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Educational intervention to reduce treatment of asymptomatic bacteriuria in long-term care

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ABSTRACT

Objective To determine if an educational intervention can decrease the inappropriate antibiotic treatment of long-term care (LTC) residents with asymptomatic bacteriuria (ASB).

Design Prospective chart audit between May and July 2017.

Setting Seven LTC facilities in Regina, Saskatchewan, Canada.

Participants Chart audits were performed on all LTC residents over 18 years of age with a positive urine culture. Educational sessions and tools were available to all clinical staff at participating LTC facilities.

Intervention Fifteen-minute educational sessions were provided to LTC facility staff outlining the harms of unnecessary antibiotic use, antibiotic resistance and the diagnostic criteria of a urinary tract infection (UTI). Educational sessions were complimented with posters and pocket cards that summarised UTI diagnostic criteria.

Main outcome measure The primary outcome measure was the number of residents who received inappropriate antibiotic treatment for ASB. Secondary outcome measures included the appropriateness of urine culture tests, number of tests and cost associated with inappropriate treatments.

Results In the preintervention period, 172 urine culture and sensitivity (UC&S) tests were performed, 62 (36.0%) were positive and 50/62 (80.6%) residents had ASB based on chart review. In the postintervention period, 151 UC&S tests were performed, 50 (33.1%) were positive and 35/50 (70.0%) residents had ASB. There was a statistically significant decrease in the number of residents treated with antibiotics for ASB, from 45/50 (90%) preintervention to 22/35 (62.9%) postintervention (χ^2=9.087, p=0.003).

Conclusions An educational intervention was associated with a statistically significant decrease in inappropriate antibiotic treatment of LTC residents with ASB.

INTRODUCTION

Urinary tract infections (UTIs) are the most common healthcare-associated infection among elderly institutionalised individuals, accounting for up to 60% of their antimicrobial use.[1 2] The accurate diagnosis of a UTI is often confounded by the high prevalence of asymptomatic bacteriuria (ASB) in long-term care (LTC) facilities. It is estimated that nearly all catheterised residents and up to 50% of non-catheterised residents in LTC facilities have ASB.[3]

Guidelines from the Infectious Diseases Society of America and Choosing Wisely Canada recommend against the treatment of ASB with antibiotics, as several randomised trials showed no associated clinical benefits.[4–7] Specifically, the treatment of ASB did not reduce mortality or recurrent infection rates, but it was associated with increased adverse drug reactions and antibiotic resistance.[8–10] Furthermore, the guidelines suggest sending urine culture and sensitivity (UC&S) tests only when residents show localising symptoms of a UTI to prevent unnecessary screening and treatment of ASB.[1 7] Localising symptoms that are indicative of a UTI are outlined in the Regina Qu'Appelle Health Region's (ie, local health region's) UTI Diagnostic Criteria (box 1).

Despite the guidelines and recommendations, up to two-thirds of LTC facility residents with ASB receive inappropriate antibiotic treatment, which was internally reported to contribute $C20 000 in healthcare costs annually in the local health region.[11] Previous studies have demonstrated the efficacy of educational interventions in decreasing inappropriate UC&S tests and antibiotic use.[12 13] Adopting the methodologies of these studies, this project was conducted as a quality improvement and antimicrobial stewardship initiative with the goal of decreasing inappropriate antibiotic use for LTC facility residents with ASB through an educational intervention.

METHODS

Study subjects

This study was conducted at seven health region-affiliated LTC facilities in Regina, Saskatchewan, Canada, from May to July 2017. Medical charts of all residents over 18 years of age with a positive UC&S result were audited. Residents were excluded if they were pregnant or were scheduled for a urological procedure, as those populations are known to clinically benefit from treatment of ASB.[4] Residents were also excluded if they had an alternate site of infection, if

Box 1 Regina Qu'Appelle Health Region's urinary tract infection diagnostic criteria

Symptoms: patients without a catheter

One of the following…

- Acute dysuria.
- Acute pain, swelling or tenderness of the testes, epididymis or prostate.
- Fever* or leucocytosis† and 1+ of the symptoms list.
- 2+ of the symptoms list.

