

Urinary tract infection in long-term care facilities

Lindsay E. Nicolle MD, FRCPC

Department of Internal Medicine and Medical Microbiology, University of Manitoba, Winnipeg, MB R3A 1R9, Canada. Email: lnicolle@hsc.mb.ca

Abstract. *Introduction:* Asymptomatic bacteriuria and pyuria are pervasive in the long-term care population. Optimal management of urinary infection for residents of long-term care facilities requires knowledge of the unique features of the infection in this setting, together with critical evaluation of each episode of potential urinary infection in the individual resident.

Method: A non-structured review of current knowledge and recommendations relevant to urinary infection in long-term care facilities.

Results: Urinary infection is the second most common infection occurring in long-term care facility residents. For residents without chronic indwelling catheters, acute, localising, genitourinary symptoms should be present to support a clinical diagnosis of symptomatic infection. Inappropriate antimicrobial use for urinary tract infection, particularly treatment of asymptomatic bacteriuria and prophylaxis of urinary infection, is a consistent observation in reviews of antimicrobial use in these facilities. Management approaches to improve treatment include observation and reassessment when symptoms are questionable or the diagnosis is unclear, limiting the use of chronic indwelling catheters, and early identification of complications, such as obstruction, of indwelling catheters.

Conclusions: Clinical diagnostic imprecision and a high prevalence of asymptomatic bacteriuria means these infections are overdiagnosed and overtreated, leading to adverse events from excess antimicrobial use. Antimicrobial stewardship programs to improve antimicrobial use for this indication need to be developed in long-term care facilities.

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Introduction

Urinary tract infection is a common problem for residents of long-term care facilities.^{1,2} Antimicrobial therapy is indicated only for treatment of symptomatic urinary infection.³ However, the very high prevalence of asymptomatic bacteriuria, impaired communication, and frequent clinical deterioration with nonlocalising symptoms in these residents means diagnostic imprecision is common, leading to overdiagnosis and overtreatment of presumed symptomatic urinary infection.⁴ Inappropriate antimicrobial treatment of asymptomatic bacteriuria remains a substantial problem contributing to excess antimicrobial use in these facilities.⁵ There are unique considerations for the small proportion of long-term care facility residents for whom voiding is managed with a chronic indwelling catheter. The pathogenesis and morbidity of urinary infection in these residents is distinct.⁶ Optimal resident care and safety requires an understanding of the morbidity, diagnosis, and treatment of urinary infection in residents of long-term care facilities, as well as a critical approach to diagnosis for each episode.

A wide variety of long-term care facilities provide care to a broad spectrum of patients. This review addresses the largest single group: elderly subjects who require continuing

residential care because of functional or mental impairment. The approach to management differs for uncomplicated or complicated urinary tract infection. Women or men with functional or structural abnormalities of the urinary tract, including indwelling catheters, are considered within the clinical syndrome of complicated urinary infection. Most residents of long-term care facilities are considered to have complicated infection because of the comorbidities and aging-associated changes which affect genitourinary function.

Discussion

Extent of the problem

Asymptomatic bacteriuria is identified when organisms are isolated in quantitative counts $\geq 10^5$ cfu mL⁻¹ from a voided urine specimen in the absence of signs or symptoms of urinary tract infection.³ The prevalence of asymptomatic bacteriuria is high in residents of long-term care facilities. For residents without chronic indwelling catheters, 40–50% of women and 30–40% of men have asymptomatic bacteriuria at any time. Residents who are more functionally impaired are more likely to have bacteriuria.⁴ The 5 to 10% of long-term care facility residents managed with chronic indwelling catheters are

Implications

- Diagnosis of symptomatic infection for residents without indwelling catheters requires localising genitourinary signs or symptoms.
- Inappropriate and excessive antimicrobial use for treatment of urinary tract infection is associated with adverse outcomes including antimicrobial resistance, *Clostridium difficile* colitis, and adverse drug effects.
- Antimicrobial stewardship programs in long-term care facilities should specifically address optimal management of symptomatic urinary infection.

