Understanding and Using Facility-Specific Antibiograms in Long-Term Care

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Session Objectives

- Describe the importance of antibiotic stewardship in LTC

- Understanding why antibiograms matter in LTC

- Applying antibiogram data to help select optimal empiric therapy for urinary tract infections

Antimicrobial Resistance (AMR) is a Threat to Public Health

AMR is undermining modern medicine as infections become more difficult to treat. The effectiveness of antibiotics to prevent infections is also reduced, making routine surgery and cancer therapy more risky. Overuse of antibiotics is contributing to rising antimicrobial resistance. Since many antibiotic prescriptions are unnecessary, AMR is a problem we can all help to address.

1.27 Million

Annual global deaths due to AMR.[1]
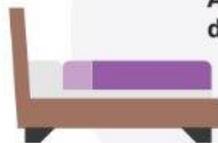
6 **Ontarian lives lost per day due to AMR.[2]**

↑30%

Increased odds of death.

In Ontario, bloodstream infections caused by AMR bacteria increase the odds of death by 30% compared to susceptible bacteria.[3]

1 in 4
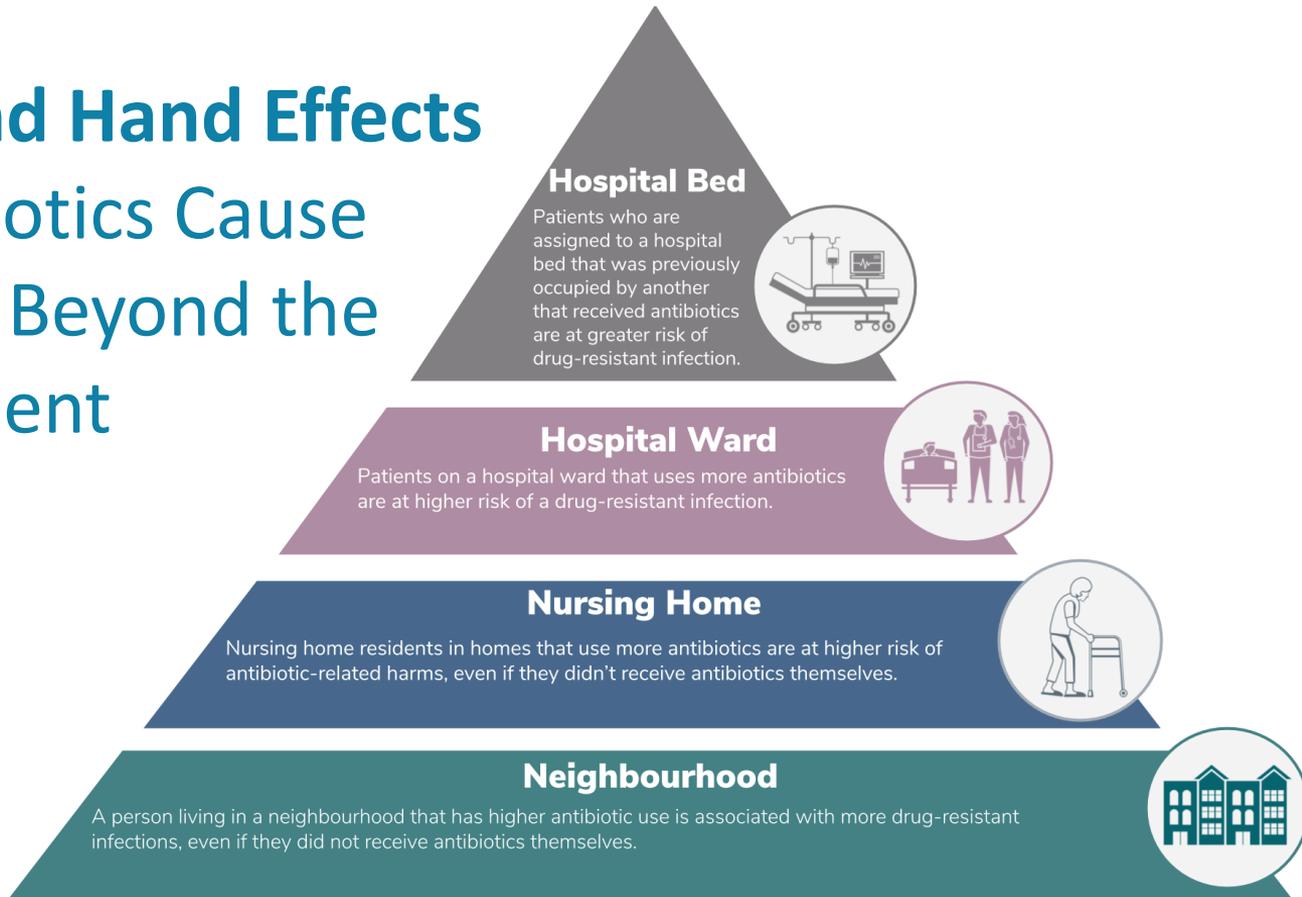
Antibiotics prescriptions are not needed.

