Effect of a multifaceted intervention on number of antimicrobial prescriptions for suspected urinary tract infections in residents of nursing homes: cluster randomised controlled trial

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Abstract

Objective To assess whether a multifaceted intervention can reduce the number of prescriptions for antimicrobials for suspected urinary tract infections in residents of nursing homes.
Design Cluster randomised controlled trial.
Setting 24 nursing homes in Ontario, Canada, and Idaho, United States.
Participants 12 nursing homes allocated to a multifaceted intervention and 12 allocated to usual care. Outcomes were measured in 4217 residents.
Interventions Diagnostic and treatment algorithm for urinary tract infections implemented at the nursing home level using a multifaceted approach—small group interactive sessions for nurses, videotapes, written material, outreach visits, and one on one interviews with physicians.
Main outcome measures Number of antimicrobials prescribed for suspected urinary tract infections, total use of antimicrobials, admissions to hospital, and deaths.
Results Fewer courses of antimicrobials for suspected urinary tract infections per 1000 resident days were prescribed in the intervention nursing homes than in the usual care homes (1.17 *v* 1.59 courses; weighted mean difference −0.49, 95% confidence intervals −0.93 to −0.06). Antimicrobials for suspected urinary tract infection represented 28.4% of all courses of drugs prescribed in the intervention nursing homes compared with 38.6% prescribed in the usual care homes (weighted mean difference −9.6%, −16.9% to −2.4%). The difference in total antimicrobial use per 1000 resident days between intervention and usual care groups was not significantly different (3.52 *v* 3.93; weighed mean difference −0.37, −1.17 to 0.44). No significant difference was found in admissions to hospital or mortality between the study arms.
Conclusion A multifaceted intervention using algorithms can reduce the number of antimicrobial prescriptions for suspected urinary tract infections in residents of nursing homes.

Introduction

One third of prescriptions for presumed urinary tract infection among nursing home residents are for asymptomatic bacteriuria, or the presence of bacteria in the urine in the absence of urinary symptoms.[1 2] Unnecessary use of antimicrobials in elderly people can lead to drug related adverse effects,[2] the development of multidrug antimicrobial resistance,[3–6] harmful drug interactions,[7] and excessive costs.[8]

To optimise antimicrobial use for suspected urinary tract infection in residents of nursing homes, we developed algorithms on the basis of evidence (figs 1 and 2).[9–16] The main recommendations of the algorithms are that in the absence of a minimum set of symptoms or signs of urinary tract infection, urine should not be cultured and antimicrobials should not be prescribed.

We hypothesised that introduction and adoption of the algorithms in a nursing home using a multifaceted intervention targeted to nurses and physicians would safely reduce antimicrobial use for suspected urinary tract infection. We carried out a cluster randomised controlled trial to test the effectiveness of this intervention on reducing rates of antimicrobial prescriptions in residents of nursing homes.

Methods

We paired nursing homes within each province or state by size (number of occupied beds) and by proportion of residents with indwelling catheters. One member of each pair was randomised to the intervention and the other to usual care. An independent statistician used a random numbers table to assign the intervention to nursing homes (odd or even) corresponding to the number selected. We measured outcomes over 12 months.

Only eligible for our study were free standing, community based nursing homes with 100 or more

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residents and no stated policy for diagnosis or treatment of urinary tract infections. We contacted 56 nursing homes—36 in Ontario and 20 in Idaho. Eligible nursing homes had to agree to refrain from using new management strategies for antimicrobial use or clinical pathways for urinary tract infection during the study. Twenty four of the nursing homes were randomised, 16 from Ontario and eight from Idaho. The homes were enrolled from September 2001 to February 2002, with the last follow-up in March 2003.

Intervention nursing homes

We introduced the nurses and physicians of the intervention homes to the algorithms. Before data collection an investigator presented six case scenarios to small groups of between 10 and 15 registered nurses or registered nursing assistants. We videotaped a reconstruction of the small group sessions and distributed the video to the nursing homes. We sent the algorithms, along with written explanatory material, to all the physicians who cared for the residents. An investigator met once individually with the physicians who cared for 80% or more of residents in each nursing home. The algorithms were explained using the case scenarios. The physicians and nurses were asked to use the algorithms when assessing residents for fever or suspected urinary tract infection. We asked the nurses to complete a log of presenting symptoms and signs for every resident in whom urinary tract infection was suspected, as a reminder to use the algorithms. Intervention homes were allowed a four week training period before data collection. We visited the nursing homes every three months to address questions and to carry out audits of the records to check that antimicrobial prescriptions had not been missed.