Symptoms list

- Acute costovertebral angle pain or tenderness.
- Suprapubic pain.
- Gross haematuria.
- New or marked increase in incontinence, urgency or frequency.

Symptoms: patients with a catheter

One of the following…

- Fever*, rigours or new-onset hypotension with no alternate site of infection.
- Acute change in mental status or acute functional decline with no alternate diagnosis and leucocytosis.†
- New-onset suprapubic pain or costovertebral angle pain or tenderness.
- Purulent discharge from around the catheter.
- Acute pain, swelling or tenderness of the testes, epididymis or prostate.

Urine culture and sensitivity

Both of the following…

- $\geq 10^8$ cfu/L.
- ≤2 organisms.

Antibiotic treatment

Treat with appropriate antibiotics, as per sensitivity test and creatinine clearance values.

*Fever: single oral >37.8°C, repeated oral >37.2°C, repeated rectal >37.5°C or >1.1°C increase from baseline.
†Leucocytosis: >14 000 leucocytes/mm^3.

they were hospitalised, or if extensive clinical judgement was required due to their abnormal clinical presentation, making the indication for the use of antibiotics unclear.

Procedure

Research followed three phases: a preintervention audit to assess the baseline use of antibiotics and UC&S tests, an educational intervention and a postintervention audit to determine if there was a reduction in inappropriate use of antibiotics and UC&S tests.

Preintervention and postintervention audits

The audit phases occurred over a 5-week period before and after the educational intervention. During this time, all positive UC&S tests from participating sites were prospectively identified and relayed from the region's laboratory service to the Antimicrobial Stewardship Program office. A member of the stewardship team (CL) then visited the corresponding LTC facility to perform a chart audit. The residents' charts were reviewed for information including: resident demographics, prescriber information, indication for the UC&S order and the type and dosage regimen of the antibiotic treatment (if applicable). The Research Electronic Database Capture tool, a secure web-based data collection application, was used to collect data.[14]

The appropriateness of UC&S tests and antibiotic orders were assessed using the local health region's diagnostic criteria for UTIs (box 1). A resident was considered symptomatic if they had a certain combination of localising UTI symptoms, such as: dysuria, costovertebral or suprapubic pain and an increase in frequency, incontinence and urgency of urination. The resident was considered to have a UTI if they were symptomatic and the UC&S test indicated bacterial colonisation over 10^8 cfu/L with less than three organisms present. Clinical staff at the LTC facilities were asked follow-up questions if there was no documentation of indications for UC&S tests or if any information required clarification.

Educational intervention

The educational intervention was designed to include several behaviour change techniques as determined by the Behaviour Change Technique Taxonomy Version 1.[15] These techniques included: feedback and monitoring (feedback on behaviour), shaping knowledge (instruction on how to perform the behaviour), natural consequences (information about health consequences, salience of consequences) and comparison of behaviour (social comparison). Our hypothesis was that combining multiple behaviour change techniques into an educational intervention would provide many routes to effecting behaviour change in clinical staff, ultimately reducing unnecessary antibiotic use for residents with ASB.

An invitation to a 15 min educational session was sent out to all clinical staff (registered nurses, nurse practitioners, licenced practical nurses, registered psychiatric nurses, nursing students and continuing care assistants) at participating LTC facilities through their directors of care and

Table 1 Demographic characteristics of preintervention and postintervention groups

	Preintervention (n=62)	Postintervention (n=50)	Statistical test*
Sex, n (%)			
Male	18 (29)	20 (40)	χ^2=1.485
Female	44 (71)	30 (60)	P=0.223
Age			
Mean age, years (SD)	76.4 (18.3)	77.9 (16.5)	P=0.653
Catheterisation, n (%)			
Catheterised	15 (24.2)	17 (34.0)	χ^2=1.304
Non-catheterised	47 (75.8)	33 (66.0)	P=0.253

*χ^2 tests performed for sex and catheterisation status and t-test for age showed no significant difference between preintervention and postintervention resident populations.

