555
15. Gauhar, V., Castellani, D., Teoh, J. Y., Nedbal, C., Chiacchio, G., Gabrielson, A. T., Heldwein, F. L., Wroclawski, M. L., de la Rosette, J., Donalisio da Silva, R., Galosi, A. B., & Somani, B. K. (2022). Catheter-Associated Urinary Infections and Consequences of Using Coated versus Non-Coated Urethral Catheters-Outcomes of a Systematic Review and Meta-Analysis of Randomized Trials. *Journal of clinical medicine*, *11*(15), 4463. https://doi.org/10.3390/jcm11154463
16. Gbinigie OA, Spencer EA, Heneghan CJ, Lee JJ, Butler CC. Cranberry extract for symptoms of acute, uncomplicated urinary tract infection: a systematic review. *Antibiotics (Basel)*. 2020;10(1):12.
17. Jepson RG, Williams G, Craig JC. Cranberries for preventing urinary tract infections. *Cochrane Database Syst Rev*. 2012;10(10):CD001321.

18. Finney EL, Pagura EJ, MacLachlan LS. Efficacy and Safety of Alternative Treatments for the Prevention of Recurrent Urinary Tract Infections. *Current Bladder Dysfunction Reports*. 2022;18:42-50.

19. Czajkowski K, Broś-Konopielko M, Teliga-Czajkowska J. Urinary tract infection in women. *Przeglad menopauzalny = Menopause review*. 2021;20(1):40–47. doi:10.5114/pm.2021.105382

20. O'Kane DB, Dave SK, Gore N, Patel F, Hoffmann TC, Trill JL, Del Mar CB. Urinary alkalisation for symptomatic uncomplicated urinary tract infection in women. *The Cochrane Database of Systematic Reviews*. 2016;4(4):CD010745. doi:10.1002/14651858.CD010745.pub2

21. National Institute for Health and Care Excellence. Urinary tract infection (recurrent): antimicrobial prescribing [NG112]. London: NICE; 2018.

22. Hodgkinson NC, Al-Rubaye T, Reed TCP, et al. Implications for methenamine hippurate use in recurrent urinary tract infection management: Formaldehyde resistance and altered urinary composition. *PLoS Pathog*. 2026;22(3):e1014081. Published 2026 Mar 24. doi:10.1371/journal.ppat.1014081

23. Howell, A. B., Dreyfus, J.-F., & Chughtai, B. (2021). Differences in Urinary Bacterial Anti-Adhesion Activity after Intake of Cranberry Dietary Supplements with Soluble versus Insoluble Proanthocyanidins. Journal of Dietary Supplements, 19(5), 621–639. https://doi.org/10.1080/19390211.2021.1908480