Usual care nursing homes

Nurses and physicians in the usual care nursing homes were notified about the study and were informed about how data were going to be collected. No other interventions were applied.

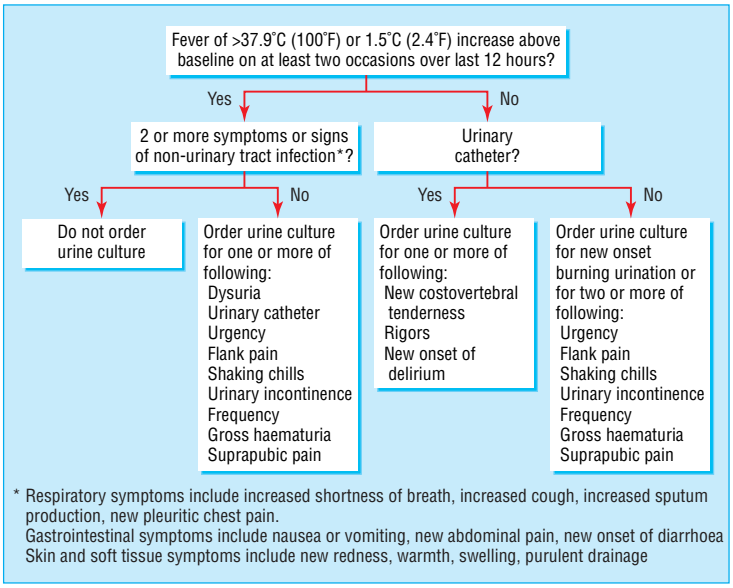

Fig 1 Diagnostic algorithm for ordering urine cultures for nursing home residents in intervention arm

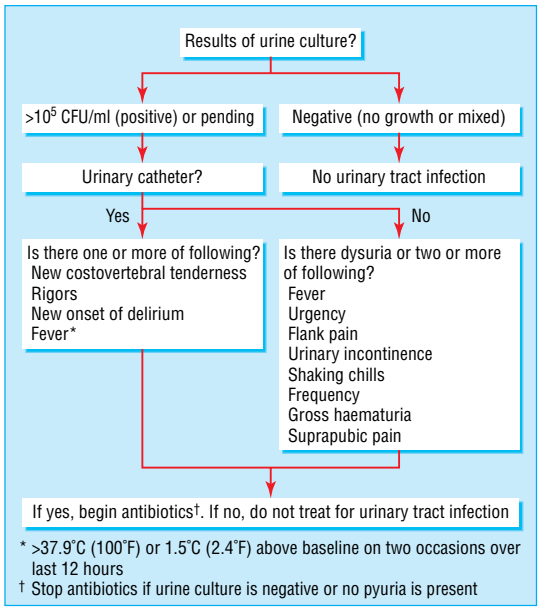

Fig 2 Treatment algorithm for prescribing antimicrobials to nursing home residents in intervention arm

Outcomes

The main outcome was the number of prescriptions for antimicrobials. We considered all antimicrobials given for one particular indication to be one course and antimicrobials prescribed for a second indication during the same period or prescribed after one week for the same indication to be separate courses. Other outcomes included number of urine cultures ordered, admissions to hospital, and deaths.

Pharmacies, but not staff in the intervention homes, were blinded to treatment allocation.

Statistical methods

The unit of analysis was the nursing home. We used paired *t* tests, weighted by size of nursing home, to analyse the following within pair differences in matched pairs of nursing homes: rates of antimicrobials prescribed for suspected urinary tract infections, proportions of antimicrobials prescribed for urinary tract infections, total rates of antimicrobials prescribed, urine cultures obtained, admissions to hospital, and mortality. To assess the effect of the intervention over time, we used linear regression to model the difference in antimicrobial rates for suspected urinary tract infection between the study homes by study month.