At least 25% of antibiotics prescribed in the community are for conditions that don't need antibiotics.[4]

1. Murray CJ, et al. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. Lancet. 2022;399(10325):629-55. Available from: https://doi.org/10.1016/S0140-6736(21)02724-0
2. Finlay BB, et al. When antibiotics fail: the expert panel on the potential socio-economic impacts of antimicrobial resistance in Canada. Ottawa, ON: Council of Canadian Academies; 2019. Available from: https://cca-reports.ca/reports/the-potential-socio-economic-impacts-of-antimicrobial-resistance-in-canada/
3. Daneman N, et al. Antimicrobial resistance and mortality following E. coli bacteremia. Eclinicalmedicine. 2023;56:101781. Available from: https://doi.org/10.1016/j.eclinm.2022.101781
4. Schwartz KL, et al. Unnecessary antibiotic prescribing in a Canadian primary care setting: a descriptive analysis using routinely collected electronic medical record data. CMAJ Open. 2020;8(2):E360-9. Available from: https://doi.org/10.9778/cmajo.20190175

AMR Harms Individuals and Populations

- Antimicrobial resistance directly harms **individuals** receiving antimicrobials since it can make drug treatment for their infection ineffective. AMR is associated with increased mortality.

- There are also important second-hand harms of AMR at the **population** level due to transmission of resistant and opportunistic organisms between people and at other levels.

Second Hand Effects
Antibiotics Cause Harm Beyond the Recipient

Hospital Bed
Patients who are assigned to a hospital bed that was previously occupied by another that received antibiotics are at greater risk of drug-resistant infection.

Hospital Ward
Patients on a hospital ward that uses more antibiotics are at higher risk of a drug-resistant infection.

Nursing Home
Nursing home residents in homes that use more antibiotics are at higher risk of antibiotic-related harms, even if they didn't receive antibiotics themselves.

Neighbourhood
A person living in a neighbourhood that has higher antibiotic use is associated with more drug-resistant infections, even if they did not receive antibiotics themselves.

Langford BJ, Daneman N, Leung V, Wu JH, Brown K, Schwartz KL, Garber G. The second-hand effects of antibiotics: communicating the public health risks of drug resistance. JAC-antimicrobial resistance. 2019 Dec;1(3):dlz059.

# Why is antimicrobial stewardship needed in LTC?

Long term care residents are vulnerable to infection

- Immuno-senescence with aging

- High frequency of comorbidities

- Close proximity to other vulnerable individuals

Nicolle *ICHE* 2000; Daneman *Drugs Aging* 2012; Crnich *Drugs Aging* 2015

Antibiotics are among the most frequently prescribed medications in long term care
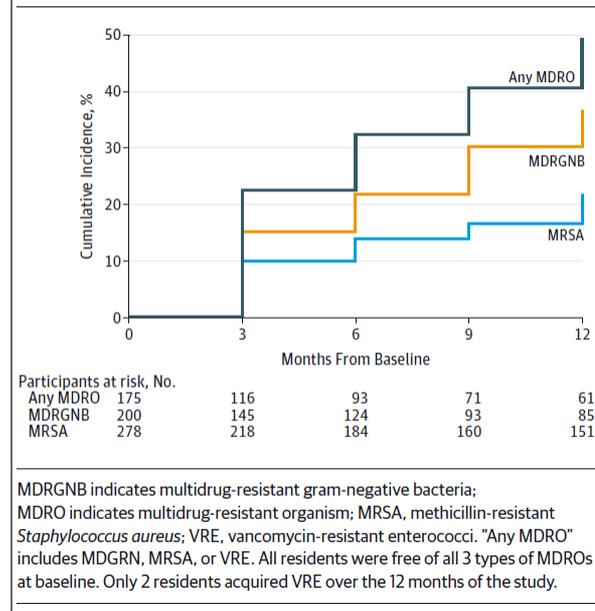