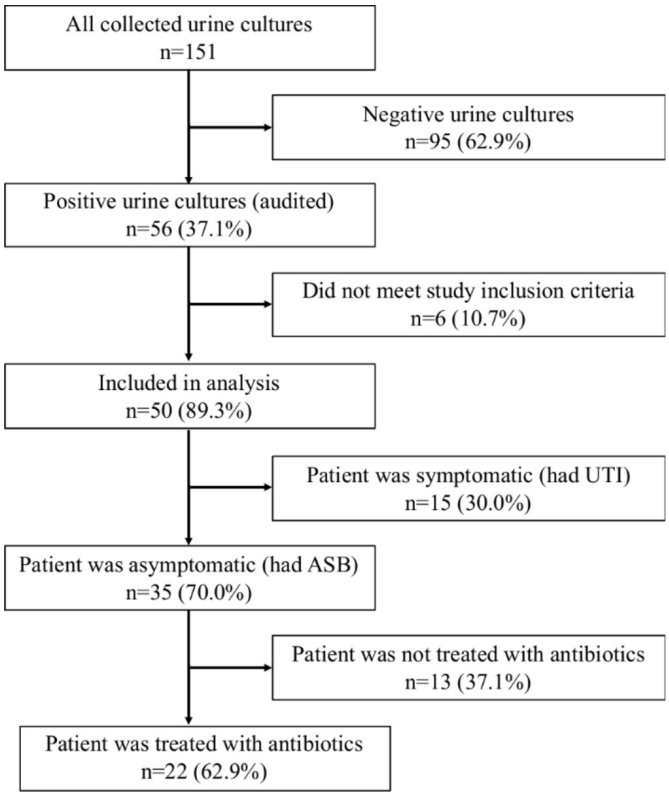

Figure 2 Flow chart of the postintervention phase. ASB, asymptomatic bacteriuria; UTI, urinary tract infection.

communication managers. The focus was on nursing staff as they were identified through conversations with infection prevention and control and other LTC facility staff as the main contributors in local facilities to documentation of symptoms and initiation of UC&S testing. From an antimicrobial stewardship perspective, the nursing staff focus also provided an opportunity to reinforce the role of nurses and other non-prescribing members of healthcare teams in antimicrobial stewardship.

The educational session was conducted by the first author of this study, and all sessions took place over an approximately 2-week period between the preintervention and postintervention audit periods. The session consisted of: (1) an overview of the evidence behind ASB treatment guidelines, (2) presentation of local findings from the preintervention audit and (3) diagnostic criteria for UTIs. Clinical staff were encouraged to perform a thorough assessment of residents to identify localising symptoms prior to sending a UC&S test. Staff were reminded that non-specific symptoms, such as confusion and cloudy, foul-smelling or dark-coloured urine, are not indicative of a UTI. They were also advised to collaborate with prescribers in not initiating antibiotic treatment in asymptomatic residents. Educational posters were displayed around the LTC facilities, and all clinical staff who attended the session received a pocket card with the diagnostic criteria for UTIs (online supplementary appendix 1, 2). The content of the educational session, pocket cards and posters was designed prior to the study's initiation in collaboration with LTC facility and infection prevention and control staff.

Following the postintervention audit, a report summarising the final data analysis was sent to each facility to provide them with the results of the study for their facility and show comparative data for the other (anonymous) facilities.

