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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

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A B S T R A C T

The diagnosis and management of urinary tract infections (UTIs) among residents of post-acute and long-term care (PALTC) settings remains challenging. Nonspecific symptoms, complex medical conditions, insufficient awareness of diagnostic criteria, and unnecessary urine studies all contribute to the

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inappropriate diagnosis and treatment of UTIs in PALTC residents. In 2017, the Infection Advisory Subcommittee at AMDA—The Society for Post-Acute and Long-Term Care Medicine convened a workgroup comprised of experts in geriatrics and infectious diseases to review recent literature regarding UTIs in the PALTC population. The workgroup used evidence as well as their collective clinical expertise to develop this consensus statement with the goal of providing comprehensive guidance on the diagnosis, treatment, and prevention of UTIs in PALTC residents. The recommendations acknowledge limitations inherent to providing medical care for frail older adults, practicing within a resource limited setting, and prevention strategies tailored to PALTC populations. In addition, the consensus statement encourages integrating antibiotic stewardship principles into the policies and procedures used by PALTC nursing staff and by prescribing clinicians as they care for residents with a suspected UTI.

Despite being among the most common infections, the diagnosis and management of urinary tract infections (UTIs) remains challenging, particularly among residents of post-acute and long-term care (PALTC) settings. Insufficient awareness of evidence-based guidelines regarding UTIs, entrenched practice patterns, as well as pressure from other staff and concerned family members can all contribute to over-diagnosis and unnecessary antibiotic use for presumed UTIs.[1–3] Furthermore, subtle changes in a resident's behavior status may prompt a concern for a UTI without consideration of whether there are clinical signs and symptoms that localize to the genitourinary tract. Additional challenges relate to specifying criteria for ordering urinalyses and urine cultures, collecting urine samples to minimize contamination, and interpreting laboratory results appropriately. Furthermore, for PALTC residents who are nonverbal, have a history of pathology related to the urinary tract, or who are otherwise perceived as vulnerable or immune compromised, clinicians may have a lower threshold to attribute nonspecific symptoms to a UTI and, subsequently, to prescribe antibiotics.

Antibiotic use contributes to the selection of multidrug-resistant organisms and also increases the risk of *Clostridioides difficile* infection. In 2013, the Centers for Disease Control and Prevention (CDC) estimated that multidrug-resistant organisms and *C difficile* caused over 2 million infections, with over 1% of those infections resulting in death.[4] Being a resident of a PALTC setting is a notable risk factor for colonization and infection with multidrug-resistant organisms and *C difficile*.[5,6] Reducing unnecessary and inappropriate antibiotic use helps to mitigate risks related to these pathogens in PALTC settings. Previous studies have reported that more than 50% of antibiotics prescribed in PALTC settings for UTIs were inappropriate, indicating that this is an important opportunity to improve resident safety.[5,7,8] The Infection Advisory Subcommittee of AMDA—the Society for Post-Acute and Long-Term Care Medicine convened an expert review panel to review evidence about UTIs specifically in the PALTC setting. Panel members reviewed the existing evidence-based data and shared their expert opinions, focusing on best care practices, quality improvement, and resident-centered care. Here, we issue the panel's consensus statement created to help guide clinicians through the diagnosis, treatment, and prevention of UTIs in PALTC residents.

Methods

The UTI consensus statement workgroup was convened in summer 2017. The purpose of the workgroup was to outline best practices for the care of residents in PALTC settings, with those best practices supported by evidence when available, and agreed upon by a group of experts. Most of the available evidence, which was not graded for strength, was based on the care of residents of skilled nursing facilities and long-term care environments, which we designate here using the more inclusive term PALTC settings. Recommendations made in this consensus statement should not override clinical judgment.

The panel began by deciding upon the topics and the questions to be addressed in the consensus statement. These topics and questions were assigned to the following 5 subgroups: scope of the problem/background (E.H., V.N.), diagnosis (D.M., S.S.), treatment (M.A., K.C., C.H., T.R., K.T., L.vB.), prevention (S.G., O.B., T.C., A.K.), and antibiotic stewardship (P.C., D.M., P.S.). The subgroups reviewed their topic, summarized the relevant literature, and submitted the summary to the chair (M.A.) of the workgroup. The chair put together an initial draft of consensus statement which was shared with the entire workgroup for review. Group consensus was obtained on all the major recommendations during scheduled conference calls and email. Once consensus was obtained from the workgroup, the document was further edited for clarity and consistency by a core group (M.A., S.G., R.J.). Subsequent revisions achieved unanimous agreement for all recommendations (Supplementary Material 1). In addition, we have italicized the consensus recommendations that are specific to PALTC residents (ie, recommendations that move beyond those found in more general guidelines that address asymptomatic bacteriuria (ASB) and UTIs). The consensus statement was reviewed and approved by the Infection Advisory Subcommittee, Clinical Practice Steering Committee of AMDA and the AMDA Board of Directors.

Definition of Urinary Tract Infections

UTI refers to an infection anywhere in the genitourinary tract; cystitis is the most commonly encountered UTI syndrome in clinical practice.[9] For cystitis, urinary symptoms are usually confined to the bladder. These are dysuria, frequency, gross hematuria, suprapubic tenderness, and new or worsening urinary incontinence or urgency. Pyelonephritis is a less common but more severe infection involving the renal parenchyma. Patients with pyelonephritis may present with fever and chills, back pain, nausea, and vomiting; localizing urinary symptoms may or may not be present. Catheter-associated urinary tract infection (CAUTI) refers to UTIs that develop in individuals with an indwelling urinary catheter.

ASB is often confused with UTI. ASB is bacteriuria in an individual without signs or symptoms of infection that localizes to the urinary tract. Individuals with ASB will have a positive urine culture with or without pyuria, detected as white blood cells on urinalyses.[3] In PALTC settings, the prevalence of ASB is as high as 50% for female residents and 40% for male residents.[10,11] Subsequently, a high proportion of urine cultures sent for nonspecific symptoms may return as "positive," leading to unnecessary antibiotic prescriptions. Although multiple tools exist to support clinicians in distinguishing between ASB and UTIs, overall management of urinary tract infections in the PALTC continuum remains complex and challenging.[12–15]

Diagnosis of UTIs

Diagnostic criteria for UTI require the presence of clinical signs and symptoms that localize to the genitourinary tract (Table 1). Dark, cloudy, or foul-smelling urine is not sufficient to indicate a UTI and may instead reflect mild dehydration or changes to diet or

Table 1
Diagnosis and Treatment for UTIs in PALTC Settings

UTI Syndrome and Associated Clinical and Microbiological Findings*	Recommended Treatment and Duration†	Additional Comments
Asymptomatic bacteriuria *Diagnostic test results* ≥100,000 colony-forming units/mL of ≥1 species of bacteria *Signs and symptoms* Nothing that localizes to the genitourinary tract	No antibiotics	In general, asymptomatic bacteriuria does not require treatment. However, screening for asymptomatic bacteriuria along with targeted short course of antibiotic treatment (1 or 2 doses) is recommended prior to a urologic procedure associated with mucosal trauma. Antibiotics in these cases should be initiated 30–60 min before the procedure.
Acute simple cystitis *Diagnostic test results* >100,000 colony forming units/mL of ≤2 species of bacteria or ≥100 colony forming units/mL of ≥1 species of bacteria in a specimen collected by in-and-out catheter *Signs and symptoms* Localizing to the bladder such as acute dysuria, suprapubic tenderness, new or worsening incontinence, frequency, urgency or gross hematuria	Nitrofurantoin, 5 d Trimethoprim/sulfamethoxazole, 3 d Beta-lactam agents, 3-7 d Fosfomycin, 1 dose Fluoroquinolones, 3 d	Male patients and those women with cystitis who are identified to be at high risk for treatment failure (Table 2) may require treatment for 7 d. Longer courses (8 to 14 d) are usually not necessary in these patients except when there is a delayed response to treatment or severe illness (eg, sepsis, bacteremia). Nitrofurantoin and fosfomycin should not be used when the infection is suspected to extend beyond the bladder and in severely ill patients (eg, sepsis, bacteremia). Reserve fosfomycin use for treatment of acute simple cystitis with highly resistant gram-negative pathogens and for whom hospitalization and/or intravenous antibiotic therapy is not warranted. Additional doses of fosfomycin will be required if intended treatment duration is >3 d. Fluoroquinolones (eg, ciprofloxacin and levofloxacin) are no longer considered first-line treatment for UTIs and their use should be minimized. Moxifloxacin should not be used for UTIs.
CAUTI *Diagnostic test results* ≥100,000 colony forming units/mL of ≥1 species of bacteria *Signs and symptoms* Systemic or nonspecific, such as fever,‡, rigors/chills, or new onset-clear cut delirium with no other identified cause or Localizing to genitourinary tract such as suprapubic or costovertebral angle tenderness or Acute pain, swelling, or tenderness of the testes, epididymis, or prostate (in men) or If a catheter was removed in the previous 48 hours, presence of signs and symptoms that localizes to the genitourinary tract such as urgency, frequency, dysuria, gross hematuria, suprapubic tenderness, or costovertebral angle tenderness	If prompt resolution of symptoms, 7 d For patients with a delayed response to treatment, 10-14 d of antibiotics is reasonable	It is important to note that a CAUTI can be present with lower colony counts of bacteria (100 to 1000 colony forming units/mL) but most persons with CAUTI have colony counts >100,000 colony forming unit/mL.[2] CAUTI can lead to complications such as prostatitis, epididymitis, and epididymo-orchitis in male patients, so presence of acute pain, swelling, or tenderness of the testes, epididymis, or prostate should trigger evaluation for these diagnoses. Presence of costovertebral angle tenderness on exam suggests renal involvement.
Acute pyelonephritis *Diagnostic test results* ≥100,000 colony forming units/mL of ≤2 species of bacteria or ≥100 colony forming units/mL of ≥1 species of bacteria in a specimen collected by in-and-out catheter *Signs and symptoms* Nonlocalizing, suggesting that the illness extends beyond the bladder, such as fever,‡, rigors/chills, marked fatigue/malaise, nausea, or vomiting and Localizing to the genitourinary tract, such as dysuria, suprapubic tenderness, costovertebral angle tenderness, pelvic or perineal pain (men), new or worsening incontinence, frequency, urgency, or gross hematuria	Trimethoprim/Sulfamethoxazole, 14 d Beta-lactams, 10-14 d Fluoroquinolones, 7 d	Nitrofurantoin and fosfomycin should not be used to treat pyelonephritis. Pyelonephritis may present without symptoms of cystitis. Shorter (7 to 10 d) treatment of trimethoprim/sulfamethoxazole may be appropriate in those select patients with rapid defervescence.[16,17] Pelvic or perineal pain in men can suggest accompanying prostatitis.

*Clinical and microbiological findings in this table have been provided to highlight differences in various UTI syndromes. PALTC settings are recommended to adapt one of the published clinical algorithms to guide the diagnosis and decision to initiate antibiotics for residents with a suspected UTI.[12,15,19,20]

†When choosing an antibiotic agent, clinicians will also need to consider additional factors including (but not limited to) resident allergies, co-morbidities, potential drug-drug interactions, availability, local resistance pattern/urine culture results, cost, and overall clinical status. Similarly, final treatment duration will also depend on overall clinical condition and response to the treatment.