universally bacteriuric because of biofilm formation along the catheter.⁶

Symptomatic urinary tract infection is the second most common infection diagnosed in residents of long-term care facilities. The reported incidence is variable, depending on the diagnostic criteria used and methods of case ascertainment (Table 1). Incidence rates of symptomatic infection from 0.1 to 2.4 per 1000 resident-days have been reported.⁴ The highest frequency is reported when less restrictive diagnostic criteria are used, including nonlocalising, nonspecific symptoms or pyuria. The use of these criteria means residents with asymptomatic bacteriuria are diagnosed as having a symptomatic urinary infection when there are other causes for the clinical alteration. Lower rates of infection are reported when using more restrictive definitions of urinary infection which require localising genitourinary signs and symptoms.

Morbidity attributed to urinary infection is increased for residents managed with a chronic indwelling urethral catheter

compared with bacteriuric residents without an indwelling catheter. The incidence of symptomatic urinary infection in residents with a catheter is four to six times higher (Table 1). The incidence of febrile episodes potentially attributed to urinary infection has been reported to be 1.1 per 100 catheter-days in women with a chronic catheter compared with 0.4 per 100 patient-days for those without a catheter.¹⁶ In individual women monitored during periods with or without an indwelling catheter, the incidence of fever of possible urinary origin was 1.1 per 100 patient-days while the catheter was in place and 0.1 per 100 patient-days when there was no catheter. Over half of the episodes of bacteraemia identified in residents of long-term care facilities were from a urinary source, and most of these occurred in residents with chronic indwelling catheters.¹⁷ An additional problem is catheter obstruction attributed to biofilm formation along the catheter. This is usually a complication of *Proteus mirabilis* bacteriuria.¹⁸

Determinants of symptomatic infection in nursing-home residents without a chronic indwelling catheter are not well-described. Symptomatic urinary tract infection occurs more frequently in individuals with greater functional disability.¹⁹ Increased post-void residual urine is not a risk for symptomatic infection. A prospective study in 150 Norwegian nursing-home residents reported the incidence of symptomatic urinary infection and frequency of recurrent infection were similar for women or men with post-void residual urine volumes less than or greater than 100 ml.²⁰ Use of an external condom catheter for incontinence management in men is reported to be associated with an increased risk of symptomatic urinary tract infection, although the frequency of infection is less than that observed in men with an indwelling urethral catheter.²¹ When a chronic indwelling

Table 1. Recent reports characterising of the prevalence and incidence of symptomatic urinary infection in long-term care facilities
NH, nursing home

Population	Definitions	Urinary infection	
		Prevalence (% of residents)	Incidence/1000 resident days
Norway: ⁷ 44 NH	Medical record review	3.8%	
Norway: ⁸ 2 annual surveys, 6 years	Modified CDC definitions	3–4%	
France: ⁹ 44 869 residents	Indwelling catheter, 0–2.7%	2.24–2.82%	
The Netherlands: ¹⁰ 1275–1772 residents, 3 surveys, 1 year apart	McGeer criteria; includes asymptomatic bacteriuria; indwelling catheter 3.8–5.6%	3.5–4.2%	
US: ² 12 270 NH residents	2004 National nursing home survey; ICD9 codes	5.2%	
US: ¹¹ 133 VA NH, 11 475 residents	Modified CDC criteria, asymptomatic bacteriuria included	Symptomatic: 1.5% Asymptomatic: 0.69%	
Germany: ¹² 103-bed home	McGeer criteria		1.0
Sweden: ¹³ 58 NH, 3002 residents	Nurse/physician diagnosed		1.89
US: ¹⁴ 5 NH	McGeer criteria; case-control		No catheter: 1.78 Catheter: 6.13
US: ¹ 17 NH	McGeer criteria		All: 0.57 Catheter: 3.2
Poland: ¹⁵ 193 residents	McGeer criteria	0.5%	0.5

catheter is present, trauma or obstruction of the catheter may precipitate symptomatic infection and bacteraemia. In a prospective study, 8.1% of episodes of catheter obstruction in women (8.1 per 100 patient-days) were complicated by fever of possible urinary origin identified on the same day as the catheter obstruction.¹⁶