- point prevalence 5-8%

- annual prevalence 50-80%
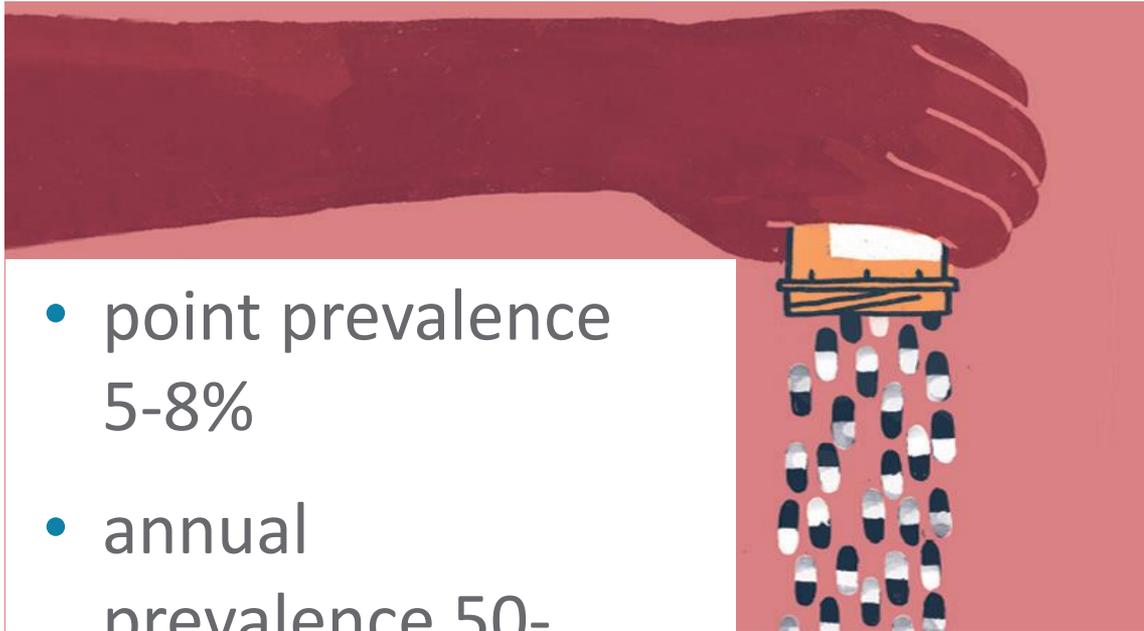
Montgomery *JGDT* 1995; Pakyz *ICHE* 2010; Daneman *JAC* 2011; Van Buul *JAMDA* 2012;

Image cropped from Choosing Wisely / PHO antibiotic awareness campaign 2018

Long term care residents are vulnerable to antibiotic-related harms

- Age-related changes in renal and hepatic function
  - decreased clearance, increased organ toxicity

- Polypharmacy
  - drug-drug interactions

- Age-related reductions in microbiome diversity
  - greater risk of *C. difficile* infection with each antibiotic course

- Skin breakdown and indwelling devices
  - increase likelihood of invasive infection once antibiotic-resistant organisms are acquired

Figure. Cumulative Incidence Rates of Resident Acquisition of Drug-Resistant Organisms During the Study Period

Participants at risk, No.					
Any MDRO	175	116	93	71	61
MDRGNB	200	145	124	93	85
MRSA	278	218	184	160	151

MDRGNB indicates multidrug-resistant gram-negative bacteria; MDRO indicates multidrug-resistant organism; MRSA, methicillin-resistant *Staphylococcus aureus*; VRE, vancomycin-resistant enterococci. "Any MDRO" includes MDGRN, MRSA, or VRE. All residents were free of all 3 types of MDROs at baseline. Only 2 residents acquired VRE over the 12 months of the study.

Mitchell *JAMA IM* 2014; Nicolle *ICHE* 2000; Crnich *Drugs Aging* 2015

Older residents of long-term care homes are at high risk for infections, but also high risk for the harmful effects of antibiotics.

Antimicrobial Stewardship

- The aim of Antimicrobial Stewardship is **to improve and measure the appropriate use** of antimicrobial agents in order to mitigate AMR.

- Appropriate use of antibiotics can be thought of in terms of initiation, selection and duration.

Appropriate Antimicrobial Prescribing

Initiation:

Prescribing antimicrobials only when necessary

Does this patient need antibiotics?

Selection:

Ensuring that the specific antimicrobial prescribed is appropriate

Is the right antibiotic agent, route of administration, dose and frequency being prescribed to optimize efficacy and safety for the condition being treated?

Duration:

Antimicrobial has been prescribed for an appropriate period of time.

Is the right duration of therapy (i.e. days) being prescribed for the condition being treated?

50% of antibiotic courses in long-term care homes are unnecessary.

Prescribe antibiotics with care.

There is variability in prescribing:

10x

Homes with the highest use are using 10x more antibiotics than homes with the lowest use
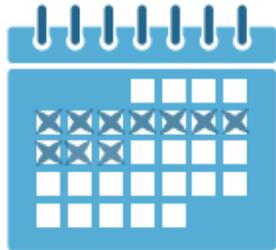
Duration of therapy is often longer than necessary

Daneman N, et al. Variability in antibiotic use across nursing homes and the risk of antibiotic-related adverse outcomes for individual residents. JAMA internal medicine. 2015 Aug 1;175(8):1331-9.

Daneman N, Gruneir A, Bronskill SE, Newman A, Fischer HD, Rochon PA, Anderson GM, Bell CM. Prolonged antibiotic treatment in long-term care: role of the prescriber. JAMA internal medicine. 2013 Apr 22;173(8):673-82.

www.publichealthontario.ca/ASP

Urinary Tract Infections in Long-term Care

Patient Scenario

76 Female with Parkinson's disease reports new pain on urination and frequency x 1 day. No flank pain or fever. Mid stream urine specimen is sent for culture and pending. No recent antibiotics. Last UTI was 2-3 years ago.

What is the best course of action, and appropriate antibiotic treatment if any?