‡More recently published criteria usually define fever as single oral temperature of ≥100°F, or repeated oral temperatures of >99°F, or increase in temperature of ≥2°F over baseline.[12,15,19,20]

medications. Furthermore, nonspecific symptoms, including change in cognition, agitation, decreased appetite, and falls, are not symptoms of UTI, especially when genitourinary tract specific signs and symptoms are absent.[12,21–24]

Unfortunately, making a diagnosis of UTI is particularly difficult in frail and medically complex residents in PALTC, some of whom may not be able to verbalize their symptoms. A study of older adults evaluated in the emergency department compared the accuracy of emergency department physicians' diagnoses, the Loeb minimum criteria for starting antibiotics, and CDC surveillance definitions to identify patients with UTIs, using retrospective chart review by experts as the gold standard.[12,25] Of 424 older adults seen in the

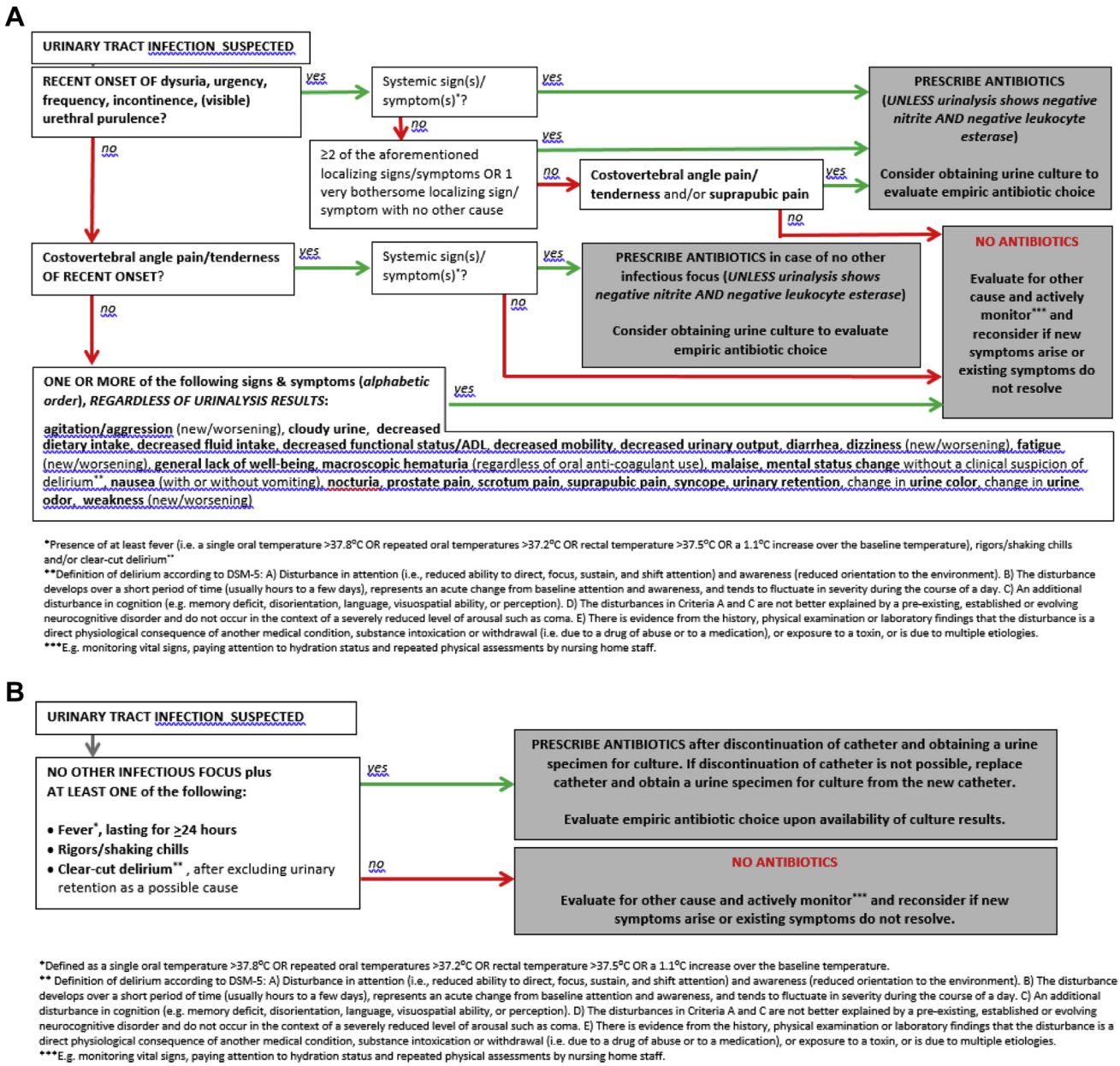

Fig. 1. (A) Decision tool for the empiric treatment of suspected UTI in frail older adults without an indwelling urinary catheter. (B) Decision tool for the empiric treatment of suspected UTI in frail older adults with an indwelling urinary catheter. Reprinted with permission from van Buul et al.[15]

emergency department, the authors identified 19 cases of UTI. From the same cohort, emergency department physicians identified 24 cases whereas the Loeb minimum criteria and CDC surveillance definitions detected 13 and 5 cases, respectively. Although based on a small number of cases, these results reflect the common clinical challenge of accurately diagnosing UTIs in older adults. Clinicians must consider both clinical presentation and diagnostic test results when evaluating a resident for a potential UTI.

Consensus-Based Criteria for Diagnosing UTIs

Several consensus-based criteria regarding UTIs in PALTC residents have been developed. The McGeer criteria, developed in the 1990s and updated in 2012, were among the first commonly used criteria specific to PALTC settings[21,26] and helped to inform the National Healthcare Safety Network (NHSN) definitions, most recently updated in 2018.[27] Both the McGeer criteria and the NHSN definitions were developed for surveillance purposes, that is to retrospectively measure and consistently identify cases to compare UTI rates over time and among institutions. These surveillance definitions were not developed with the intent to guide diagnosis of UTI though they are sometimes used for that purpose. A study of 130 patients in a tertiary care facility compared cases of CAUTI as determined using the 2009 NHSN definitions to clinical CAUTIs. Leekha et al found that approximately 50% of NHSN-defined cases were not considered clinical CAUTIs and that approximately 60% of clinical CAUTIs did not meet NHSN definitions.[18] Based on these findings, *we recommend that surveillance criteria should not be routinely used for establishing diagnosis and making decisions about initiating antibiotic treatment for UTIs.*

Other consensus criteria help guide the diagnosis and decisions about initiating antibiotics in PALTC residents in whom there is a concern for UTI. In 2001, Loeb et al developed a consensus statement

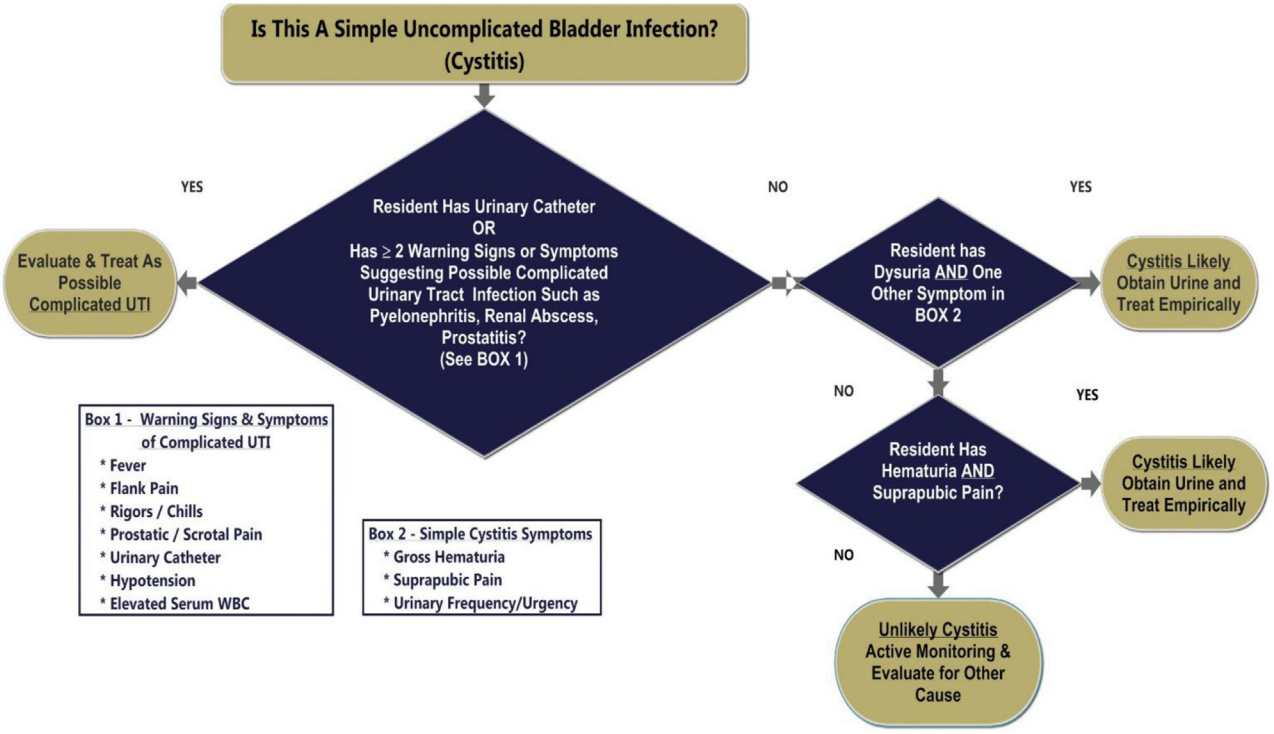

Fig. 2. Algorithm for the diagnostic approach to uncomplicated cystitis in non-catheterized nursing home residents. Reprinted with permission from Nace et al.[20]

describing the minimum criteria for initiating antibiotics in PALTC residents with possible infection.[12] Commonly referred to as the Loeb minimum criteria, the statement describes the clinical signs and symptoms that should be present prior to starting an antibiotic and is more prospective in nature than surveillance definitions. For residents without an indwelling urinary catheter, the signs and symptoms are acute dysuria alone or fever (100°F or 2.4°F over baseline) and at least one of the following signs or symptoms that localize to the genitourinary tract: frequency, gross hematuria, suprapubic tenderness, costovertebral angle tenderness and new or worsening urinary incontinence, or urgency. For residents with an indwelling urinary catheter, clinical signs and symptoms of a CAUTI include the presence of at least one of the following: fever, new costovertebral tenderness, rigors (shaking chills), or new onset of delirium.