Accelerated functional decline is reported for residents of nursing homes following an episode of infection. A prospective study of residents in 39 nursing homes in Switzerland assessed functional outcomes following any infection, and stratified these outcomes by the type of infection. There was no functional decline following symptomatic urinary infection, whereas respiratory infection was associated with significant decline.²² The definition used for urinary infection in this study, however, was non-specific. Urinary tract infection accounts for 32 to 66% of antimicrobial prescriptions in long-term care facilities.⁵ This antimicrobial pressure contributes to the emergence of bacteria of increasing antimicrobial resistance, as well as complications such as *C. difficile* colitis and adverse drug effects.^{23,24} Urinary infection is, however, rarely a direct cause of mortality in nursing-home residents.

Antimicrobial resistance

Antimicrobial-resistant organisms are common in long-term care facilities and frequently persist for extended periods in a colonised resident.^{25,26} A recent Australian study²⁶ compared the susceptibility of bacteria isolated from urine specimens submitted from nursing-home residents with that of elderly subjects in the community. There was a significantly higher prevalence of multi-drug resistant isolates in the nursing-home urine specimens for all Enterobacteriaceae (12.4% v. 6.1%), for *E. coli* (8.3% v. 3.9%), and for *P. mirabilis* (27.4% v. 8.1%). The presence of indwelling devices, including chronic urethral catheters, is also a risk for colonisation with resistant bacteria. Globally, extended-spectrum β -lactamase (ESBL)-producing Enterobacteriaceae²⁷ and carbapenemase-producing *Klebsiella pneumoniae* and other Enterobacteriaceae^{28,29} have been increasingly reported in residents of long-term care facilities.

The isolation of an antimicrobial-resistant organism from a urine specimen in a long-term care facility resident correlates with recent antimicrobial use and with frequency of antimicrobial use.^{5,28–30} The prevalence of ESBL-producing, ciprofloxacin-resistant *E. coli* in resident faecal samples in 20 nursing homes in Belfast varied from 0 to 75%²⁷ and was 9.2% in residents with a urinary catheter and 2.3% without one. In a multivariate analysis, the only independent risk factors for isolation of an ESBL *E. coli* were days of fluoroquinolone use while the resident was in the nursing home and a history of prior urinary infection. Fortunately, morbidity attributed to urinary tract infection with these resistant organisms remains limited. However, the urine remains a reservoir for resistant organisms which may be transferred among residents, or to other patients should the resident be transferred to an acute-care facility.

Management of urinary tract infection

Asymptomatic bacteriuria

Asymptomatic bacteriuria should not be screened for or treated with antimicrobials in residents of long-term care facilities.³ Treatment of asymptomatic bacteriuria, with or without a chronic indwelling catheter, will not decrease the frequency of symptomatic infection. However, treatment is consistently associated with emergence of organisms of increased antimicrobial resistance as well as adverse drug effects. An exception is the requirement for preoperative surgical antimicrobial prophylaxis should a bacteriuric resident undergo a traumatic urologic procedure. Antimicrobial therapy should be initiated immediately before the intervention to decrease the risk for post-procedure sepsis for bacteriuric residents; usually a single dose is sufficient.³ The high prevalence of asymptomatic bacteriuria in this population is presumed to be a result of aging-associated changes and comorbidities which have necessitated the institutional care. There are no interventions which are known to be effective for preventing bacteriuria, other than removal of a chronic indwelling catheter if one is present. Cranberry products are not associated with a decreased frequency of bacteriuria in these populations.³¹

Pyuria accompanies bacteriuria for over 90% of elderly residents. It is also present in 30% of elderly residents without bacteriuria. Identification of pyuria by urinalysis or leukocyte esterase dipstick is not diagnostic for symptomatic urinary infection, nor is it an indication for antimicrobial therapy. Chronic genitourinary symptoms such as incontinence, dysuria, and nocturia are common in residents of long-term care facilities. These chronic symptoms are not attributed to urinary infection, even when bacteriuria is present, and treatment of bacteriuria does not improve chronic symptoms.⁴ Cloudy urine or the presence of an unpleasant odour may be associated with asymptomatic bacteriuria, but changes in character of the urine are also attributable to other factors, and are not by themselves an indication for antimicrobial treatment.