Appropriate Antimicrobial Prescribing for UTI

Initiation:

Prescribing antimicrobials only when necessary

Selection:

Ensuring that the specific antimicrobial prescribed is appropriate

Duration:

Antimicrobial has been prescribed for an appropriate period of time.
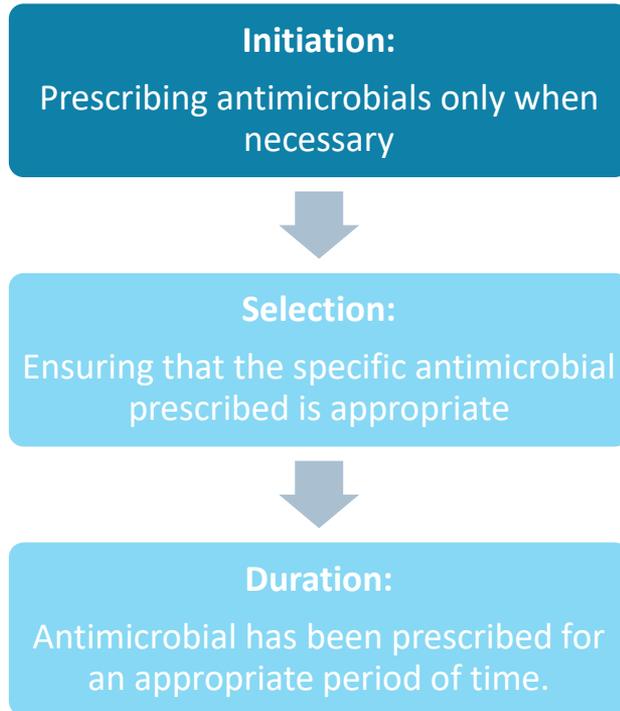
Use Criteria To Assist in Diagnosis
Asymptomatic bacteriuria in older adults is a common mimicker of UTI

ASB and the Inappropriate Prescribing Cascade

Non specific signs/symptoms
- Altered mental status
- Falls
- Smelly/cloudy urine

Urine Culture

Antibiotic Treatment

Antibiotic Harms
- Side Effects
- *C. difficile*
- AMR
- Altered microbiome – risk of infection
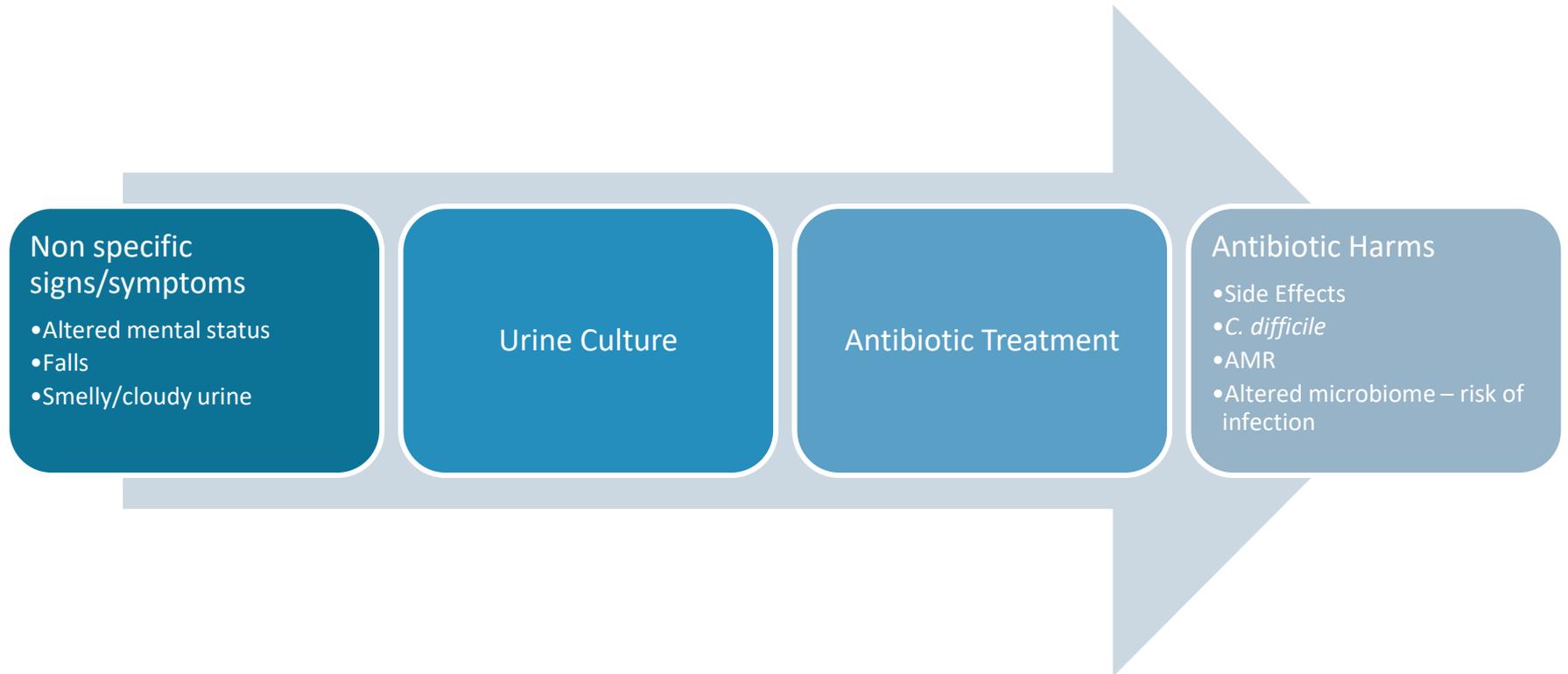
Brown KA, Daneman N, Schwartz KL, Langford B, McGeer A, Quirk J, Diong C, Garber G. The urine-culturing cascade: variation in nursing home urine culturing and association with antibiotic use and Clostridiodes difficile infection. Clinical Infectious Diseases. 2020 Apr 10;70(8):1620-7.