The Agency for Healthcare Research and Quality (AHRQ) also developed criteria, which were incorporated into a standard communication and decision aid tool that is being adopted by PALTC settings in the United States.[19] Per the AHRQ tool, for residents without an indwelling urinary catheter, the diagnosis of UTI is based on acute dysuria alone or fever (100°F) with any one of the following new or worsening signs and symptoms: urgency, frequency, back or flank pain, suprapubic pain, gross hematuria, and urinary incontinence. For afebrile residents without an indwelling urinary catheter and who do not have acute dysuria, the diagnosis of UTI requires at least 2 of the following signs and symptoms: urgency, frequency, suprapubic pain, gross hematuria, and urinary incontinence. For residents with an indwelling catheter, one of the following signs and symptoms needs to be present to consider a diagnosis of CAUTI: back or flank pain, acute pain, rigors/shaking chills, new dramatic change in mental status, hypotension and fever (100°F or repeated temperature of 99°F, or 2°F above the baseline), especially when there is no obvious alternative etiology for these symptoms. The use of this tool has been shown to result in 30% reduction in unnecessary antibiotics for UTIs.[19]

Recently, 2 publications describe using a Delphi consensus procedure to develop algorithms for the evaluation of PALTC residents in whom there is a concern for infection. The first used an international panel of experts to reach consensus on which of several signs and symptoms to consider during diagnostic evaluation and making decisions about initiating empiric antibiotics for UTI in older adults with frailty.[15] The resulting decision tool recognizes both specific and nonspecific signs and symptoms that are associated with UTI in practice, indicating combinations of those signs and symptoms that justify antibiotic prescribing (Figure 1). The second publication describes a consensus reached by a panel of geriatricians practicing in PALTC settings and did not reach consensus that dysuria alone is sufficient for a diagnosis of cystitis (Figure 2).[20] Both decision tools consider PALTC residents with and without urinary catheters, provide guidance on when to obtain a urinalysis and urine culture and when to start empiric antibiotics; neither has yet been tested using prospective clinical investigations.

We recommend that PALTC settings use one of the clinical algorithms discussed above to guide the diagnosis and decision to initiate antibiotics for residents with a suspected UTI and furthermore, to incorporate those criteria into their antibiotic stewardship policy. When selecting one of the clinical algorithms discussed above, we suggest that PALTC settings determine which seems most closely aligned with their current practices to facilitate the implementation.

Diagnostic Testing for UTIs

ASB, common among PALTC residents, does not lead to any increased morbidity or mortality yet the “positive tests” associated with ASB do lead to unnecessary antibiotic exposure and subsequent adverse events.[3,28,29] We recommend that urinalysis and urine cultures should only be conducted for residents who meet clinical criteria for UTI as described above. Furthermore, we agree with previous expert recommendations[7] to avoid sending urinalyses and urine cultures as a test-of-cure for asymptomatic residents.

Urinalyses are often used as a screening test for UTIs, with a "positive" or "dirty" test erroneously regarded as indicative of an infection. A urine dipstick that detects leukocyte esterase and/or nitrites has a low (45%) positive predictive value to indicate a UTI in PALTC residents.[30] Furthermore, pyuria, defined as >10 white blood cells per high-power field, may be found in up to 90% of older adults residing in PALTC settings, rendering this an unhelpful diagnostic test for UTIs.[31] The absence of both leukocyte esterase and nitrite, however, has been shown to have 100% negative predictive value for the diagnosis of UTI in residents of nursing homes suspected of having a UTI.[30,32] Therefore, a urinalysis that is negative for leukocyte esterase and nitrites rules out a UTI. A urinalysis that is positive for either leukocyte esterase or nitrite, however, does not confirm a UTI. Similarly, because of the high prevalence of ASB in older adults, although a negative urine culture (obtained prior to antibiotic exposure) rules out a UTI, a positive culture does not confirm a UTI.[14]

Collecting Urine from People with and without Urinary Catheters

In residents without a urinary catheter, a voided midstream or clean catch specimen is ideal, though only approximately one-half of PALTC residents may be able to provide these samples.[33] The absence of epithelial cells reflects a lack of contamination from the skin and indicates the specimen is of good quality. In men, cleansing the meatus is recommended; however, the evidence is equivocal on the need for cleansing in women.[34] Women who are unable to provide a good quality voided specimen may require in and out urinary catheterization. For men, temporary use of a condom catheter, in the range of 30 to 120 minutes, may permit collection of a good quality urine specimen.[35,36]

Best practices for collecting urine specimens from residents with urinary catheters have been previously published.[2,37] Our expert panel agrees with those previous recommendations, which are summarized here. Urine samples should not be obtained from a urine collection bag connected to an indwelling catheter (including a suprapubic catheter) unless a new catheter (along with the new collection bag) was inserted immediately prior to sample collection. In residents with urinary catheters present for over 2 weeks, the catheter should be replaced or discontinued altogether if no longer needed, prior to collecting a urine specimen. Indwelling urinary catheters, including suprapubic catheters, impair some of the normal defenses of the bladder. The catheters become a nidus for biofilms and removing the catheter may help improve symptoms.[38] The most recent guidelines from the Infectious Diseases Society of America (IDSA) do not comment directly on removing and replacing urinary catheters in place for less than 2 weeks.[2] A common practice is to obtain urine from the sampling port of catheters in place for less than 2 weeks. A small prospective study published in 1982 may provide some of the rational for this 2-week time frame.[39] The authors collected weekly urine samples from the catheters of 20 residents with chronic urinary catheters. They defined new bacteriuria as the recovery of a bacterial strain not present during the previous week and found that the mean time to the development of any new episode of bacteriuria was 1.8 weeks. However, time intervals shorter than 1.8 weeks between catheterization and development of bacteriuria have also been described.[40] *Therefore, when a urinary catheter has been in place for less than 2 weeks, we recommend that the decision of obtaining a urine sample from the sampling port of the existing catheter or removing the catheter before obtaining a urine sample should be made on case-by-case basis. Clinicians should consider the potential clinical benefits and risks of removing and, if necessary, replacing urinary catheters present for less than 2 weeks as part of the evaluation for residents with suspected CAUTI.* The interval from placement of a new urinary catheter and detection of a clinically relevant biofilm is an important area for further study in PALTC residents.

Role of Behavioral Change of a Resident in Diagnosing a UTI

Although the possibility of serious conditions presenting with nonspecific signs and symptoms is a classic principle of geriatric medicine, there is limited evidence to support behavioral change as evidence of a UTI.[7] Nonetheless, cultures are commonly obtained from PALTC residents in the context of mental status changes,[41] which in clinical experience is often simply a change in behavior. Because of the high prevalence of ASB in nursing home residents, there is a high likelihood that urine cultures collected from nursing home residents will be positive, regardless of the resident's mental status at any given time.

Although it is clear that delirium can be present in urosepsis, current recommendations suggest that there should be systemic or specific urinary findings to attribute a UTI as the cause of delirium.[2,3,21,42] In a resident with unequivocal delirium, a UTI diagnosis should only be considered if there is no other cause for these acute, fluctuating symptoms. For older adults with a change in mental status, the diagnosis of a UTI or CAUTI is a diagnosis of exclusion. Clinical criteria (as mentioned above) can assist clinicians in making diagnostic and treatment decisions for residents with a change in behavior.

Treatment of UTIs

Treatment of UTIs should include supportive care, most notably increased hydration. Other aspects of treatment include deciding when to start an antibiotic, choosing the appropriate agent, modifying the treatment plan based on clinical response and culture results if necessary, and continuing antibiotics for the appropriate duration, which depends on the UTI syndrome being treated (eg, cystitis, pyelonephritis, CAUTI). The presence or absence of complicating factors or warning signs such as fever, rigors, acute delirium, or unstable vital signs, may also influence some of those decisions.[20] Screening for and treatment of ASB is not recommended for older adults residing in PALTC settings except before undergoing transurethral resection of the prostate or other urologic procedures associated with mucosal trauma.[3]

Initiating Empiric Antibiotics in Suspected UTI

Antibiotic treatment for UTI should not be initiated unless clinical criteria for UTI are met. For residents who meet clinical criteria for a suspected UTI, we recommend sending a urine specimen for urinalysis and culture before initiating empiric antibiotics. For residents who meet clinical criteria for UTI and have severe symptoms with evidence of systemic infection (warning signs), clinicians should consider empiric treatment with broad-spectrum agents and then de-escalate based on the results of urine studies and the clinical course. For residents who meet clinical criteria for UTI and have mild symptoms (no warning signs), the selection of empiric antibiotics should be guided in part based on local resistance patterns, discussed in further detail below. When evaluating residents for presence of clinical criteria for UTI, clinicians should also take into consideration the fact that in some clinical scenarios localizing signs and symptoms (suggestive of UTI) might just be a manifestation of an alternative etiology (eg, frequency in a resident who was recently started on diuretic). If an alternative etiology is suspected for localizing signs and symptoms in a resident, clinicians should consider addressing that etiology.

For residents who do not meet clinical criteria for UTI (and do not have warning signs), but for whom clinical concern for UTI still exist, we recommend responding to this situation of diagnostic uncertainty with

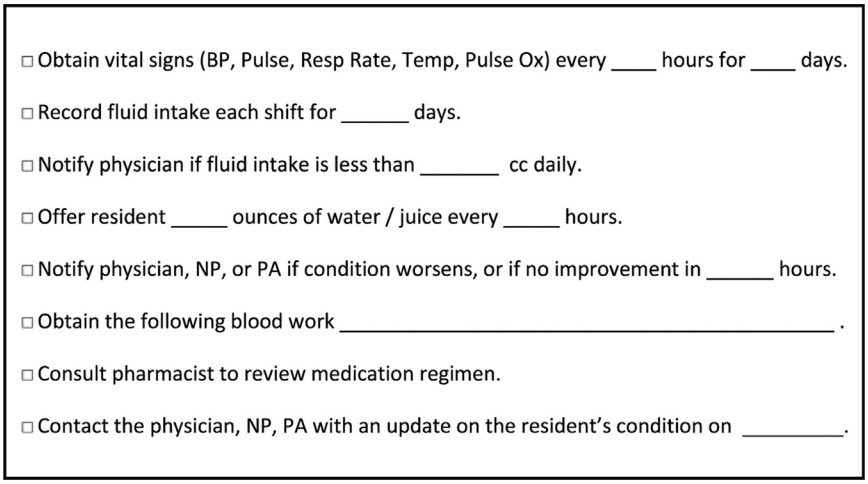

Fig. 3. Example of an active monitoring order set. Reprinted with permission from Nace et al.[7]

'active monitoring', previously referred to as 'watchful waiting' or 'careful observation'. This includes frequent monitoring of vital signs, paying attention to hydration status (eg, recording fluid intake, stimulating fluid intake), and repeated physical assessments by nursing home staff. Supportive care, including hydration, offered in the meantime may resolve the clinical concerns and obviate the need for antibiotics. A physician should be notified if signs and symptoms worsen or do not resolve, if new signs and symptoms arise, or if fluid intake is less than a certain predefined amount. Figure 3 provides an example of an 'active monitoring' order set.[7]

Choosing Empiric Antibiotics

Empiric treatment for UTIs in older adults generally follows the same treatment algorithm as in younger adults. *If prior culture data are available, clinicians should review previously identified organisms and their susceptibilities*. When clinicians considered susceptibility results from previous urine cultures, such as the preceding 6 to 24 months, three-quarters of empiric antibiotics provided adequate coverage for the current UTI.[43] In contrast, only one-third of empiric therapy provided adequate coverage for a current UTI when the chosen antibiotics were not effective against previously identified pathogens. *In the absence of prior culture data, we recommend that clinicians use facility or local resistance rates (ie, antibiograms) to select empiric antibiotics for residents with clinical signs and symptoms of a UTI.* Recent literature offers suggestions for using antibiograms in PALTC settings.[44–47]

The 2010 IDSA guidelines support the use of trimethoprim-sulfamethoxazole as first-line empirical therapy for acute uncomplicated/simple cystitis if local resistance rates of uropathogens causing acute uncomplicated cystitis do not exceed 20%.[1] *Escherichia coli,* the most commonly identified pathogen in urine cultures, generally has low rates of resistance to nitrofurantoin, which can also be used as first-line empirical therapy. Although the Food and Drug Administration recommended against using nitrofurantoin in patients with a creatinine clearance (CrCl) $\leq$60 milliliters/minute (mL/min), recent data suggest that nitrofurantoin can be used effectively for cystitis regardless of renal function.[48,49] The risk of pulmonary toxicity is greater in adults with a CrCl $\leq$30 mL/min and the Beers criteria recommend against use of nitrofurantoin in older adults $\geq$65 years with a CrCl $\leq$30 mL/min.[50] More recently an AHRQ funded project used Delphi procedure to reach a consensus on a set of recommendations for the empirical treatment of cystitis in nursing home residents.[51] An expert panel of 19 clinical pharmacists reached agreement that the preferred drugs for empiric treatment of uncomplicated cystitis were nitrofurantoin and trimethoprim-sulfamethoxazole. Clinicians should be aware of the risk of hyperkalemia with the use of trimethoprim-sulfamethoxazole in those with advanced renal disease especially when their CrCl is $<$15 mL/min.[51] For patients with CrCl of $<$15 mL/min alternative antibiotic agents should be used for treatment of UTI.