Results

The characteristics of the pairs of intervention and usual care nursing homes were similar at baseline (see bmj.com). Two nursing homes dropped out of the study (see bmj.com), each citing insufficient nurses as the reason. One of these homes had over 26 nurses per 100 residents, the median number of nurses in all study nursing homes. The nursing home in the intervention arm dropped out of the study after randomisation but before beginning data collection. The home in the usual care arm dropped out after collecting data for eight weeks. These nursing homes and their paired homes were withdrawn from the study. The analysis is based on follow-up data from 10 pairs of nursing homes.

Rates of antimicrobial courses for suspected urinary infection (per 1000 resident days) and number of occupied beds in 10 intervention and 10 usual care study nursing homes

Nursing home pair	Intervention home courses per 1000 resident days		Usual care home courses per 1000 resident days	
	Antimicrobial rate	No of occupied beds	Antimicrobial rate	No of occupied beds
1	0.85	148	1.49	148
2	1.05	233	1.99	238
3	1.00	248	0.63	252
4	0.77	170	1.06	172
5	0.70	367	1.93	350
6	1.59	149	1.14	131
7	0.79	171	0.69	162
8	0.51	198	1.29	210
9	2.10	108	2.68	97
10	2.27	101	2.95	107

Complete follow-up data were available from all nursing homes except one that had changed ownership and lost some records for antibiotics for the second half of the study period. We were unable to obtain the missing data. We based our analyses of antimicrobial prescribing on the first six months of data collected from this home, using the same period in the corresponding usual care home as a comparator.

Antimicrobial use

Overall, 4906 courses of antimicrobials were prescribed, 2337 in the intervention homes and 2569 in the usual care homes. Of the 4906 antimicrobial courses, 1655 (664 in the intervention arm and 991 in the usual care arm) were for suspected urinary tract infection. The table shows the rates of antimicrobials prescribed for urinary indications for the 10 pairs of nursing homes.

The rate of antimicrobial use for suspected urinary tract infections was significantly lower in the intervention arm than in the usual care arm (1.17 courses of antimicrobials per 1000 resident days prescribed *v* 1.59; weighted mean difference −0.49, 95% confidence interval −0.93 to −0.06). The monthly rates of antimicrobials for suspected urinary tract infection were consistently lower in the intervention homes over the 12 months of the study. The difference was, however, reduced over time (fig 3). The weighted linear regression analysis showed a tendency towards a reduced effect over time, although this was not significant (regression coefficient −0.017, −0.056 to 0.02).

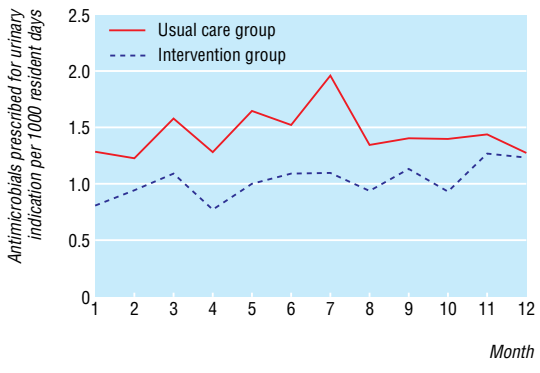

Fig 3 Monthly rates of antimicrobial prescriptions for urinary indications in intervention and usual care nursing homes

The proportion of total antimicrobials prescribed for suspected urinary tract infection in the intervention arm was significantly lower than in the usual care arm: 28% of antimicrobial courses versus 39% of courses (weighted mean difference −9.6%, −16.9% to −2.4%). Proportions of antimicrobials for respiratory, skin and soft tissue, or other infections did not differ between the study arms. The rate of defined daily dosages of antimicrobials prescribed (equivalent to the standard amount of antibiotic in a typical prescription[17]) for suspected urinary tract infections was 6.9 per 1000 resident days in the intervention arm compared with 10.9 in the usual care arm (weighted mean difference −3.85, −7.37 to −0.34).

Total antimicrobial use between the intervention and usual care groups was not significantly different (3.52 courses of antimicrobials per 1000 resident days compared with 3.93, respectively; weighed mean difference −0.37, −1.17 to 0.44).