Diagnosis of symptomatic infection

Non-specific, non-localising clinical deterioration is frequently attributed to urinary infection because bacteriuria with pyuria is common at any time. However, for residents without a chronic indwelling catheter, a clinical diagnosis of symptomatic urinary infection requires localising genitourinary signs or symptoms.^{32–34} Prospective studies evaluating episodes of clinical deterioration potentially attributable to urinary infection report only 43%³⁵ and 48%³⁶ of these episodes as having a positive urine culture. This is similar to the usual prevalence of bacteriuria in the long-term care population. Symptoms which correlated with bacteriuria and pyuria in one study were dysuria, mental status deterioration, and change in character of urine.³⁵ However, residents with asymptomatic bacteriuria are more likely to

have mental impairment or changes in character of the urine at any time than those without bacteriuria, so these presentations are subject to bias.³⁷ A Swedish study reported symptoms of restlessness, fatigue, confusion, aggressiveness, 'not being himself or herself', dysuria, urgency, and fever did not correlate with bacteriuria in nursing-home residents in the short-term or over several months.³⁸ Falls are also not a presentation of urinary infection, when evaluated prospectively.³⁹ Less than 10% of bacteriuric residents without indwelling catheters who present with fever without localising genitourinary findings have serologic evidence consistent with a urinary source for infection.³⁴ Thus, systematic evaluation of the relevance of chronic genitourinary symptoms and non-specific, non-localising clinical deterioration consistently concludes that these presentations are not attributable to urinary infection, irrespective of the urine culture result.

For a resident with a chronic indwelling catheter, the most common clinical presentation of symptomatic urinary infection is fever without localising findings. Some episodes present with localising signs or symptoms such as costovertebral angle pain or tenderness, suprapubic tenderness, a history of recent catheter trauma, acute haematuria, or catheter obstruction. When these localising findings occur, they are useful to support a diagnosis of urinary infection. While fever is the most frequent presentation of urinary infection in subjects with indwelling catheters, most episodes of non-localising fever in these residents are of short duration and resolve without antimicrobial therapy. Fever duration was 1 day or less for 58% of episodes in women in one nursing home, and 71% had a maximum temperature of less than 38.3°C in one study.¹⁶ When a resident with a catheter presents with fever and no localising genitourinary findings, serologic evidence consistent with urinary infection is present for only 50% of episodes.³⁴ This proportion is substantially higher than observed for bacteriuric residents without an indwelling catheter, but clearly, potential causes for fever other than urinary infection must always be considered.

Microbiologic diagnosis

A urine culture should be obtained for any nursing-home resident in whom symptomatic urinary infection is suspected or clinically diagnosed.³² The specimen should always be collected before starting antimicrobial therapy, as the urine is rapidly sterilised following initiation of systemic antimicrobials. The wide variety of potentially infecting organisms and high likelihood of antimicrobial-resistant strains means obtaining a culture is essential in order to characterise the bacteriology and susceptibilities, as well as to confirm a potential urinary source. A voided urine specimen is appropriate for residents who are able to cooperate with voiding. For men, a urine specimen may be obtained from a freshly applied condom catheter if a voided specimen is not possible. Women who are unable to cooperate for collection of a voided specimen should have a urine specimen collected

using an in-and-out catheter. When a resident has a chronic indwelling catheter, the catheter should be replaced and a urine specimen collected from the new catheter immediately before instituting antimicrobial therapy.³² The specimen from the new catheter identifies organisms present in the bladder, rather than the catheter biofilm. Catheter replacement also decreases the duration of fever and the likelihood of symptomatic relapse in the early post-therapy period.⁴⁰

The appropriate quantitative criteria for a positive culture to diagnose infection is $\geq 10^5$ cfu mL⁻¹. The frequency and clinical situations in which lower quantitative counts may be clinically relevant have not been critically or systematically assessed for residents of long-term care facilities.