If there is significant concern for multidrug-resistant organisms, oral fosfomycin trometamol may be effective.[52] This is dosed as 1 oral sachet every 3 days, with most courses involving 1 to 2 doses. Because of the limited number of agents effective against multidrug-resistant gram-negative pathogens, particularly oral options, fosfomycin trometamol is an antibiotic that should be reserved for symptomatic residents with a recent or current urine culture indicating a highly resistant bacterial pathogen. Finally, fluoroquinolones are no longer considered first-line treatment for UTIs because of the high rate of resistance against these agents as well as risks for developing serious life-threatening or disabling side effects including prolongation of the QT interval, tendon rupture, hypoglycemia, rupture of an aortic aneurysm, peripheral neuropathy and other central nervous system (CNS) side effects.[1,53]

If pyelonephritis is suspected, neither fosfomycin nor nitrofurantoin should be used.[1] If planning to treat a resident for suspected pyelonephritis in PALTC settings with an oral antibiotic when susceptibility of the uropathogen is unknown, an initial dose of long-acting parenteral agent (such as ceftriaxone) is recommended. The culture results should be followed and antibiotics tailored once the susceptibility result of the uropathogen is available. It is also important to note that oral beta-lactam agents are less effective than other available oral agents (such as trimethoprim-sulfamethoxazole, ciprofloxacin or levofloxacin) for treatment of pyelonephritis.[1] Oral beta-lactam agents should not be used for treatment of pyelonephritis when alternative treatment options are available and if used, an initial dose of long-acting parenteral agent (such as ceftriaxone) is recommended.

De-escalation of Antibiotics

Whenever possible, clinicians should use resident-specific factors and susceptibility results to de-escalate antibiotic therapy. With the increasing prevalence of multidrug-resistant organisms, reviewing urine culture and susceptibility results is a necessary component for providing good quality care to older adults. Monitoring for changing signs and symptoms may also be helpful in determining if antibiotic therapy is effective. In cases where organisms recovered from urine cultures are

Table 2
Factors that may Predispose Residents With a UTI to Treatment Failure or Complications*

Complicating Factors	Clinical Examples	Considerations
Obstruction	Ureteric or urethral strictures Tumors of the urinary tract Urolithiasis Prostatic hypertrophy Diverticulae Pelvicalyceal obstruction Renal cysts Congenital abnormalities	A history of obstruction, by itself, is not a complicating factor unless the obstruction is still ongoing. Older male patients have been historically considered to be at high risk as many presenting with UTI may also have underlying urologic abnormalities like prostatic hypertrophy. More recent evidence indicates that 7 d of antibiotic is sufficient to treat cystitis in men (see text). Prostatitis (which requires longer length of therapy) should be suspected in residents with recurrent cystitis or if resident also has fever or pelvic or perineal pain. Management of obstruction is also a key component of UTI treatment.
Instrumentation	Indwelling urethral catheter Intermittent catheterization Ureteric stent Nephrostomy tube Urological procedures	Frequently reassess the need for an indwelling catheter and if deemed unnecessary, remove the catheter.
Impaired voiding	Neurogenic bladder Cystocele Vesicoureteral reflux Ileal conduit	Risks of complication may depend on severity of the voiding impairment.
Metabolic abnormalities	Nephrocalcinosis Medullary sponge kidney Renal failure (eCrCl <30 mL/min) Diabetes mellitus	Risks of complications in patients with diabetes with good glycemic control and without long-term diabetes complications will be lower than those with poor glycemic control and presence of diabetic complications.[60]
Immunocompromised	Renal transplant	

eCrCl, estimated CrCl.
*Content adapted from Nicolle LE; AMMI Canada Guidelines Committee.[61]

resistant to the empiric antibiotic selected and residents continue to experience UTI symptoms, therapy modification is warranted. However, if the resident clinically improved despite the discordant therapy, the organisms recovered from the urine culture may represent colonization and discontinuation of antibiotic therapy should be considered. Similarly, when a urine culture collected before initiation of empiric treatment is negative or the amount of growth reported is below the threshold for a positive culture, strong consideration should be given to stopping antibiotics and looking for another etiology of the symptoms.

De-escalation of antibiotic therapy once culture and susceptibility results are available is a cost-saving practice and may help decrease the incidence of adverse effects, slow the spread of multidrug-resistant organisms, reduce lengths of stay, and decrease overall mortality.[54–57] After selection of an empiric antibiotic, the resident's clinical response and the results of diagnostic studies should inform whether continuing antibiotics is warranted. If the initial antibiotic was a broad-spectrum agent and the culture results indicate that a more narrow-spectrum agent would be effective, clinicians should consider changing to the narrow-spectrum agent.

Length of Therapy

Table 1 outlines recommended treatment durations for UTI syndromes commonly managed in PALTC settings and highlights the differences in the length of therapy for some commonly used agents. Evidence supports that for older adults with uncomplicated cystitis, a shorter duration of antibiotics (<7 days) has similar efficacy compared with a longer duration of antibiotics (≥7 days). In 2004, Vogel et al conducted a double-blind randomized controlled trial comparing 3 and 7 day courses of ciprofloxacin in older adults.[58] They reported similar cure rates in both groups 2 days after completion of the treatment (98% vs 93%, $P = .16$). Reinfection and relapse rates were similar at 6 weeks (14% vs 18%, $P = .54$ and 15% vs 13%, $P = .83$, respectively). Adverse events, however, were significantly less in the 3-day vs the 7-day group (0.9 vs 1.6 at 5 days and 1.2 vs 2.1 at 9 days, both $P = .001$). A systematic review published in 2008 also concluded that for uncomplicated UTIs in older adults, 3 to 6 days of antibiotics is as effective as 7 to 14 days.[59] Therefore, *adult patients (including older adults) with cystitis who are not severely ill and are not at high risk for developing complications can be treated with fewer than 7 days of antibiotics.*

Several factors may influence the length of therapy including the UTI syndrome being treated, the resident's clinical response to care (ie, rapid improvement vs delayed clinical response) and the following complicating factors: structural or functional abnormalities of the urinary tract, immunosuppression, and certain chronic diseases (Table 2).[61] Usual practice has been to treat patients with a potentially complicated UTI, including all men, with 10 to 14 days of antibiotics.[61] Shorter lengths of therapy, even among individuals at high risk of recurrent or complicated infections, may be sufficient. A retrospective study of critically ill trauma patients with CAUTI showed that 3 to 5 days of antibiotic therapy led to a clinical cure rate of 82%.[62] Another retrospective study of febrile UTIs among patients with neurogenic bladder found no difference in the clinical cure rate at 1 month post-treatment when comparing <10 days, 10 to 15 days or >15 days of antibiotic treatment.[63] More recently, a randomized, double-blind, placebo-controlled, noninferiority trial compared 7- and 14-day courses of antibiotics for men and women with a febrile UTI.[64] In women, 7 days of antibiotics was noninferior to 14 days for both short- and long-term cure. In men, 7 days of antibiotics was inferior to 14 days in achieving short term (10 to 18 days post-treatment) clinical cure (86% vs 98%, difference −11.2; 90% CI -20.6 to 1.8). However, the long-term clinical cure rates were similar (92% vs 91%, difference 1.8; 90% CI -5.3 to 8.4) indicating no difference in outcomes at 70 to 84 days post-treatment. Together, these findings suggest that the older scheme of classifying UTI as complicated or uncomplicated may no longer be useful for deciding the length of therapy.[14] Instead, each individual should be evaluated on a case-by-case basis for clinical relevance of potential complicating factors. Furthermore, older age by itself should not influence treatment duration for various UTI syndromes.

For PALTC residents who may be at higher risk of treatment failure, the length of antibiotic therapy should be based on the severity of the illness and response to the treatment. For most of these residents, 7 days of antibiotic treatment should be adequate if they respond promptly to antibiotics (within 72 hours). Longer durations (ie, 10-14 days) are reasonable for residents with severe illness, such as those with bacteremia, or a delayed response to treatment.

Prevention of UTIs

Role of Cranberry Formulations

Cranberries (genus *Vaccinium*, including the species *V oxycoccus, V macrocarpon, V microcarpum,* and *V erythrocarpum*) have been touted as a home remedy to prevent UTIs. One proposed mechanism is acidification of the urine though clinical trials have not found urinary acidification after the use of cranberry products to be a major factor in preventing UTIs.[65] A second proposed mechanism is that proanthocyanidins (PACs) in cranberries may inhibit P-fimbriated *E coli* from adhering to uroepithelial cells lining the bladder wall.[66] Clinical studies, however, do not support a role for cranberry products as a preventative measure for UTIs among PALTC residents.[67–69] A double-blind, placebo-controlled efficacy trial randomized 185 female nursing home residents to a daily dose of 2 cranberry capsules (72 mg PAC) or placebo for 1 year.[67] The authors found no significant differences in the presence of bacteriuria with pyuria in the treatment vs control group. Furthermore, they found no significant differences in the following outcomes: bacteriuria with multidrug-resistant gram-negative bacteria, number of symptomatic UTIs, antibiotics administered for suspected UTIs, total antimicrobial utilization, rates of death, or hospitalization. Furthermore, a Cochrane systematic review found that the evidence of benefit resulting from cranberry juice is small and the authors did not recommend it as a means to prevent UTIs.[68] Current evidence does not support the use of cranberry products for the prevention of UTI.

Role of Vaginal Estrogens

Pelvic prolapse, lack of estrogen, loss of lactobacilli in the vaginal flora, and increased periurethral colonization by *E coli* may contribute to increased rates of UTI in aging women.[70] A postmenopausal state is also often associated with vaginal atrophy; manifested as vaginal dryness, itching, dyspareunia, and urinary incontinence—symptoms which may mimic a UTI.[71]

Vaginal estriol preparations may help reduce the incidence of UTIs in postmenopausal women. In a randomized, placebo-controlled trial, Raz and Stamm studied the effects of topical estriol cream applied over an 8-month period in 93 postmenopausal women.[72] The UTI rate was 0.5% in the treatment group compared with 5.9% in the placebo group. Eriksen et al studied the effect of an estrogen pessary to reduce recurrent symptomatic and bacteriologically confirmed UTIs in a randomized, open-label trial of 108 postmenopausal women.[73] The rate of recurrent UTIs was 51% in treatment group and 80% in the placebo group, with a cumulative likelihood of a disease-free interval of 45% in treatment group vs 20% in placebo group after 9 months ($P = .008$). Neither of these studies specifically addressed PALTC residents. However, the results of these trials suggest that for postmenopausal women, local (vaginal) estrogen therapy may help reduce recurrent UTIs. Moreover, it may be considered to treat atrophic vaginitis, the symptoms of which often mimic UTI.