Data analysis

The primary outcome of interest was the number of residents who received inappropriate antibiotic treatment for ASB. The secondary outcomes included: the appropriateness of UC&S tests, the total number of UC&S requests and costs associated with inappropriate UC&S tests and antibiotic treatments. χ^2 tests were used to compare categorical data from preintervention to postintervention, namely the proportion of residents receiving antibiotics for ASB and the proportion of inappropriate UC&S tests sent. Paired t-tests were used to compare the total number of UC&S tests sent at each LTC facility, recognising that the small sample size at each location would limit the meaningful interpretation of the result. The cost of UC&S tests and antibiotics were provided by the health region's laboratory services and pharmacy department, respectively, to determine the cost associated with the inappropriate diagnosis and treatment of ASB.

RESULTS

Baseline characteristics that may have an impact on the prevalence and treatment of UTIs were collected. Out

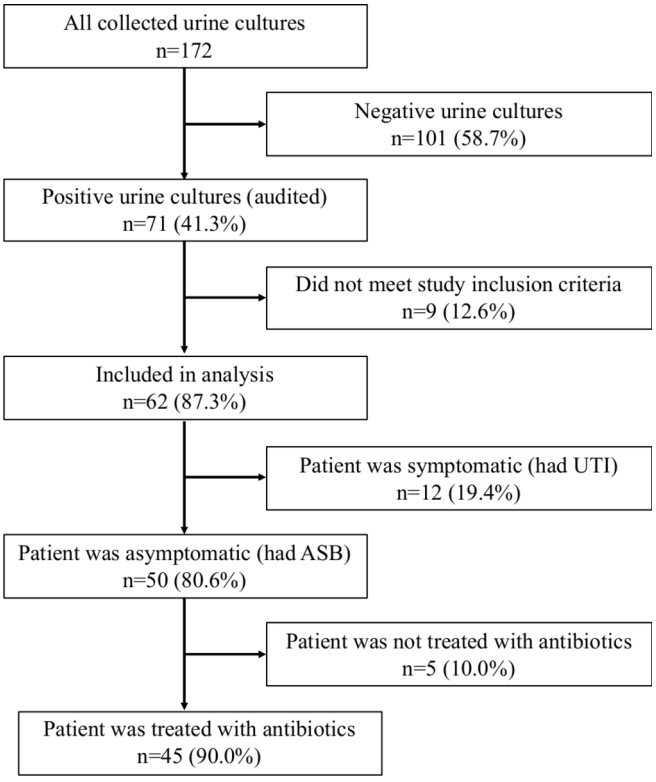

Figure 1 Flow chart of the preintervention phase. ASB, asymptomatic bacteriuria; UTI, urinary tract infection.

of the 62 residents whose charts were audited preintervention, 18 (29%) were women and 44 (71%) were men. This was similar in the postintervention phase where 20 (40%) were women and 30 (60%) were men out of 50 residents. The mean age of residents was 76.4 years in the preintervention period and 77.9 years postintervention. Fifteen (24.2%) residents in the preintervention group were catheterised, while 17 (34.0%) residents were catheterised in the postintervention group. Resident demographics are summarised in table 1; no statistically significant differences were identified between the demographics of preintervention and postintervention groups based on χ^2 and t-tests for sex, age and catheterisation status.

Preintervention

During the preintervention period, a total of 172 UC&S tests were performed, of which 71 (41.3%) were positive and audited. Of the 71 residents with positive UC&S results, nine (12.7%) did not meet the inclusion criteria and were excluded from analysis. Of the 62 residents who had positive UC&S results and met the inclusion criteria, 50 (80.6%) were classified as having ASB. Finally, 45/50 (90.0%) residents with ASB were inappropriately treated with antibiotics (figure 1).

Postintervention

During the postintervention period, a total of 151 UC&S tests were performed, of which 56 (37.1%) were positive and audited. Of the 56 residents with positive UC&S results, six (10.7%) did not meet the inclusion criteria and were excluded from analysis. Of the 50 residents who had positive UC&S results and met the inclusion criteria, 35 (70.0%) were classified as having ASB. Lastly, 22/35 (62.9%) residents with ASB were inappropriately treated with antibiotics (figure 2).