Asymptomatic Bacteriuria is Common in LTC

Up to **40%** of Men

Up to **50%** of Women

Up to **100%** of catheterized patients

Biggel M, et al. BMC geriatrics. 2019 Dec;19(1):170.

BLADDER Score: A Boosting Tool for Urinary Diagnostic and Antibiotic Stewardship in Hospitalized Adults

A multi-faceted intervention using a 6-item mnemonic scoring tool was developed based on existing minimum criteria for prescribing antibiotics in hospitalized patients with presumed uncomplicated cystitis. The scoring tool was combined with ward- and prescriber-level feedback and education. This was a single-center retrospective design with interrupted time series analysis.

Scoring Tool

B	Blood in urine	1 point
L	Loss of urinary control (incontinence)	1 point
A	Abdominal or suprapubic pain	1 point
DD	Dysuria	2 points
E	Elevated Temperature	1 point
R	Repeated urination (frequency)	1 point

0-1 points
Do not send urine for culture, monitor & assess for other causes

2+ points
Send urine for culture, initiate antibiotics if UTI is suspected
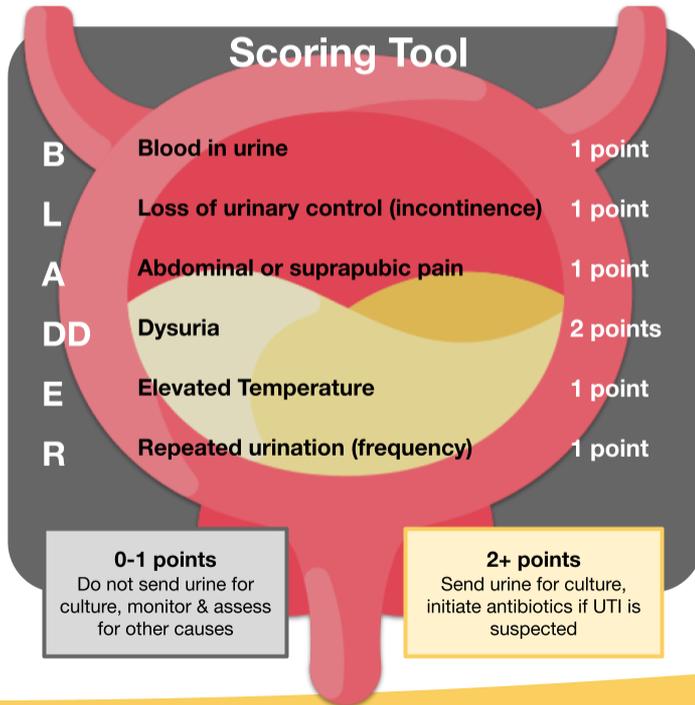
Outcomes

Urine Culturing

13% decrease
IRR 0.87 (95%CI: 0.67 to 1.12)
(not statistically significant)

Urinary Antibiotic Prescribing

32% decrease
IRR 0.68 (95%CI: 0.59 to 0.79)

Clinical Outcomes

No change
In length of stay, acute care transfers, or mortality

Langford BJ, Amoah S, Hansen J, Hudd L, Almohri, Wright J. Infection Control & Hospital Epidemiology. 2024.

Urine Culturing in LTC: Practice Gaps

✓ Obtain urine cultures only when residents have indicated clinical signs and symptoms of a UTI.

✓ Obtain and store urine cultures properly.

✓ Prescribe antibiotics only when specified criteria have been met, and reassess once urine culture and susceptibility results have been received.

✗ Do not use dipsticks to diagnose a UTI.

✗ Discontinue routine annual/admission screening if residents do not have indicated clinical signs and symptoms of a UTI.

www.publichealthontario.ca/UTI

Appropriate Antimicrobial Prescribing for UTI

Initiation:

Prescribing antimicrobials only when necessary

Selection:

Ensuring that the specific antimicrobial prescribed is appropriate

Duration:

Antimicrobial has been prescribed for an appropriate period of time.
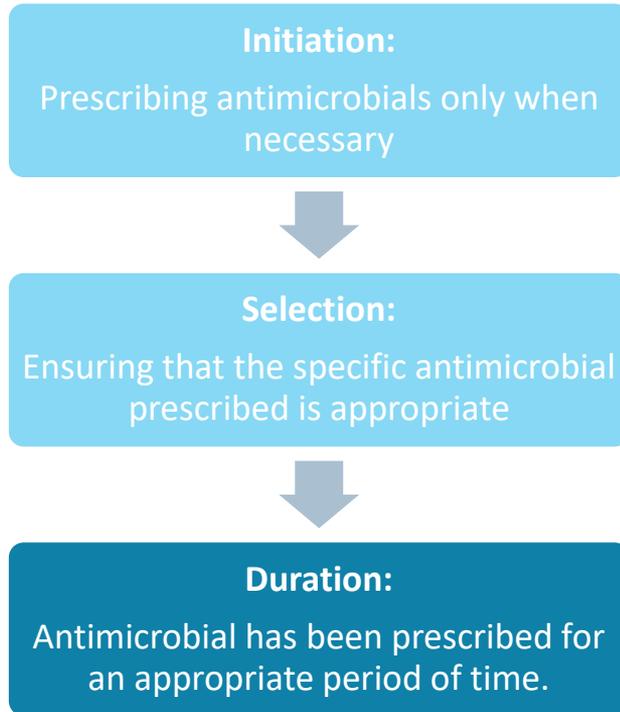
Remember Shorter is Smarter
Use the minimum effective duration to minimize patient harm

Estimating Daily Antibiotic Harms
Umbrella Review and Meta-Analysis

Public Health Ontario | Santé publique Ontario

35 Systematic Reviews   **71** Short vs. Long Antibiotic Duration Trials

92% studies evaluated respiratory tract and urinary tract infections

23,174 patients evaluated

Adverse Events
N=20,345

4%↑
odds ratio/day

Antibiotic Resistance
N=2,330

3%↑ *
odds ratio/day

Super-infections
N=5,776

2%↓ *
odds ratio/day

Each Additional Day Can Cause Harm

5 vs 3 Days   **9%↑** odds ratio
Of adverse events

7 vs 3 Days   **19%↑** odds ratio
Of adverse events

* Non-statistically significant difference

Ontario
Agency for Health Protection and Promotion
Agence de protection et de promotion de la santé

AMS Strategies in LTC: Shorter is Smarter

Appropriate Antimicrobial Prescribing for UTI

Initiation:

Prescribing antimicrobials only when necessary

⬇

Selection:

Ensuring that the specific antimicrobial prescribed is appropriate

⬇

Duration:

Antimicrobial has been prescribed for an appropriate period of time.

Personalize Treatment

Assess patient risk and review your facility specific antibiogram; re-assess with culture results

Empiric Therapy for UTIs

Consider the following "5-S"

Symptoms: does your patient have symptoms consistent with UTI?

Syndrome: is this lower (cystitis) vs. upper (pyelonephritis), other?

Severity: is the patient admitted to hospital for UTI?

Susceptibility (risk of multi-drug resistance): local resistance rates and history of: a) healthcare exposure, b) antibiotic use, c) infection or colonization with resistant organism

Situational (patient-specific factors): allergies, contraindications, renal function, etc.

Nelson Z, et al. Guidelines for the prevention, diagnosis, and management of urinary tract infections in pediatrics and adults: a WikiGuidelines Group consensus statement. JAMA network open. 2024 Nov 4;7(11):e2444495

Empiric Treatment Options for UTI

Antibiotic	Advantages	Disadvantages
Cephalexin	• Well tolerated	• Frequent administration (up to 4 times per day)
Amoxicillin-Clavulanate	• Good activity against several organisms that can cause UTI (e.g., E. coli, Klebsiella species, Enterococcus)	• Elevated risk of gastrointestinal adverse events, including C. difficile • Spectrum may be broader than needed
Trimethoprim-Sulfamethoxazole	• Good urinary concentrations	• Elevated risk of side effects (e.g., dermatologic) and drug interactions (e.g., medications that increase K+) • Caution in renal dysfunction
Ciprofloxacin	• Good urinary concentrations • Highly efficacious • Generally well tolerated	• High risk of selection for antimicrobial resistance • High risk of C. difficile infection • Warnings due to rare but serious risk of tendon rupture, aortic aneurysm, and central nervous system side effects
Fosfomycin	• Convenient single dose regimen • Generally well-tolerated • Low risk of C. difficile infection	• Cannot be used for pyelonephritis/prostatitis • Potential risk of developing resistance on treatment
Nitrofurantoin	• Good urinary concentrations • Generally well tolerated • Low risk of *C. difficile* infection	• Cannot be used for pyelonephritis/prostatitis due to inadequate tissue levels

Using Local Data to Inform Treatment Decisions

- "We suggest development of [institutional] stratified antibiograms over solely relying on non-stratified antibiograms to assist ASPs in developing guidelines for empiric therapy" – IDSA Guidelines 2016

- Long-term care homes should work with consultant laboratories to create a facility-specific summary of antibiotic susceptibility patterns from the organisms commonly isolated in microbiology cultures – CDC Core Elements of Antibiotic Stewardship

- Overall, selection should be guided by local susceptibilities and patient-specific risk factors. – UTI WikiGuidelines

1. Barlam TF, et al. *Clin Infect Dis*. 2016;62(10):e51-e77. doi:10.1093/cid/ciw118.
2. Centers for Disease Control and Prevention. Core elements of antibiotic stewardship for nursing homes. Available from: https://www.cdc.gov/antibiotic-use/core-elements/pdfs/core-elements-antibiotic-stewardship-appendix-a-508.pdf.
3. Nelson Z, et al. Guidelines for the prevention, diagnosis, and management of urinary tract infections in pediatrics and adults: a WikiGuidelines Group consensus statement. JAMA network open. 2024 Nov 4;7(11):e2444495

What is an antibiogram?