Urine cultures obtained

Overall, 1402 cultures were sent from the intervention homes compared with 1737 from the usual care homes. The rate of urine cultures sent was lower in the intervention homes (2.03 urine cultures per 1000 resident days *v* 2.48). This difference was not significant (weighted mean difference −0.51, −1.38 to 0.35).

Adverse events

We found no significant difference in overall admissions to hospital or mortality between the two study arms. The rate of all cause admissions to hospital was 0.98 per 1000 resident days in the intervention homes versus 0.81 (weighted mean difference 0.17, −0.14 to 0.48). The rate of admission to hospital for sepsis of suspected urinary origin or of unknown origin was 0.026 per 1000 resident days in the intervention arm compared with 0.018 (weighted mean difference 0.008, −0.025 to 0.039). Mortality was 1.11 per 1000 resident days in the intervention arm compared with 1.09 (weighted mean difference 0.07, −0.22 to 0.36).

Discussion

Clinical algorithms targeted to physicians and nurses and implemented using multiple interventions reduced the rate of antimicrobials prescribed for urinary indications in a large group of nursing home residents. Our findings of a 31% reduction in antimicrobial use for urinary indications support recommendations that without a minimum set of urinary symptoms or signs, urine should not be cultured and antimicrobials should not be prescribed for residents of nursing homes.[16] Although antimicrobial use for suspected urinary tract infection was reduced, the intervention did not significantly reduce overall antimicrobial use. This finding is not unexpected because the intervention was limited to urinary indications.

The rate of culturing urine was not significantly different between the study groups. The purpose of the diagnostic algorithm was to reduce the number of inappropriate urine cultures, leading to fewer prescriptions for antimicrobials. Where a significant difference was shown, it is possible that the therapeutic algorithm was the more important of these two components of the intervention. Alternatively, the reduction in number of urine cultures ordered may have helped

What is already known on this topic

Little is known about interventions to optimise antimicrobial use in nursing home residents

What this study adds

A multifaceted intervention using diagnostic and therapeutic algorithms resulted in fewer antimicrobial prescriptions for urinary indications in nursing home residents

Implementing large scale intervention studies to improve antimicrobial use in long term care facilities is feasible

reduce urinary antimicrobial use even if a significant reduction in culture rate could not be shown.

One limitation of our study is that the results may not be generalisable to nursing homes with fewer than 100 residents. Our study was underpowered to assess important differences in admissions to hospital and death between study arms. Another limitation is that differences between the study arms in antimicrobials courses for urinary indications were reduced during the final months of the study, although the trend was not statistically significant. This may have been due to fatigue of the healthcare provider with the intervention.

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Competing interests: None declared.

Ethical approval: This study was approved by the McMaster University ethics committee and the medical advisory committees or resident councils of the nursing homes.

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Academic medicine scenarios: final votes

On 9 July we published five possible futures for academic medicine; for a detailed description of each scenario, see the article (*BMJ* 2005;331:101-4). Coinciding with the article, we conducted an online poll, which had a final tally of 263 respondents (including 142 doctors and 50 academics). The responses were as follows:

Looking ahead to 2025, which scenario do you find the most [description]?

	Response count				
Description	Academic Inc	Reformation	In the public eye	Global academic partnership	Fully engaged
Creative	52	54	29	73	55
Liberating	25	88	20	63	50
Distasteful	104	24	88	6	13
Desirable	18	39	27	102	66
Likely	76	46	27	33	63

Totals are less than 263 because some respondents didn't indicate a preference.

Which do you consider to be the two or three most important elements in academic medicine's future?

Element	Response count
Teaching and lifelong learning are priorities	125
Gap between knowledge and practice closes	116
Academic medicine becomes much more multidisciplinary (including, for example, humanities, ethics, and law)	106
All academic medical institutions share the goal of global health equity	95
Teamwork predominates	59
Patients assume a higher profile	56
Dismantling of the traditional triad (research, teaching, and clinical practice)	51
Academic medicine becomes academic health sciences	50
Academic medicine becomes more business-like	38
Students have a voice	33
Institutions specialise	28

Responses ordered in descending order of popularity.

For more detailed results, see: http://bmj.bmjjournals.com/cgi/content/full/331/7508/DC2