Role of Physical Activity and Mobility

In general, improving or maintaining physical activity and mobility of older adults, including PALTC residents, decreases urinary incontinence.[74,75] Whether these benefits extend to prevention of UTIs is not well-characterized for PALTC populations. A single-center prospective randomized controlled trial of 42 spinal cord injury patients living in a PALTC setting found that moderate aerobic exercise reduced ASB but did not assess the influence on UTI.[76] Examining over 400,000 skilled nursing facility (SNF) residents age 65 years and older, a large retrospective cohort study evaluated the association between mobility and the risk of hospitalization for UTI.[77] This study reported that maintaining or improving walking ability during a SNF stay reduced the risk of hospitalization for a UTI by 53%. Even in residents with severely limited mobility at the time of SNF admission, increasing the ability to move in bed or to transfer between positions decreased the risk of hospitalization for UTI, with the greatest effect (80% reduction) among residents with a missing limb. For residents who develop UTI, diminished physical activity and mobility may be either a cause or result.[78] Although improving these functional measures enhance quality of life, programs focused on these outcomes are typically resource-intensive. At present, the role of physical activity and mobility as a preventative measure for UTIs remains unclear.

Role of Prophylactic Antibiotics to Prevent Recurrent UTIs

The use of antibiotics to prevent recurrent uncomplicated UTIs remains an active topic of discussion. Although few studies specifically address PALTC residents, several focus on community-dwelling older women. Recent literature acknowledges that although prophylactic antibiotics may reduce recurrent UTIs, they also pose several risks, specifically medication side-effects, drug-drug interactions, *C difficile* infection, and selection for multidrug-resistant organisms.[79–81] Specifically, a double-blinded randomized controlled trial compared trimethoprim with cranberry extract on the incidence of UTIs in women ≥45 years old. The authors reported that although differences were not statistically significant, trimethoprim use was associated with a slightly lower risk of recurrent UTI (cranberry vs trimethoprim; relative risk 1.6, 95% confidence interval [CI] 0.93–2.79) and a higher risk of study withdrawal because of adverse effects.[82]

A systematic review and meta-analysis of 3 randomized controlled trials of community-dwelling older women with recurrent UTIs found that long-term antibiotic use (daily use for 6 months) reduced the risk of microbiologically confirmed UTI by 24% (pooled RR 0.76; 95% CI 0.61–0.95) compared with control groups.[81] Although the risk of mild and serious adverse effects were not different between the antibiotic-treated and control populations, one of the included studies found that after 1 month, over 80% of all urinary and fecal *E coli* isolates were resistant to both trimethoprim-sulfamethoxazole, the prophylactic antibiotic, and to amoxicillin, which was not given as part of the clinical protocol.[83] Three months after cessation of the antibiotic prophylaxis, the prevalence of *E coli* resistant to trimethoprim-sulfamethoxazole and amoxicillin had not returned to baseline levels. *E coli* isolates recovered from the control groups did not demonstrate increased antibiotic resistance.

Although antibiotics may reduce the risk of recurrent, uncomplicated UTIs, the potential harms associated with long-term use, coupled with the prevalence of multidrug-resistant organisms among PALTC residents,[6] *argues against long-term antibiotic prophylaxis.* Similarly, because of concerns about selection for multidrug-resistant organisms, systemic antibiotics should not be used to prevent infection in residents with short- or long-term indwelling urinary catheters.[2] In residents with ASB, evidence supports the use of prophylactic antibiotics prior to urologic procedures associated with mucosal trauma, including transurethral resection of the prostate.[3]

Role of Methenamine Salts

Methenamine salts have been used in clinical practice to prevent UTI.[84] They are not used for treatment of active infection. Methenamine salts are hydrolyzed to ammonia and formaldehyde, which is responsible for the antibacterial activity of methenamine.[2] The urinary concentration of formaldehyde, which also correlates with the antimicrobial activity in the urine, is dependent on the concentration of methenamine in the urine, the urine pH, and the time the drug remains in the bladder.[2] It has been suggested that a urinary pH below 5.5 is needed to generate bacteriostatic concentrations of free

Table 3
Applying the CDC's Core Elements for Antibiotic Stewardship in Nursing Homes to Support the Diagnosis, Treatment, and Prevention of Suspected UTIs*

Core Elements	Description/Examples
1. Leadership commitment	Description: Demonstrate support and commitment to safe and appropriate antibiotic use in your facility. Examples: • Establish that the appropriate diagnosis and treatment of UTIs is a priority. • Communicate that priority to nursing staff, prescribing clinicians and to residents and families with consistent messaging and education.
2. Accountability	Description: Identify individuals accountable for antibiotic stewardship activities who have the support of facility leadership. Examples: • Empower the medical director to establish policies and procedures for the diagnosis of UTIs based on specific signs and symptoms, and for treatment with recommended antibiotics and length of therapy. • Empower the director of nursing to establish standards for evaluating the necessity of urinary catheters, catheter care, collecting high-quality urine specimens and for communication with providers.
3. Drug expertise	Description: Establish access to individuals with antibiotic expertise. Examples: • Engage the consultant pharmacist to help improve the selection of antibiotics used to treat a suspected UTI, including the dose and duration, with consideration of potential drug-drug interactions. • Ask for assistance from the consultant pharmacists, the microbiology laboratory or experts from hospitals within your referral network to help develop diagnostic and treatment protocols for suspected UTI and an antibiogram specific to urinary pathogens for your population.
4. Action	Description: Implement at least one policy or practice to improve antibiotic use. Examples: • Implement a Situation, Background, Assessment and Recommendations (SBAR) tool for data to gather prior to contacting a medical provider about a suspected UTI.[19] • Establish standing orders for active monitoring (eg, hydration, mobilization, medical/nursing evaluation, regular vital signs and ongoing monitoring) for residents with a non-specific change in condition in whom a UTI is suspected but not clinically obvious.[7]
5. Tracking	Description: Monitor at least one process measure and one outcome measure of antibiotic use at your facility. Examples: • Determine how often nursing staff and prescribing clinicians document signs and symptoms that localize to the genitourinary tract for residents diagnosed with a UTI. • Assess the antibiotics and length of therapy prescribed for residents diagnosed with a UTI. • Track the rate of UTIs per 1000 resident d or the rate of CAUTIs per 1000 catheter d.
6. Reporting	Description: Provide regular feedback on antibiotic use and resistance to prescribing clinicians, nursing staff and other relevant staff. Examples: • Report how often residents who are diagnosed with a UTI: ○ Had documentation of signs and symptoms that localize to the genitourinary tract in their medical record. ○ Received an antibiotic and length of therapy concordant with your facility's policy and procedure. • Share graphs of the rate of UTIs per 1000 resident d with nurses (at morning report or stand-up), prescribing clinicians, the Quality Assurance and Performance Improvement team members and the resident and family council. Provide context to help explain changes in rates, such as a new policy or educational intervention.
7. Education	Description: Provide resources to prescribing clinicians, nursing staff, residents and families about antibiotic resistance and opportunities for improving antibiotic use. Examples: • Provide an in-service for nursing staff about asymptomatic bacteriuria. Include materials they may share with residents and families. Repeat this at least annually. • Incorporate "fast facts" about UTIs into staff meetings or emails shared with prescribing clinicians. • Use the reports about UTI metrics as a chance to remind stakeholders about diagnostic criteria for UTI or interpretation of urine culture results.

*Adapted from the CDC's Core Elements for Antibiotic Stewardship in Nursing Homes.[101]

formaldehyde from methenamine hippurate.[85] Acidification of urine is usually achieved with additional high doses of vitamin C.[2] Because methenamine efficacy also depends on the time the drug remains in the bladder, it is generally considered to have limited effectiveness in catheterized patients.[2]

Several studies have evaluated the role of methenamine salts in preventing UTI but its effectiveness is not well-studied in PALTC settings.[84,86–88] A Cochrane systematic review in 2012 analyzed 13 studies to evaluate the effectiveness of methenamine hippurate in preventing symptomatic UTI and ASB.[84] Based on the subgroup analysis of 6 studies that assessed symptomatic UTI, methenamine hippurate was found to be effective in preventing UTI in patients without urinary tract abnormalities (RR 0.24, 95% CI 0.07–0.89) but not with urinary tract abnormalities (RR 1.54, 95% CI 0.38–6.20).[84] However, the studies evaluating the impact on symptomatic UTI in patients without urinary tract abnormalities considered either pregnant women or patients undergoing gynecologic procedures.[84,86–88] Short-term treatment duration (7 days or less) significantly reduced symptomatic UTI in patients without urinary tract abnormalities (RR 0.14, 95% CI 0.05–.38).[84] Long-term treatment did not reveal similar benefits. In short, current evidence does not support the long-term use of methenamine salts for prevention of UTI.

Preventing Catheter-Associated UTIs

Although there is limited evidence on the benefits or harms of routine urinary catheter changes in those with long-term catheterization, CDC guidelines recommend against changing indwelling catheters or drainage bags at routine, fixed intervals.[89] Urinary catheters that are obstructed or otherwise compromised (eg, a break in the closed system) or are implicated in an infection should be removed and replaced only if still indicated.

Recognition of CAUTIs as the most common healthcare-acquired infection prompted regulatory changes to incentivize reduction of this preventable infection in both hospital and PALTC settings.[2,90,91] A large retrospective cohort study of SNFs found that in 2003, whereas 12.6% of residents had an indwelling urinary catheter on admission, only 4.5% of them still had a catheter in place during their annual assessment.[92] A more recent observational cohort study of 28 nursing homes found that in 2013–2014, of 228 long-stay residents with an indwelling urinary catheter, 86% had an indication documented in their medical record and of those, 99% were for appropriate indications, which include strict output monitoring, acute or chronic urinary retention, end-of-life care, and to assist in healing sacral pressure ulcers in incontinent residents.[93,94] These findings underscore that in general, PALTC settings have incorporated strategies to

reduce the rate of CAUTIs, by only placing catheters when necessary and removing them whenever possible.

Further strategies to reduce the incidence of CAUTI in PALTC residents come from intervention bundles that incorporate technical and socioadaptive strategies.[95,96] Technical features focus on aseptic insertion, training for catheter care, assessments, and stop orders. Socioadaptive strategies engage staff, residents, and their families along with emphasizing leadership and communication. These strategies proved effective at reducing CAUTI by over 50% (from 6.78 to 2.63 CAUTIs/1000 catheter days) among 404 community nursing homes.[95] A similar intervention in Veterans Affairs nursing homes, termed Community Living Centers, where the baseline rates of CAUTI were lower (2.26 CAUTIs/1000 catheter days), did not yield similar reductions, likely a reflection of previous, successful efforts to reduce CAUTI.[97,98] PALTC settings may want to review their CAUTI rates before dedicating resources specifically to a CAUTI reduction bundle.