- Collection of antibiotic susceptibility data for common organisms

- Can be stratified by healthcare setting, specimen type, etc.

- There are standardized recommendations for their development

Organisms in rows

Number of organisms tested

Antibiotics in columns

	isolate #	Antibiotic A	Antibiotic B	Antibiotic C
Organism A	100	0%	60%	80%
Organism B	50	80%		25%
Organism C	30	10%	30%	90%

Proportion of organisms susceptible

Truong WR, Hidayat L, Bolaris MA, Nguyen L, Yamaki J. The antibiogram: key considerations for its development and utilization. JAC-antimicrobial resistance. 2021 Jun;3(2):dlab060.

Antibiograms in Ontario

- Provincial: Ontario Antibiogram

- Regional: LifeLabs Antibiogram

- Antibiogram For Your Home

Now Available!

Your Long-term Care Home's Antibiogram
Tailored to Your Facility's Urine Culture Data

Efficient Facility Feedback of Existing Culture Testing is Able to Mitigate Resistance (EFFECT-AMR)

- **Purpose:** harness routinely available microbiology data in Ontario to improve AMR surveillance, increase quality of test ordering and antimicrobial prescribing, and ultimately decrease the population burden of AMR

- **Intervention:**
  - Generate & disseminate facility specific antibiograms for LTC
  - Assess utilization & impact of antibiograms

- **Your Participation:** review and disseminate your facility-specific antibiogram and ensure local practices reflect these recommendations

LTCH-Specific Antibiogram

- Over 600 unique urinary antibiograms produced on web-based tool and disseminated via email

- Organisms for each home provided separately AND combined into a syndromic antibiogram to simplify treatment decisions

- Provincial data is used to inform local estimates if sample sizes are small

- Empiric recommendations provided for uncomplicated and complicated UTI based on highest susceptibility (while considering risk of resistance/*C. difficile*).

To receive your home's antibiogram, email:
ASP@oahpp.ca

Ontario Long–Term Care Home Antibiogram Tool

Urine Culture Data for Institution #xyz

Ensure that your resident has local and/or systemic signs and symptoms of infection before collecting urine for culture and initiating antibiotics.

In hemodynamically stable non–catheterized patients, use this scoring system to assess likelihood of infection. To support antibiotic stewardship for your residents, visit Public Health Ontario's Urinary Tract Infection (UTI) Program.

First–Line Recommendations

For those who have definitive signs/symptoms of urinary tract infection (UTI), we recommend the following empiric antibiotics as optimal based on resistance patterns in your home:

👍 For uncomplicated UTI, use **nitrofurantoin**.

👍 For complicated UTI, use **amoxicillin–clavulanate**.

Note that empiric antibiotic selection may need to be adjusted or discontinued based on patient–specific culture and susceptibility results.
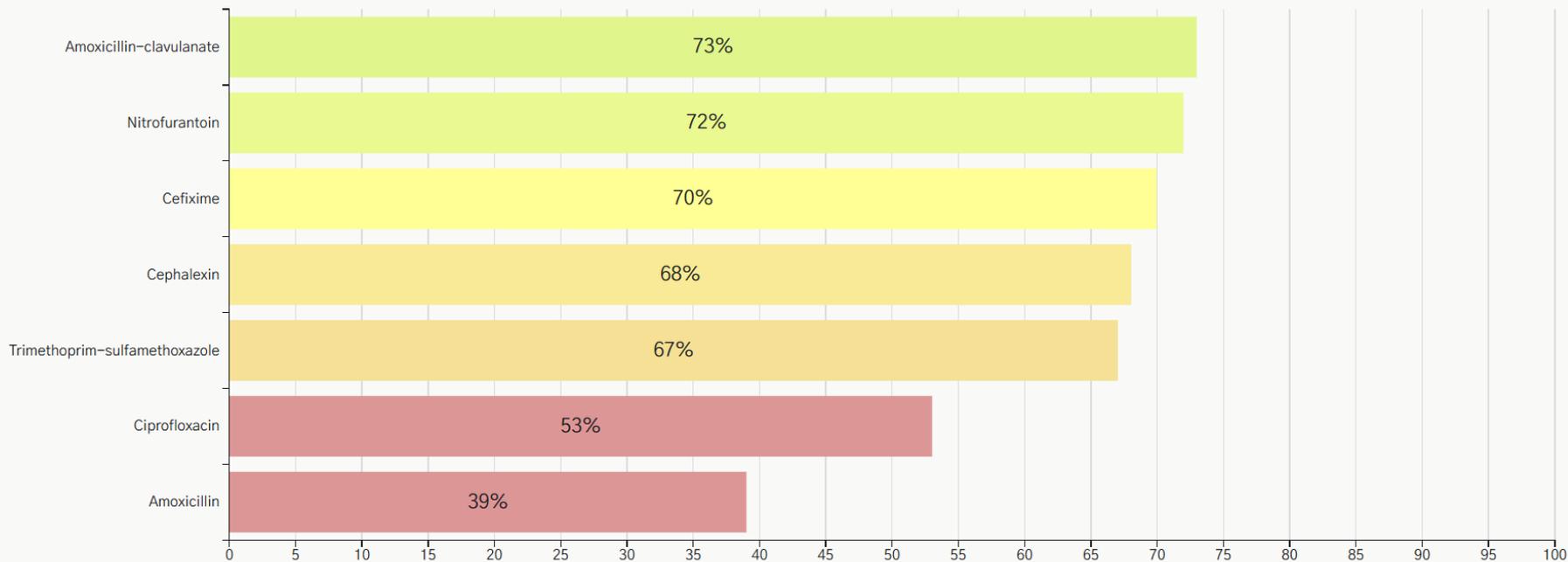
Ontario Long-Term Care Home Antibiogram Tool