Guidelines

There are several guidelines addressing the diagnosis and treatment of urinary infection in long-term care facility residents. All of these recommend restrictive clinical criteria for diagnosis. The McGeer criteria are consensus-derived surveillance definitions developed several decades ago which have also been widely used for clinical diagnosis.³⁴ These definitions were recently revised and updated to develop evidence-based criteria wherever possible.³⁴ Localising signs and symptoms must be present for a diagnosis of symptomatic urinary infection in residents without an indwelling catheter (Box 1). These definitions have been developed for surveillance purposes, not for treatment, and the revised criteria have not yet been validated in practice.

The Infectious Diseases Society of America (IDSA) has published guidelines for evaluation of fever and infection in older adults in the long-term care setting.³² These guidelines recommend that diagnostic laboratory evaluation for suspected urinary infection be reserved for residents with an acute onset of symptoms potentially associated with urinary infection: fever, dysuria, gross haematuria, new or worsening urinary incontinence, or suspected bacteraemia. For residents with long-term indwelling catheters, evaluation is indicated for suspected urosepsis (fever, shaking chills, hypotension, delirium), especially if there is recent catheter obstruction. The initial diagnostic test is urinalysis or a urine dipstick. A urine specimen for culture should be collected only if there is pyuria or a positive leukocyte esterase or nitrite test, as a negative urinalysis has a high negative predictive value for excluding urinary infection.

Consensus guidelines recommend minimal clinical criteria which should be present before initiation of antimicrobial therapy, pending culture results, for infections in long-term care residents.³³ For urinary infection, localising genitourinary signs and symptoms are required before instituting antimicrobial therapy in residents without an indwelling catheter (Box 2). A prospective, randomised trial validated the safety and efficacy of these criteria for patient care. Implementation of the criteria was also associated with a significant decrease in antimicrobial use for asymptomatic bacteriuria.⁴¹ In recent reports, however, most nursing-home

Box 1. NHSN surveillance definitions for urinary tract infections³⁴

- (1) For residents without an indwelling catheter:

Both criteria present:

- (i) At least one of the following present:

(a) Acute dysuria or acute pain, swelling, or tenderness of the testes, epididymis, or prostate

(b) Fever or leukocytosis

And at least **one** of the following:

– Acute costovertebral angle pain or tenderness

– Suprapubic pain

– Gross haematuria

– New or marked increase in incontinence

– New or marked increase in urgency

– New or marked increase in frequency

- (c) At least
- two**
- or more of the following:

– Suprapubic pain

– Gross hematuria

– New or marked increase in incontinence

– New or marked increase in urgency

– New or marked increase in frequency

AND

- (ii) A voided urine culture with one of the following:

(a) $\geq 10^5$ cfu mL⁻¹ of no more than two species of microorganisms(b) A properly processed specimen collected by in and out catheter specimen with $\geq 10^2$ cfu mL⁻¹ of any number of organisms.**Box 2. Minimum criteria to be met before initiation of antimicrobial therapy for suspected urinary tract infection in long-term care facility residents, pending culture results³³**

- (1) For residents without an indwelling catheter:

- (i) Pain or difficulty with urination, or

- (ii) Fever
- ^A
- and at least
- one**
- of the following:

(a) New or increased urgency to urinate

(b) New or increased frequency in urination

(c) New or increased suprapubic pain

(d) New case of costovertebral angle tenderness

(e) Obvious blood in urine

(f) New/worsened urinary incontinence

- (2) For residents with an indwelling catheter, no alternate source and at least
- one**
- of the following:

- (i) Fever
- ^A

- (ii) New case of costovertebral angle tenderness

- (iii) Symptoms of rigors, or new symptoms of delirium

^AFever is defined as a temperature on the day of prescription greater than 1.5°C above the resident's average routine temperature, or over 37.9°C.

residents treated for urinary tract infection do not meet these criteria. A review of residents in 12 North Carolina nursing homes reported only 10% of prescriptions for treatment of urinary tract infections were given to residents with clinical presentations meeting the minimal criteria.⁴² In another US

nursing home, only 16% of patients with advanced dementia who were treated with antimicrobials for urinary infection met the criteria.⁴³ Thus, inappropriate antimicrobial treatment for urinary infection remains a substantial problem in long-term care facilities.