For some PALTC settings, CAUTI-reduction might be incorporated into more comprehensive infection prevention efforts. A multimodal targeted infection prevention program implemented at 12 community nursing homes decreased both the prevalence of multidrug-resistant organisms among residents with indwelling devices and the incidence of CAUTIs.[99] The program included active surveillance for infections, ongoing educational programs for staff, hand hygiene promotion, and preemptive barrier precautions for all residents with indwelling devices. Although resource intensive, this targeted infection prevention program for high-risk residents was ultimately cost-saving and also improve quality-adjusted life-years for residents.[100] *Implementing a comprehensive infection prevention and control bundle is a safe and effective strategy to reduce CAUTI in PALTC settings.*

Applying Principles of Antibiotic Stewardship to UTIs in the PALTC Population

Antibiotic stewardship is defined as "a set of commitments and actions designed to optimize the treatment of infections while reducing adverse events associated with antibiotic use."[101] The CDC has established 7 core elements for antibiotic stewardship in nursing homes, which are reflected in the guidance used to assess compliance with CMS requirements for an antibiotic stewardship program.[101–103] Table 3 summarizes the Core Elements and provides examples of how these apply to the diagnosis, treatment and prevention of UTIs in PALTC settings. *We strongly encourage PALTC settings to adapt existing resources as they codify antibiotic stewardship policies and procedures tailored to their organization and also recommend incorporating antibiotic stewardship into their Quality Assurance and Performance Improvement program.*[44]

Conclusions

In general, the workgroup's recommendations for the diagnosis, treatment, and prevention of UTIs in PALTC residents aligns with previous expert guidance, emphasizing the use of clinical signs and symptoms, evidenced-based diagnostic criteria, critical interpretation of diagnostic studies, and judicious use of antibiotics.[1–3,35,37] To help prescribing clinicians apply this consensus statement to their clinical practice, we strove to provide reasoning for each recommendation and advise that guidance provided in this consensus statement should not override clinical judgment. Although salient knowledge gaps remain, our review of the literature and clinical experience indicate that incorporating evidence-based practices into the care of PALTC residents with suspected UTIs will yield tangible improvements in resident safety, enhance quality of life, and reduce the prevalence of multidrug-resistant organisms.

References

1. Gupta K, Hooton TM, Naber KG, et al. International clinical practice guidelines for the treatment of acute uncomplicated cystitis and pyelonephritis in women: A 2010 update by the Infectious Diseases Society of America and the European Society for Microbiology and Infectious Diseases. Clin Infect Dis 2011;52:e103–e120.
2. Hooton TM, Bradley SF, Cardenas DD, et al. Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in adults: 2009 International Clinical Practice Guidelines from the Infectious Diseases Society of America. Clin Infect Dis Off Publ Infect Dis Soc Am 2010;50:625–663.
3. Nicolle LE, Gupta K, Bradley SF, 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:e83–e110.
4. Threat Report 2013 | Antimicrobial Resistance | CDC. Available at: http://www.cdc.gov/drugresistance/threat-report-2013/index.html. Accessed October 20, 2013.
5. Mitchell SL, Shaffer ML, Loeb MB, et al. Infection management and multidrug-resistant organisms in nursing home residents with advanced dementia. JAMA Intern Med 2014;174:1660–1667.
6. Dumyati G, Stone ND, Nace DA, et al. Challenges and strategies for prevention of multidrug-resistant organism transmission in nursing homes. Curr Infect Dis Rep 2017;19:18.
7. 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;15:133–139.
8. Zabarsky TF, Sethi AK, Donskey CJ. Sustained reduction in inappropriate treatment of asymptomatic bacteriuria in a long-term care facility through an educational intervention. Am J Infect Control 2008;36:476–480.
9. Foxman B. Urinary tract infection syndromes: Occurrence, recurrence, bacteriology, risk factors, and disease burden. Infect Dis Clin North Am 2014;28:1–13.
10. Ninan S, Walton C, Barlow G. Investigation of suspected urinary tract infection in older people. BMJ 2014;349:g4070.
11. Nicolle LE. Urinary tract pathogens in complicated infection and in elderly individuals. J Infect Dis 2001;183:S5–S8.
12. Loeb M, Bentley DW, Bradley S, et al. Development of minimum criteria for the initiation of antibiotics in residents of long-term-care facilities: Results of a consensus conference. Infect Control Hosp Epidemiol 2001;22:120–124.
13. Toolkit 1. Start an Antimicrobial Stewardship Program | Agency for Healthcare Research and Quality. Available at: https://www.ahrq.gov/nhguide/toolkits/implement-monitor-sustain-program/toolkit1-start-program.html. Accessed April 25, 2017.
14. Cortes-Penfield NW, Trautner BW, Jump RLP. Urinary tract infection and asymptomatic bacteriuria in older adults. Infect Dis Clin North Am 2017;31:673–688.
15. van Buul LW, Vreeken HL, Bradley SF, et al. The development of a decision tool for the empiric treatment of suspected urinary tract infection in frail older adults: A delphi consensus procedure. J Am Med Dir Assoc 2018;19:757–764.
16. Fox MT, Melia MT, Same RG, et al. A seven-day course of TMP-SMX may be as effective as a seven-day course of ciprofloxacin for the treatment of pyelonephritis. Am J Med 2017;130:842–845.
17. Hooton TM. Clinical practice. Uncomplicated urinary tract infection. N Engl J Med 2012;366:1028–1037.
18. Leekha S, Preas MA, Hebden J. Association of National Healthcare Safety Network–defined catheter-associated urinary tract infections with alternate sources of fever. Infect Control Amp Hosp Epidemiol 2015;36:1236–1238.
19. Toolkit 1. Suspected UTI SBAR Toolkit. 2016. Available at: https://www.ahrq.gov/nhguide/toolkits/determine-whether-to-treat/toolkit1-suspected-uti-sbar.html. Accessed November 10, 2018.
20. Nace DA, Perera SK, Hanlon JT, et al. The Improving Outcomes of UTI Management in Long-Term Care Project (IOU) consensus guidelines for the diagnosis of uncomplicated cystitis in nursing home residents. J Am Med Dir Assoc 2018;19:765–769.e3.
21. Stone ND, Ashraf MS, Calder J, et al. Surveillance definitions of infections in long-term care facilities: Revisiting the McGeer criteria. Infect Control Hosp Epidemiol 2012;33:965–977.
22. Boscia JA, Kobasa WD, Abrutyn E, et al. Lack of association between bacteriuria and symptoms in the elderly. Am J Med 1986;81:979–982.
23. Sundvall P-D, Ulleryd P, Gunnarsson RK. Urine culture doubtful in determining etiology of diffuse symptoms among elderly individuals: A cross-sectional study of 32 nursing homes. BMC Fam Pract 2011;12:36.
24. Crnich CJ, Jump RL, Nace DA. Improving management of urinary tract infections in older adults: A paradigm shift or therapeutic nihilism? J Am Geriatr Soc 2017;65:1661–1663.
25. Caterino JM, Leininger R, Kline DM, et al. Accuracy of current diagnostic criteria for acute bacterial infection in older emergency department patients. J Am Geriatr Soc 2017;65:1802–1809.
26. McGeer A, Campbell B, Emori TG, et al. Definitions of infection for surveillance in long-term care facilities. Am J Infect Control 1991;19:1–7.
27. LTC Surveillance for UTIs | NHSN | CDC. 2018. Available at: https://www.cdc.gov/nhsn/ltc/uti/index.html. Accessed November 10, 2018.
28. Cai T, Nesi G, Mazzoli S, et al. Asymptomatic bacteriuria treatment is associated with a higher prevalence of antibiotic resistant strains in women with urinary tract infections. Clin Infect Dis 2015;61:1655–1661.