Educational intervention

Out of 1454 clinical staff members who were invited to participate in an educational session, 212 (14.6%) attended; attendance ranged among LTC facilities from 9.3% to 29.0%. Among the attendees were registered nurses, nurse practitioners, licenced practical nurses, registered psychiatric nurses, nursing students, continuing care assistants, unit clerks, managers, administrators and directors of care. The staff who attended the educational sessions were generally receptive to the information and evidence presented and were engaged in the presentation of both the audit results and the information regarding appropriate use of antibiotics. Several sessions sparked discussions about connections with physicians and resident family members surrounding UTIs and antibiotic prescriptions. The attendees generally thought the posters and pocket cards would be helpful reminders for appropriate care regarding UTIs, although some staff considered the pocket cards too large.

The educational intervention was associated with a statistically significant decrease in the number of inappropriate antibiotic prescriptions for residents with ASB (χ^2=9.087, p=0.003). In the preintervention period, 45/50 (90.0%) residents with ASB received an antibiotic treatment, while in the postintervention period, 22/35 (62.9%) residents received treatment. All facilities (except for one which showed no change) showed a decrease in inappropriate ASB treatment. An OR indicated that residents were five times more likely to receive an antibiotic treatment for ASB in the preintervention period compared with the postintervention period (OR=5.32, 95% CI 1.68 to 16.81).

The educational intervention was also associated with a decrease in the proportion of inappropriate UC&S orders, although it was not statistically significant. The proportion of residents presenting with localising UTI symptoms increased from 21/62 (33.8%) preintervention to 22/50 (44.0%) postintervention (χ^2=1.201, p=0.273). The total number of UC&S orders decreased preintervention to postintervention from 13.2 UC&S/100 beds to 11.6 UC&S/100 beds in the seven LTC facilities, a decrease of 12% (although not statistically significant). The decrease in inappropriate antibiotic treatment and UC&S tests resulted in a decrease in associated healthcare costs (all costs in CAD). The cost of antibiotic treatment for residents with ASB dropped 63.6% from $285.10 preintervention to $103.78 postintervention (table 2).

Table 2 Cost and usage of common antibiotics for the treatment of asymptomatic bacteriuria

Antibiotic	Cost per treatment	Number of cases: preintervention (cost)	Number of cases: postintervention (cost)
Amoxicillin	$4.24	3 ($12.71)	1 ($4.24)
Amox-Clav	$6.05	2 ($12.10)	2 ($12.10)
Ampicillin	$15.65	4 ($62.59)	–
Cephalexin	$3.13	6 ($18.78)	3 ($9.39)
Ciprofloxacin	$0.95	10 ($9.45)	7 ($6.62)
Fosfomycin	$18.75	2 ($37.50)	–
Nitrofurantoin	$11.57	11 ($127.31)	6 ($69.44)
Trimethoprim/sulfamethoxazole	$0.67	7 ($4.67)	3 ($2.00)
		Total: $285.10	Total: $103.78

The cost of UC&S tests, determined as $42.80 by laboratory services, dropped 30% from $2140 preintervention to $1498 postintervention.