Antimicrobial treatment

When residents have mild or questionable symptoms, antimicrobial therapy should be delayed pending urine culture results. If localising symptoms persist with no alternate explanation once a positive culture result becomes available, specific antimicrobial therapy targeted at the infecting organism can be initiated. The antimicrobial regimen selected for treatment of residents who meet clinical criteria for symptomatic urinary infection is determined by the clinical presentation, patient tolerance, and known or suspected antimicrobial susceptibility of the infecting organism.⁴ There is a decline in glomerular filtration rate with age but antimicrobial dose adjustment is not required on the basis of age alone. When empiric parenteral therapy has been initiated because of severe symptoms, the antimicrobial should be reassessed and altered based on urine culture results once these become available.

For residents with cystitis, nitrofurantoin or trimethoprim/sulfamethoxazole (TMP/SMX) are recommended initial regimens.⁴ Nitrofurantoin is effective only for the treatment of acute cystitis. Many resistant organisms such as vancomycin-resistant enterococci or extended-spectrum β -lactamase-producing *E. coli* remain susceptible to nitrofurantoin. It should not be used in individuals with renal failure because of potential neurologic toxicities with accumulation of metabolites. Fluoroquinolones should be reserved for treatment of known resistant organisms or more severe presentations, with a goal of limiting antimicrobial pressure and resistance emergence to these agents in the long-term care setting.

There are few comparative randomised clinical trials evaluating treatment regimens for symptomatic urinary infection in this population. In one study of elderly women,⁴⁴ about half of whom were nursing-home residents, cure rates were 85% with TMP/SMX, and 95% with ciprofloxacin, both given for 10 days. The difference in cure rates was largely attributable to the greater frequency of TMP/SMX-resistant organisms. In a population of elderly women in the community, ciprofloxacin therapy given for 3 days was as effective as 7 days' therapy, and associated with fewer adverse effects.⁴⁵ Thus, shorter course therapy is likely appropriate for women with cystitis who are resident in long-term care facilities and do not have known genitourinary structural abnormalities which might compromise the effectiveness of therapy. The optimal duration of therapy for men has not been studied, but 7 days is generally recommended for cystitis.³ When a chronic indwelling catheter is present, a 7-day course of therapy is usually adequate. A goal of therapy for residents with chronic catheters is to limit the duration of antimicrobial therapy so the emergence of antimicrobial resistance in the biofilm bacteria is minimised.

Residents with severe presentations consistent with sepsis and without a clear source of infection should be managed within the clinical paradigm of potential sepsis. This includes prompt supportive care and early initiation of broad-spectrum antimicrobial therapy after microbiology specimens are

obtained. While any infection may present with fever and acute delirium, urinary infection is an unlikely source for this presentation in subjects without chronic indwelling catheters. Management includes empiric antimicrobial therapy which provides coverage for urinary and other infections if no source is apparent, pending diagnostic results. If the urine culture is subsequently negative or an alternate source becomes apparent, antimicrobial therapy for urinary infection should be discontinued.

Prevention

The only interventions effective for decreasing the frequency of symptomatic infection are removal of a chronic indwelling catheter, if present, or identification and correction of structural abnormalities, such as obstructing stones or strictures. There is no evidence to support the use of prophylactic antimicrobial therapy, cranberry products, probiotics, or topical oestrogen for prevention of recurrent infection in residents of long-term care facilities.⁴ Prophylactic antimicrobial therapy is also not indicated when indwelling catheters are changed, as this procedure has a low risk for infection complications.