29. Das R, Towle V, Ness PHV, Juthani-Mehta M. Adverse outcomes in nursing home residents with increased episodes of observed bacteriuria. Infect Control Hosp Epidemiol 2011;32:84–86.
30. Juthani-Mehta M, Tinetti M, Perrelli E, et al. Role of dipstick testing in the evaluation of urinary tract infection in nursing home residents. Infect Control Hosp Epidemiol 2007;28:889–891.
31. Rodgers K, Nicolle L, McIntyre M, et al. Pyuria in institutionalized elderly subjects. Can J Infect Dis 1991;2:142–146.
32. Devillé WL, Yzermans JC, van Duijn NP, et al. The urine dipstick test useful to rule out infections. A meta-analysis of the accuracy. BMC Urol 2004;4:4.
33. Juthani-Mehta M, Perley L, Chen S, et al. Feasibility of cranberry capsule administration and clean catch urine collection among long-term care residents. J Am Geriatr Soc 2010;58:2028–2030.
34. LaRocco MT, Franek J, Leibach EK, et al. Effectiveness of preanalytic practices on contamination and diagnostic accuracy of urine cultures: A laboratory medicine best practices systematic review and meta-analysis. Clin Microbiol Rev 2016;29:105–147.
35. High KP, Bradley SF, Gravenstein S, et al. Clinical practice guideline for the evaluation of fever and infection in older adult residents of long-term care facilities: 2008 update by the Infectious Diseases Society of America. Clin Infect Dis 2009;48:149–171.
36. Ouslander JG, Greengold BA, Silverblatt FJ, Garcia JP. An accurate method to obtain urine for culture in men with external catheters. Arch Intern Med 1987;147:286–288.
37. Jump RLP, Crnich CJ, Mody L, et al. Infectious diseases in older adults of long-term care facilities: Update on approach to diagnosis and management. J Am Geriatr Soc 2018;66:789–803.
38. Trautner BW, Darouiche RO. Role of biofilm in catheter-associated urinary tract infection. Am J Infect Control 2004;32:177–183.
39. Warren JW, Tenney JH, Hoopes JM, et al. A prospective microbiologic study of bacteriuria in patients with chronic indwelling urethral catheters. J Infect Dis 1982;146:719–723.
40. Dalen DM, Zvonar RK, Jessamine PG. An evaluation of the management of asymptomatic catheter-associated bacteriuria and candiduria at The Ottawa Hospital. Can J Infect Dis Med Microbiol 2005;16:166–170.
41. Juthani-Mehta M, Quagliarello V, Perrelli E, et al. Clinical features to identify urinary tract infection in nursing home residents: A cohort study. J Am Geriatr Soc 2009;57:963–970.
42. Balogun SA, Philbrick JT. Delirium, a smptom of UTI in the elderly: Fact or fable? A systematic review. Can Geriatr J 2013;17:22–26.
43. Linsenmeyer K, Strymish J, Gupta K. Two simple rules for improving the accuracy of empiric treatment of multidrug-resistant urinary tract infections. Antimicrob Agents Chemother 2015;59:7593–7596.
44. Jump RLP, Gaur S, Katz MJ, et al. Template for an antibiotic stewardship policy for post-acute and long-term care settings. J Am Med Dir Assoc 2017;18:913–920.
45. Tolg M-SA, Dosa DM, Jump RLP, et al. Antimicrobial stewardship in long-term care facilities: Approaches to creating an antibiogram when few bacterial isolates are cultured annually. J Am Med Dir Assoc 2018;19:744–747.
46. Fridkin SK, Pack J, Licitra G, et al. Creating reasonable antibiograms for antibiotic stewardship programs in nursing homes: Analysis of 260 facilities in a large geographic region, 2016–2017. Infect Control Hosp Epidemiol 2019;40:839–846.
47. Hughes M-SA, Dosa DM, Caffrey AR, et al. Antibiograms Cannot be used interchangeably between acute care medical centers and affiliated nursing homes. J Am Med Dir Assoc; 2019.
48. Santos JM, Batech M, Pelter MA, Deamer RL. Evaluation of the risk of nitrofurantoin lung injury and its efficacy in diminished kidney function in older adults in a large integrated healthcare system: A matched cohort study. J Am Geriatr Soc 2016;64:798–805.
49. Geerts AFJ, Eppenga WL, Heerdink R, et al. Ineffectiveness and adverse events of nitrofurantoin in women with urinary tract infection and renal impairment in primary care. Eur J Clin Pharmacol 2013;69:1701–1707.
50. American Geriatrics Society 2019 Updated AGS Beers Criteria® for potentially inappropriate medication use in older adults. J Am Geriatr Soc 2019;67:674–694.
51. Hanlon JT, Perera S, Drinka PJ, et al. The IOU Consensus Recommendations for Empirical Therapy of cystitis in nursing home residents. J Am Geriatr Soc 2019;67:539–545.
52. Grigoryan L, Trautner BW, Gupta K. Diagnosis and management of urinary tract infections in the outpatient setting: A review. JAMA 2014;312:1677–1684.
53. FDA warns about increased risk of ruptures or tears in the aorta blood vessel with fluoroquinolone antibiotics in certain patients. FDA. 2019. Available at: http://www.fda.gov/drugs/drug-safety-and-availability/fda-warns-about-increased-risk-ruptures-or-tears-aorta-blood-vessel-fluoroquinolone-antibiotics. Accessed June 11, 2019.
54. Ohji G, Doi A, Yamamoto S, Iwata K. Is de-escalation of antimicrobials effective? A systematic review and meta-analysis. Int J Infect Dis 2016;49:71–79.
55. Khasawneh F, Karim A, Mahmood T, et al. Safety and feasibility of antibiotic de-escalation in bacteremic pneumonia. Infect Drug Resist 2014;7:177–182.
56. Dellinger RP, Levy MM, Rhodes A, et al. Surviving Sepsis Campaign: International guidelines for management of severe sepsis and septic shock, 2012. Intensive Care Med 2013;39:165–228.
57. Rieger KL, Bosso JA, MacVane SH, et al. Intravenous-only or intravenous transitioned to oral antimicrobials for *Enterobacteriaceae*-associated bacteremic urinary tract infection. Pharmacotherapy 2017;37:1479–1483.
58. Vogel T, Verreault R, Gourdeau M, et al. Optimal duration of antibiotic therapy for uncomplicated urinary tract infection in older women: A double-blind randomized controlled trial. CMAJ 2004;170:469–473.
59. Lutters M, Vogt-Ferrier NB. Antibiotic duration for treating uncomplicated, symptomatic lower urinary tract infections in elderly women. In: Cochrane Database of Systematic Reviews. John Wiley & Sons, Ltd; 2008.
60. Nitzan O, Elias M, Chazan B, Saliba W. Urinary tract infections in patients with type 2 diabetes mellitus: Review of prevalence, diagnosis, and management. Diabetes Metab Syndr Obes Targets Ther 2015;8:129–136.
61. Nicolle L. Complicated urinary tract infection in adults. Can J Infect Dis Med Microbiol 2005;16:349–360.
62. Jarrell AS, Wood GC, Ponnapula S, et al. Short-duration treatment for catheter-associated urinary tract infections in critically ill trauma patients. J Trauma Acute Care Surg 2015;79:649–653.
63. Dinh A, Toumi A, Blanc C, et al. Management of febrile urinary tract infection among spinal cord injured patients. BMC Infect Dis 2016;16:156.
64. van Nieuwkoop C, van der Starre WE, Stalenhoef JE, et al. Treatment duration of febrile urinary tract infection: A pragmatic randomized, double-blind, placebo-controlled non-inferiority trial in men and women. BMC Med 2017;15:70.
65. Howell AB. Cranberry proanthocyanidins and the maintenance of urinary tract health. Crit Rev Food Sci Nutr 2002;42:273–278.
66. Howell AB, Vorsa N, Marderosian AD, Foo LY. Inhibition of the adherence of P-fimbriated *Escherichia coli* to uroepithelial-cell surfaces by proanthocyanidin extracts from cranberries; 2009.
67. Juthani-Mehta M, Ness PHV, Bianco L, et al. Effect of cranberry capsules on bacteriuria plus pyuria among older women in nursing homes: A randomized clinical trial. JAMA 2016;316:1879–1887.
68. Jepson RG, Williams G, Craig JC. Cranberries for preventing urinary tract infections. Cochrane Database Syst Rev 2012;10:CD001321.
69. Caljouw MAA, van den Hout WB, Putter H, et al. Effectiveness of cranberry capsules to prevent urinary tract infections in vulnerable older persons: A double-blind randomized placebo-controlled trial in long-term care facilities. J Am Geriatr Soc 2014;62:103–110.
70. Stamm WE, Raz R. Factors Contributing to susceptibility of postmenopausal women to recurrent urinary tract infections. Clin Infect Dis 1999;28:723–725.
71. Raz R. Urinary tract infection in postmenopausal women. Korean J Urol 2011;52:801–808.
72. Raz R, Stamm WE. A controlled trial of intravaginal estriol in postmenopausal women with recurrent urinary tract infections. N Engl J Med 1993;329:753–756.
73. Eriksen BC. A randomized, open, parallel-group study on the preventive effect of an estradiol-releasing vaginal ring (Estring) on recurrent urinary tract infections in postmenopausal women. Am J Obstet Gynecol 1999;180:1072–1079.
74. Ouslander JG, Griffiths PC, McConnell E, et al. Functional incidental training: A randomized, controlled, crossover trial in veterans affairs nursing homes. J Am Geriatr Soc 2005;53:1091–1100.
75. Vinsnes AG, Helbostad JL, Nyrønning S, et al. Effect of physical training on urinary incontinence: A randomized parallel group trial in nursing homes. Clin Intervent Aging 2012;7:45–50.
76. Lavado EL, Cardoso JR, Silva LG, et al. Effectiveness of aerobic physical training for treatment of chronic asymptomatic bacteriuria in subjects with spinal cord injury: A randomized controlled trial. Clin Rehabil 2013;27:142–149.
77. Rogers MA, Fries BE, Kaufman SR, et al. Mobility and other predictors of hospitalization for urinary tract infection: A retrospective cohort study. BMC Geriatr 2008;8:31.
78. Büla CJ, Ghilardi G, Wietlisbach V, et al. Infections and functional impairment in nursing home residents: A reciprocal relationship. J Am Geriatr Soc 2004;52:700–706.
79. Mody L, Juthani-Mehta M. Urinary tract infections in older women. JAMA 2014;311:844–854.
80. Arnold JJ, Hehn LE, Klein DA. Common questions about recurrent urinary tract infections in women. Am Fam Phys 2016;93:560–569.
81. Ahmed H, Davies F, Francis N, et al. Long-term antibiotics for prevention of recurrent urinary tract infection in older adults: Systematic review and meta-analysis of randomised trials. BMJ Open 2017;7:e015233.
82. McMurdo MET, Argo I, Phillips G, et al. Cranberry or trimethoprim for the prevention of recurrent urinary tract infections? A randomized controlled trial in older women. J Antimicrob Chemother 2009;63:389–395.
83. Beerepoot MAJ, Riet G ter, Nys S, et al. Lactobacilli vs antibiotics to prevent urinary tract infections: A randomized, double-blind, noninferiority trial in postmenopausal women. Arch Intern Med 2012;172:704–712.
84. Lee BSB, Bhuta T, Simpson JM, Craig JC. Methenamine hippurate for preventing urinary tract infections. Cochrane Database Syst Rev 2012;10:CD003265.
85. Geerlings SE, Beerepoot MAJ, Prins JM. Prevention of recurrent urinary tract infections in women: Antimicrobial and nonantimicrobial strategies. Infect Dis Clin North Am 2014;28:135–147.
86. Schiøtz HA, Guttu K. Value of urinary prophylaxis with methenamine in gynecologic surgery. Acta Obstet Gynecol Scand 2002;81:743–746.

87. Tyreman N-O, Andersson P-O, Kroon L, Orstam S. Urinary tract infection after vaginal surgery: Effect of prophylactic treatment with methenamine hippurate. Acta Obstet Gynecol Scand 1986;65:731–733.
88. Furness ET, McDonald PJ, Beasley NV. Urinary antiseptics in asymptomatic bacteriuria of pregnancy. N Z Med J 1975;81:417–419.
89. CAUTI Guidelines | Guidelines Library | Infection Control | CDC. Available at: https://www.cdc.gov/infectioncontrol/guidelines/cauti/index.html. Accessed November 11, 2018.
90. Saint S, Meddings JA, Calfee D, et al. Catheter-associated urinary tract infection and the Medicare rule changes. Ann Intern Med 2009;150:877–884.
91. Approved. CAUTI NPSG for Nursing Care Centers. Available at: http://www.jointcommission.org/approved_cauti_npsg_nursing_care_centers/. Accessed January 3, 2019.
92. Rogers MAM, Mody L, Kaufman SR, et al. Use of urinary collection devices in skilled nursing facilities in five states. J Am Geriatr Soc 2008;56:854–861.
93. Gurwitz JH, DuBeau C, Mazor K, et al. Use of Indwelling urinary catheters in nursing homes: Implications for quality improvement efforts. J Am Geriatr Soc 2016;64:2204–2209.
94. Gould CV, Umscheid CA, Agarwal RK, et al. Committee (HICPAC) HICPA. Guideline for prevention of catheter-associated urinary tract infections 2009. Infect Control Hosp Epidemiol 2010;31:319–326.
95. Mody L, Greene MT, Meddings J, et al. A national implementation project to prevent catheter-associated urinary tract infection in nursing home residents. JAMA Intern Med 2017;177:1154–1162.
96. Meddings J, Rogers MAM, Krein SL, et al. Reducing unnecessary urinary catheter use and other strategies to prevent catheter-associated urinary tract infection: An integrative review. BMJ Qual Saf 2014;23:277–289.
97. Krein SL, Greene MT, King B, et al. Assessing a national collaborative program to prevent catheter-associated urinary tract infection in a Veterans Health Administration Nursing Home Cohort. Infect Control Hosp Epidemiol 2018;39:820–825.
98. Mody L, Greene MT, Saint S, et al. Comparing catheter-associated urinary tract infection prevention programs between Veterans Affairs nursing homes and non–Veterans Affairs nursing homes. Infect Control Hosp Epidemiol 2017;38:287–293.
99. Mody L, Krein SL, Saint SK, et al. A Targeted infection prevention intervention in nursing home residents with indwelling devices. JAMA Intern Med 2015;175:714–723.
100. Hutton DW, Krein SL, Saint S, et al. Economic evaluation of a catheter-associated urinary tract infection prevention program in nursing homes. J Am Geriatr Soc 2018;66:742–747.
101. The core elements of antibiotic stewardship for nursing homes | nursing homes and assisted living (LTC) | CDC. Available at: http://www.cdc.gov/longtermcare/prevention/antibiotic-stewardship.html. Accessed June 25, 2016.
102. Federal Register | Medicare and Medicaid Programs; Conditions of Participation: Immunization standards for hospitals, long-term care facilities, and home health Agencies. Available at: https://www.federalregister.gov/articles/2002/10/02/02-25096/medicare-and-medicaid-programs-conditions-of-participation-immunization-standards-for-hospitals. Accessed August 31, 2016.
103. Medicare State Operations Manual, Appendix PP: Interpretive Guidelines for Long-Term Care Facilities. Available at: https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/Internet-Only-Manuals-IOMs-Items/CMS1201984.html. Accessed July 13, 2017.