Urine Culture Data for Institution #xyz

Organism-Specific Data

Susceptibility legend:
- ≥ 80%
- 60–70%
- ≤ 60%

Organism versus Percent Susceptibility	Count	Amoxicillin-clavulanate	Cefixime	Ciprofloxacin	Nitrofurantoin	Trimethoprim-sulfamethoxazole	Amoxicillin	Cephalexin
Escherichia coli	38	70%	71%	39%	97%	65%	40%	73%
Proteus mirabilis	8	100%	93%	43%	0%	82%	91%	97%
Klebsiella pneumoniae	7	95%	90%	88%	45%	93%	0%	90%
Citrobacter freundii	<6	0%	60%	85%	100%	89%	0%	0%
Enterococcus faecalis, all isolates	<6	100%	0%	49%	100%	0%	100%	0%
Pantoea species	<6	99%	100%	100%	38%	63%	0%	38%

Antibiotic Notes

This tool aims to provide facility-specific data on the susceptibility of urinary bacteria to common antibiotics. Selection of empiric antibiotic therapy should be guided by these local data, but also tailored to patient-factors including a consideration of allergies, contraindications, renal and hepatic function, as well as prior history of antimicrobial resistance and antibiotic use.

Note that empiric antibiotic selection may need to be adjusted or discontinued based on patient-specific culture and susceptibility results.

The following are key considerations for antibiotics often used to treat uncomplicated cystitis: *(click to expand)*

Amoxicillin-clavulanate	⌄
Cephalexin	⌄
Ciprofloxacin	⌄
Fosfomycin	⌄
Nitrofurantoin	⌃

Typical Regimen for Cystitis			Caution
CrCl	**Dose**	**Duration**	• Poor tissue penetration; cannot be used in pyelonephritis • Unsafe and less effective in residents with impaired renal function
≥30 mL/min	100 mg PO q12h (macrocrystals)	5 days	
<30 mL/min	Not recommended		

Trimethoprim-sulfamethoxazole	⌄

Patient Scenario

76 Female with Parkinson's disease reports new pain on urination and frequency x 1 day. No flank pain or fever. Mid stream urine specimen is sent for culture and pending. No recent antibiotics. Last UTI was 2-3 years ago.

What is the most appropriate antibiotic treatment if any?

Strategies to Encourage Use of Antibiograms

- Provide links via email and on intranet

- QR codes on screensavers

- Print and post treatment recommendations

- Incorporate recommendations into health record

- Discuss with team members at interdisciplinary/ council meetings

- Other suggestions?

Key Takeways about Using Antibiograms

- Antibiograms can be used to help guide antibiotic selection for an individual patient when an organism is not yet known or when final susceptibility results are pending. However they are not useful if final culture and susceptibility data are available.

- Other key uses for antibiograms include informing local recommendations and tracking resistance over time.

- Patient factors, including prior antibiotic resistance, prior antibiotic use, and type of infection need to be taken into account when using an antibiogram.

Summary

- AMR is a global public health issue; antibiotic use drives AMR

- Unnecessary usage in LTC puts residents at risk of harm; there is wide variation in antibiotic prescribing between LTC homes

- UTI is a good target condition for stewardship in LTC; the main opportunity for improvement is to reduce testing and treatment for asymptomatic bacteriuria

- Facility-specific antibiograms generated from provincial laboratory data are now available

- To improve patient care and reduce risk of harm: consult these facility-specific antibiograms, in tandem with considerations about the type of infection and patient specific considerations

Help reduce antibiotic resistance in long-term care homes.

Prescribe antibiotics with care.

www.PublicHealthOntario.ca

For more information or to receive your home's antibiogram, contact:

ASP@oahpp.ca

Public Health Ontario keeps Ontarians safe and healthy. Find out more at **PublicHealthOntario.ca**