Antimicrobial stewardship

Given the consistent evidence of excessive and inappropriate antimicrobial prescribing for urinary infection, programs directed at improving antimicrobial use for urinary infection are an important component of antimicrobial stewardship for long-term care facilities.⁵ Recent prevalence surveys of antimicrobial use in long-term care facilities globally have also consistently reported a high frequency of prescriptions given for prevention of urinary infection. One or more agents for urinary infection prophylaxis, including methanamine, vitamin C, cranberry products, oestrogens, trimethoprim and nitrofurantoin were being received by 18% of 1473 Norwegian long-term care residents.⁴⁶ Urinary tract prophylaxis accounted for 35.8% of total prescriptions in Irish nursing homes, including 6% of residents with indwelling catheters who were receiving prophylaxis.⁴⁷ A European prevalence survey of 323 nursing homes in 21 countries reported 30.9% of oral antimicrobials were given for prophylaxis, and the majority of these were for urinary infection.⁴⁸ Finally, a point-prevalence study in Ontario, Canada, reported 21% of antimicrobials were prescribed for over 90 days, and most of these long-term prescriptions were for urinary agents (nitrofurantoin, TMP/SMX, ciprofloxacin and norfloxacin).⁴⁹ The widespread use of prophylaxis for urinary tract infection is extraordinary given the absence of evidence to support a benefit in this population. In other populations with complicated urinary infection, prophylactic antimicrobial therapy has consistently been reported not to be effective.⁵⁰ These observations confirm the importance of antimicrobial stewardship programs in these facilities in improving antimicrobial use for both the treatment and prophylaxis of urinary infection.

Several reports describe the implementation and evaluation of antimicrobial stewardship programs which address urinary infection in long-term care facilities. A cluster randomised-controlled trial in 58 nursing homes in Sweden evaluated a multi-faceted intervention which included small-group education sessions for physicians and nurses, development of local guidelines, feedback on prescribing with reference to available guidelines, and discussion of structural organisational and social barriers to change.⁵¹ The primary outcome was decrease in fluoroquinolone use for urinary infection. While fluoroquinolone use for this indication did decrease after 2 years, the decline between the control and intervention homes was not significant. The frequency of urinary tract infections was also similar for the two groups, but antimicrobial treatment for all infections was significantly decreased and a 'wait and see' approach significantly increased in the intervention homes. A single facility program which included education of nursing staff to discourage urine cultures in the absence of symptoms, pocket cards giving indications for urine cultures, and education of physicians and nurse practitioners not to treat asymptomatic bacteriuria was evaluated in a pre- and post-analysis.⁵¹ Inappropriate collection of urine cultures, treatment of asymptomatic bacteriuria, and total antimicrobial days were significantly decreased in the 6 months following the intervention. An antimicrobial stewardship program instituted in 25 primary care hospitals and 39 nursing homes in Finland specifically addressed the problem of excessive use of prophylaxis for urinary infection.⁵² This comprehensive, multimodal intervention included the visit of a study team to each facility to provide education and structured interviews around specific patients and diagnostic practices for urinary infection, together with development of regional guidelines and annual questionnaires to reinforce guidelines. The proportion of patients receiving antimicrobial prophylaxis for urinary infection in these homes decreased from 13% in 2005 to 6% in 2008 following institution of the program.⁵³

These reports describe different programs and report variable improvements following institution of stewardship programs. All of them included multiple simultaneous interventions. The impact of specific program elements and the cost-effectiveness of the programs is unknown, as is the long-term sustainability of any improvement attributed to the interventions. Further evaluation of antimicrobial stewardship programs and specific components of those programs, particularly for treatment of asymptomatic bacteriuria and prophylaxis of urinary infection, is needed. The impact of these programs on other relevant outcomes, including antimicrobial resistance, adverse antimicrobial effects, and *C. difficile* colitis also needs to be assessed.

Conclusions

Urinary tract infection remains an important problem for residents of long-term care facilities. While asymptomatic bacteriuria should not be treated in this population, there continues to be substantial inappropriate antimicrobial use for

the treatment and prophylaxis of presumed symptomatic urinary tract infection in bacteriuric residents with non-urinary causes of clinical deterioration. Antimicrobial therapy for symptomatic infection should be initiated only in residents with localising genitourinary symptoms when the resident does not have a chronic indwelling catheter. However, strategies to optimise therapy and limit adverse effects require further critical evaluation, including cost-effectiveness assessments, to justify support at the national and local facility level.

Conflicts of interest

None.

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