Supplementary Material 1. Summary of Recommendations From the UTI Consensus Statement

This document summarizes the recommendations of the UTI consensus statement. Some recommendations concur with guidelines about UTIs among adults in general. Others represent the UTI consensus statement workgroup's review of available evidence (evidenced-based; EB), a consensus statement (CS) or both.

Definition of Urinary Tract Infections

UTI refers to an infection anywhere in the genitourinary tract.

- Cystitis: urinary symptoms are usually confined to the bladder. These are dysuria, frequency, gross hematuria, supra-pubic tenderness, and new or worsening urinary incontinence or urgency.
- Pyelonephritis is a more severe infection involving the renal parenchyma. Patients with pyelonephritis may present with fever and chills, back pain, nausea, and vomiting; localizing urinary symptoms may or may not be present.
- Catheter-associated urinary tract infection (CAUTI) refers to UTIs that develop in individuals with an indwelling urinary catheter.

Diagnosis of UTIs

Clinical Diagnosis of UTI

(1) Post-acute and long-term care (PALTC) settings should use one of the clinical algorithms (eg, Loeb Minimum Criteria, Agency for Healthcare Research and Quality (AHRQ) decision tool, Improving Outcomes of UTI (IOU) Consensus Guideline, International Delphi Consensus decision tool) to guide the diagnosis and decision to initiate antibiotics for residents with a suspected UTI. PALTC should incorporate those criteria into their antibiotic stewardship policy. When selecting one of the clinical algorithms discussed above, PALTC settings should determine which seems most closely aligned with their current practices in order to facilitate the implementation. (CS)
(2) Surveillance criteria (eg, McGeer criteria, National Healthcare Safety Network (NHSN) definitions) should not be routinely used in clinical practice for establishing the diagnosis of UTIs. (EB)
(3) For older adults with a change in mental status, the diagnosis of a UTI or CAUTI should be a diagnosis of exclusion. In a resident with unequivocal delirium, a UTI diagnosis should only be considered if there is no other cause for these acute, fluctuating symptoms. Clinical criteria can assist clinicians in making diagnostic and treatment decisions for residents with a change in behavior. (EB, CS)

Diagnostic testing for UTIs

(1) Urinalysis and urine cultures should only be conducted for residents who meet clinical criteria for UTI. (EB)
(2) Avoid sending urinalyses and urine cultures as a test-of-cure for asymptomatic residents. (CS)
(3) In residents without a urinary catheter, a voided midstream or clean catch specimen should be attempted. If PALTC residents are unable to provide a clean sample, an in-and-out catheterization may be necessary. (EB)
(4) Urine samples should not be obtained from a urine collection bag connected to an indwelling catheter (including a suprapubic catheter) unless a new catheter and new collection bag was inserted immediately prior to sample collection. (EB)
(5) In residents with urinary catheters present for over two weeks, the catheter should be replaced prior to collecting a urine specimen. (EB)
(6) When urinary catheter have been in place for less than 2 weeks, the decision to obtain a urine sample from the sampling port of the existing catheter or to remove the catheter before obtaining a urine sample should be made on case-by-case basis. (CS)

Treatment of UTIs

Asymptomatic Bacteriuria

(1) Screening for and treatment of ASB is not recommended for older adults residing in PALTC facilities except before undergoing transurethral resection of the prostate or other urologic procedures associated with mucosal trauma. (EB)

Initiating Empiric Antibiotics in Suspected UTI

(1) Antibiotic treatment for UTI should not be initiated unless clinical criteria for UTI are met. (EB)
(2) For residents who meet clinical criteria for a suspected UTI, send a urine specimen for urinalysis and culture before initiating empiric antibiotics. (CS)
(3) For residents who meet clinical criteria for UTI and have severe symptoms with evidence of systemic infection (warning signs), clinicians should consider empiric treatment with broad-spectrum agents and then de-escalate based on the results of urine studies and the clinical course. (CS)
(4) The culture results should be followed and antibiotics tailored once the susceptibility result of the uropathogen is available. (CS)
(5) For residents who do not meet clinical criteria for UTI (and do not have warning signs), but for whom clinical concern for UTI still exist, we recommend responding to this situation of diagnostic uncertainty with 'active monitoring' protocol. (CS)
(6) For residents who meet clinical criteria for UTI and have mild symptoms (no warning signs), the selection of empiric antibiotics should be guided in part based on local resistance patterns. (EB)
(7) If prior culture data are available, clinicians should review previously identified organisms and their susceptibilities to help guide antibiotic choice. (EB, CS)
(8) In the absence of prior culture data, clinicians should use facility or local resistance rates (ie, antibiograms) to select empiric antibiotics for residents with clinical signs and symptoms of a UTI. (EB)
(9) Nitrofurantoin and trimethoprim-sulfamethoxazole are considered first line drugs for empiric treatment of uncomplicated (acute simple) cystitis if permissible by the sensitivity patterns and resident factors. (CS)
(10) Because of the limited number of agents effective against multidrug-resistant gram-negative pathogens, particularly oral options, fosfomycin trometamol should be reserved only for symptomatic residents with a recent or current urine culture indicating a highly resistant bacterial pathogen. (CS)
(11) Fluoroquinolones are no longer considered first-line treatment for UTIs because of the high rate of resistance against these agents as well as risks for developing serious

life-threatening or disabling side effects including prolongation of the QT interval, tendon rupture, hypoglycemia, rupture of an aortic aneurysm, peripheral neuropathy and other central nervous system (CNS) side effects. (EB)

(12) If pyelonephritis is suspected, fosfomycin or nitrofurantoin should not be used. (EB)
(13) If planning to treat a resident for suspected pyelonephritis in PALTC settings with an oral antibiotic when susceptibility of the uropathogen is unknown, an initial dose of long-acting parenteral agent (such as ceftriaxone) is recommended. (CS)

De-escalation of Antibiotics

(1) Whenever possible, clinicians should use resident-specific factors and susceptibility results to de-escalate antibiotic therapy to the narrowest spectrum antibiotic that the bacterium is susceptible to. (CS)
(2) If the resident clinically improved despite the discordant therapy, the organisms recovered from the urine culture may represent colonization and discontinuation of antibiotic therapy should be considered. (CS)
(3) When a urine culture collected before initiation of empiric treatment is negative or the amount of growth reported is below the threshold for a positive culture, strong consideration should be given to stopping antibiotics and looking for another etiology of the symptoms. (CS)

Length of Therapy

(1) Adult patients (including older adults) with cystitis who are not severely ill and are not at high risk for developing complications can be treated with fewer than 7 days of antibiotics. (EB)
(2) For PALTC residents who may be at higher risk of treatment failure, the length of antibiotic therapy should be based on the severity of the illness and response to the treatment. For most of these residents, 7 days of antibiotic treatment should be adequate if they respond promptly to antibiotics (within 72 hours). Longer durations (ie, 10-14 days) are reasonable for residents with severe illness, such as those with bacteremia, or a delayed response to treatment. (CS)

Prevention of UTIs

(1) Current evidence does not support the use of cranberry products for the prevention of UTI. (EB)
(2) For postmenopausal women, local (vaginal) estrogen therapy should be considered for the prevention of recurrent UTIs. Moreover, it should be considered to treat atrophic vaginitis, the symptoms of which often mimic UTI. (EB)
(3) Although antibiotics may reduce the risk of recurrent, uncomplicated UTIs, the potential harms associated with long-term use, coupled with the prevalence of multidrug-resistant organisms among PALTC residents, argues against long-term antibiotic prophylaxis. Similarly, because of concerns about selection for multidrug-resistant organisms, systemic antibiotics should not be used to prevent infection in residents with short- or long-term indwelling urinary catheters. (EB, CB)
(4) Current evidence does not support the long-term use of methenamine salts for prevention of UTI. (EB)
(5) CDC guidelines recommend against changing indwelling catheters or drainage bags at routine, fixed intervals. (EB)
(6) Implementing a comprehensive infection prevention and control bundle is a safe and effective strategy to reduce CAUTI in PALTC settings. (EB)

Applying Principles of Antibiotic Stewardship to UTIs in the PALTC Population

(1) PALTC settings should adapt existing resources as they codify antibiotic stewardship policies and procedures tailored to their organization and also incorporate antibiotic stewardship into their Quality Assurance and Performance Improvement (QAPI) program. (CS)

Supplementary References

1. CAUTI Guidelines | Guidelines Library | Infection Control | CDC. Available at: https://www.cdc.gov/infectioncontrol/guidelines/cauti/index.html. Accessed November 11, 2018.
2. Gould CV, Umscheid CA, Agarwal RK, et al. Committee (HICPAC) HICPA. Guideline for prevention of catheter-associated urinary tract infections 2009. Infect Control Hosp Epidemiol 2010;31:319–326.
3. Gupta K, Hooton TM, Naber KG, et al. International Clinical Practice Guidelines for the Treatment of Acute Uncomplicated Cystitis and Pyelonephritis in Women: A 2010 update by the Infectious Diseases Society of America and the European Society for Microbiology and Infectious Diseases. Clin Infect Dis 2011;52:e103–e120.
4. Hanlon JT, Perera S, Drinka PJ, et al. The IOU Consensus recommendations for empirical therapy of cystitis in nursing home residents. J Am Geriatr Soc 2019;67:539–545.
5. High KP, Bradley SF, Gravenstein S, et al. Clinical practice guideline for the evaluation of fever and infection in older adult residents of long-term care facilities: 2008 update by the Infectious Diseases Society of America. Clin Infect Dis 2009;48:149–171.
6. Hooton TM, Bradley SF, Cardenas DD, et al. Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in adults: 2009 International Clinical Practice Guidelines from the Infectious Diseases Society of America. Clin Infect Dis 2010;50:625–663.
7. Loeb M, Bentley DW, Bradley S, et al. Development of minimum criteria for the initiation of antibiotics in residents of long-term-care facilities: Results of a consensus conference. Infect Control Hosp Epidemiol 2001;22:120–124.
8. Nace DA, Perera SK, Hanlon JT, et al. The Improving Outcomes of UTI Management in Long-Term Care Project (IOU) consensus guidelines for the diagnosis of uncomplicated cystitis in nursing home residents. J Am Med Dir Assoc 2018;19:765–769.e3.
9. Nicolle L. Complicated urinary tract infection in adults. Can J Infect Dis Med Microbiol 2005;16:349–360.
10. Nicolle LE, Gupta K, Bradley SF, et al. Clinical Practice Guideline for the Management of Asymptomatic Bacteriuria: 2019 update by the Infectious Diseases Society of America. Clin Infect Dis 68(10):e83-e110
11. Stone ND, Ashraf MS, Calder J, et al. Surveillance definitions of infections in long-term care facilities: Revisiting the McGeer criteria. Infect Control Hosp Epidemiol 2012;33:965–977.
12. van Buul LW, Vreeken HL, Bradley SF, et al. The development of a decision tool for the empiric treatment of suspected urinary tract infection in frail older adults: A Delphi consensus procedure. J Am Med Dir Assoc 2018;19:757–764.