DISCUSSION

The Centers for Disease Control and Prevention (CDC) reports that up to 70% of residents in LTC facilities receive one or more courses of antibiotics in a year, and 40%–75% of those may be unnecessary or inappropriate.[16] The inappropriate use of antibiotics is dangerous for residents as it can lead to the emergence of antibiotic resistant organisms and adverse drug reactions.[10 17] For this reason, the implementation of antimicrobial stewardship initiatives in LTC facilities is highly recommended by health organisations such as the CDC and Infectious Diseases Society of America.[4 16] One of the core elements of antimicrobial stewardship outlined by the CDC is education, including face-to-face interaction or distribution of educational tools (eg, posters, pocket cards and flyers).[16] Education is considered a relatively resource-efficient method that bridges knowledge gaps surrounding clinical guidelines, which is considered one of the main factors in inappropriate antimicrobial use for ASB.[18] The educational approach employed here also allowed for the incorporation of multiple behaviour change techniques. Audit and feedback of UC&S tests and antibiotic use for residents with ASB allowed for both feedback on behaviour and social comparison (between facilities) to be used. Information about health consequences and their salience were included by discussing the potential harms of unnecessary antibiotic use and providing examples of poor outcomes in mock patients. Finally, the information in the presentation and handouts provided knowledge shaping by instructing how to perform the desired behaviours (ie, a clear, step-by-step guide to performing appropriate assessment and treatment of ASB).

Despite research findings and guidelines, inappropriate diagnosis and treatment of ASB with antibiotics is a common clinical practice in LTC facilities. Walker *et al*,[19] in a qualitative study of physicians' and nurses' perceptions, speculated that the emergence of non-specific signs and symptoms as well as pressure from residents and their families contributes to such practice. Furthermore, Zabarsky *et al*[13] emphasised the role of nursing staff in decreasing the inappropriate screening of ASB. This study suggested that nurses often ordered UC&S tests for non-specific signs and symptoms such as cloudy, dark or foul-smelling urine, following catheter changes and with increased resident falls, even prior to a prescriber order.[13] The prescriber often received a positive UC&S result and initiated antibiotics without a thorough reassessment of the resident, as positive tests results are hard to ignore.[11] A similar process had been indicated in the LTC facilities included in this study. Thus, this initiative concentrated on the education of clinical staff, including licenced practical nurses and continuing care assistants who largely contribute to monitoring and reporting changes in residents. In the educational sessions, misconceptions about the association of non-specific symptoms and UTIs were addressed, and clinical staff were advised not to send UC&S tests unless residents show localising symptoms as outlined in the diagnostic criteria for UTIs.

Following the educational intervention, there was a statistically significant decrease in the overtreatment of ASB from 90.0% to 62.9% of cases. Considering that only 15% of staff participated in the educational intervention and the study duration was only 10 weeks, it is likely that an even greater decrease could be observed with higher participation rates and a longer audit and feedback period. This decrease in ASB treatment led to a decrease in several associated healthcare costs (ie, drug and laboratory costs) from $2425.10 to $1601.78; annual cost avoidance can be extrapolated to $4281.26 from these seven LTC facilities alone.

The educational intervention also resulted in a decrease in the total number of UC&S tests and the proportion of inappropriate UC&S tests ordered, although this was not statistically significant. From the preintervention to postintervention phase, the total UC&S tests ordered decreased 12.1% from 13.2 UC&S/100 beds to 11.6 UC&S/100 beds. The proportion of UC&S tests that were sent due to localising symptoms of a UTI increased 10.2%. It is possible that other factors could have affected the ordering of UC&S tests, including orders for antimicrobial-resistant organism screening (if the original positive site was the urine), as part of the referral process to other geriatric programmes. Also, as the intervention took place over the summer, there is a greater chance of residents being dehydrated and having UC&S tests ordered, despite concentrated urine not being an indication to do so. These factors could contribute to increased UC&S tests, thus limiting the effects of the intervention and reducing the statistical significance of the reduction we observed.

It is also interesting to note that, while physicians (who perform the majority of prescribing) were not part of the intervention, we did see a decrease in the number of antibiotic prescriptions for ASB. One possibility is that, following the education session, nurses may feel more confident in discussing the appropriateness of treatment with physicians for residents without localising UTI symptoms.

It should be noted that, while the educational sessions were the most direct intervention occurring in the LTC facilities at the time of this study, we cannot rule out the potential impact of other general antimicrobial stewardship education initiatives occurring at the same time. However, we would expect the impact to be negligible as there were no concurrent initiatives directly involving physicians or other prescribers outside of LTC.

Our study results are in line with other studies that also implemented an educational intervention to decrease inappropriate antibiotic treatment of ASB.[12 13] However, unlike previous studies, our intervention was not associated with a statistically significant reduction in

inappropriate usage of UC&S tests: Chowdhury *et al* saw a decrease in UC&S test use from 3419 to 3127 (p<0.001) and Zabarsky *et al* saw a reduction in inappropriate UC&S tests ordered from 2.6 UC&S/1000 patient days to 0.9 UC&S/1000 patient days (p<0.0001).[12 13] The difference may be a result of the limitations of our study, as described below.

Limitations

The primary limitation of this study was the short time frame (10 weeks) that led to a small sample size. The small sample size limits the significance of statistical analyses and the ability to generalise findings to the larger population. Furthermore, due to shift changes and vacation schedules, only 14.6% of all LTC facility clinical staff attended an educational session. Also lacking among the attendees were residents, residents' families and physicians, people who are considered to have a major role in driving UC&S testing and antibiotic use. Due to the short time frame of this study, we were also unable to determine a base level of awareness among LTC facility staff regarding the educational content as well as whether the intervention increased this knowledge base among staff. We were also unable to determine which part(s) of the intervention (eg, presentation, posters and pocket cards) or which specific behaviour change technique may have had the greatest effect on behaviour. It was noted during the postintervention chart audits that the posters were visible throughout each facility, indicating that the information was being shared.

Importantly, without appropriate follow-up measures in place, the effect of an educational intervention may wane over time. Even for staff who attended an educational session, frequent follow-up may be required to instil a lasting change in practice behaviour. Unfortunately, due to lack of personnel and other financial constraints, the Antimicrobial Stewardship Program has been unable to devote sufficient resources to continue a dedicated follow-up with the involved LTC facilities beyond the time frame of this project.

Another important limitation is that there is still a lack of a universally accepted gold standard for diagnosing a UTI, despite the high prevalence of this condition in LTC facilities. Specifically in the elderly population, frequent emergence of non-specific symptoms is a known difficulty in the correct diagnosis of a UTI. The local health region uses a modified version of the McGeer criteria, which some argue should only be used for surveillance purposes as they are highly specific.[20] These criteria outline specific symptoms that must be present prior to UC&S testing, which may lead to missed cases of UTI when one is truly present. In contrast, other studies have used more lenient diagnostic criteria, which may explain the higher rates of ASB in this study compared with others (81% vs 46%–83%).[12 13 21]

Strengths

This study was conducted in seven LTC facilities, each with different levels of care. There were both large and small facilities with residents that require different levels of care; these factors contribute to the generalisability of the results. Unlike other studies that include only nurses and physicians in the educational intervention, this study was open to all clinical staff at LTC facilities (even non-clinical staff were present). As continuing care assistants have an increasing role in caring for residents, especially in documenting and reporting resident symptoms, their inclusion could have had an impact on the positive outcome. Lastly, this study assessed the appropriateness of both the UC&S test and antibiotic treatment for suspected UTIs unlike other studies that mostly focus on antibiotic treatment. This allowed for assessing the adherence to guideline recommendations to not order UC&S in the absence of localising symptoms.

CONCLUSION

Our results suggest that an educational intervention may contribute to decreasing inappropriate treatment of ASB for residents of LTC facilities. The impact of an educational intervention on decreasing inappropriate UC&S testing was not statistically verified, although a decrease was observed. Locally, continued efforts should be made in each LTC facility in collaboration with the Antimicrobial Stewardship Program to build on and sustain the reduction in the inappropriate screening and treatment of ASB.

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Contributors All authors contributed to the conception and design of the study. CL performed chart audits, educational interventions and data analysis. All authors contributed to the final manuscript.

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Competing interests None declared.

Patient consent Not required.

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