Antibiotic Stewardship Interventions for Urinary Tract Infections in Outpatient Settings: A Narrative Review

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KEYWORDS

• Urinary tract infection (UTI) • Antibiotic stewardship • Outpatient • Primary care
• Audit and feedback

KEY POINTS

- Inappropriate antibiotic choice or duration of therapy for urinary tract infections (UTIs) in outpatients is common and is a major contributor to antibiotic overuse.
- Most studies on antibiotic stewardship for UTIs in primary care followed a pre-post study design and employed a multifaceted intervention; these trials generally found improvement in appropriateness of antibiotic use for UTI.
- Of the 5 identified randomized controlled trials, only one focused exclusively on prescribing for UTIs. Three of these trials significantly improved appropriateness of antibiotic use for UTIs; of these, 1 trial focused exclusively on UTIs.
- Audit and feedback was one of the most commonly employed strategies across these trials but may not be sustainable.

INTRODUCTION

This narrative review addresses antibiotic stewardship interventions for urinary tract infections (UTIs) in outpatient care settings because UTIs are a frequent reason for inappropriate antibiotic prescribing, either in choice or duration of antibiotics. UTIs are among the top 3 diagnoses for which antibiotics are prescribed to adults in outpatient settings.[1] An estimated 10.5 million outpatient clinic visits and 2 to 3 million emergency department (ED) visits are made for UTIs in the United States annually.[2] In a

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national survey, 84.7% of ED visits and 69.7% of outpatient clinic visits with a diagnosis of UTI were associated with an antibiotic prescription.[3]

Inappropriate antibiotic choice and excessive duration confer risks to the patients receiving these drugs in terms of side effects, risk of resistance among their own flora, and potential for *Clostridioides difficile* colitis. Unfortunately, inappropriate choice and duration of antibiotic therapy for UTIs is well documented in multiple settings around the world.[4–9] Current Infectious Diseases Society of America international guidelines recommend nitrofurantoin for 5 days, trimethoprim-sulfamethoxazole (TMP-SMX) for 3 days and a single dose of fosfomycin as the first-line regimen for uncomplicated cystitis in women.[10] The guidelines relegated a 3-day course of fluoroquinolones to second-line therapy due to a risk of inducing antibiotic resistance and potential side effects.[10,11] However, in a study of outpatient UTI visits within a commercial insurance database between 2009 and 2013, fluoroquinolones were the most commonly prescribed antibiotic class both before and after release of the guidelines (45% and 42%).[4] In addition, only 21% of fluoroquinolone prescriptions, 26% of TMP-SMX prescriptions, and 16% of nitrofurantoin prescriptions had guideline-recommended durations.[4] Similarly, a study in France found that only 20% of outpatient UTIs were treated with the guidelines-recommended drug, dose, and duration.[9] A more recent US database study of outpatient female patients for uncomplicated recurrent UTIs between 2016 and 2018 found that only 21.5% of prescriptions included a first-line agent with the guideline-concordant duration.[8]

Fluoroquinolones remained the most commonly prescribed antibiotic class also after 3 sequential US Food and Drug Administration (FDA) black box warnings from 2016 to 2018[12–14] that discourage the use of fluoroquinolones for acute cystitis given the risk of severe side effects, including neuropathy, delirium, tendinitis, tendon rupture, arrhythmias, kidney injury, and aortic dissection. The FDA boxed warning against using fluoroquinolones to treat uncomplicated cystitis[15,16] was not associated with a statistically significant reduction of fluoroquinolone prescribing for cystitis in outpatient settings in Florida and Texas.[6,7] A US study of 44.9 million female patient visits with uncomplicated UTIs between 2015 and 2019 found that fluoroquinolones were still the most commonly prescribed antibiotic class (36.4%) and only 58.4% of women received guideline-concordant treatment.[17]

Quantitative and qualitative studies have identified some of the factors associated with inappropriate antibiotic prescribing for uncomplicated cystitis, either in choice of antibiotic or in duration of therapy.[5,18,19] Fluoroquinolone prescribing was significantly higher in older patients[5,17,19] and those residing in rural areas.[19] Older age and the presence of diabetes were also associated with longer treatment duration.[18–20] A qualitative study exploring provider-prescribing decisions when treating women with UTIs found a widespread belief in greater potency of fluoroquinolones relative to first-line antibiotic choices, and a misplaced belief that fluoroquinolones act faster to relieve symptoms of acute cystitis in women.[21] Most providers were also unfamiliar with fosfomycin as a possible first-line agent for the treatment of cystitis.[21] For support in clinical decision-making, few providers relied on guidelines, preferring instead to have decision support embedded in the electronic medical record (EMR). In another qualitative study, both community providers and residents voiced frustrations with guidelines being difficult to easily incorporate into daily practice due to the length and extraneous information.[22]

Multiple interventional studies have addressed the issue of inappropriate choice and duration of outpatient UTI treatment. Most of the studies used a quasi-experimental pre-intervention or post-intervention design that provided weaker evidence than randomized controlled trials (RCTs). Of the 5 RCTs, 4[23–26] aimed to improve prescribing

for several conditions such as respiratory infections and asthma, in addition to UTIs. Only one of the RCTs was exclusively focused on UTI antibiotic stewardship.[27] All 5 RCTs were performed in primary care clinics, and none were performed in the United States.

In this narrative review, we summarize publications and evidence for UTI-focused antibiotic stewardship interventions in the EDs and primary care. We present RCTs separately because they represent the highest quality of evidence, then we present the quasi-experimental trials. Studies using case vignettes are also presented separately, because they measure intended prescribing instead of actual prescribing.

Through this review, we will highlight what has and has not worked to improve antibiotic use for UTIs in outpatient care, and suggest directions for future interventions. The scope of this review focuses on antibiotic stewardship for uncomplicated cystitis in women, as current practice guidelines do not address how to manage UTIs in men or people of other genders or complicated UTIs. This review also does not address the topic of diagnostic stewardship, which has a very important role upstream in the care process from antibiotic stewardship.

Randomized Controlled Trials of Outpatient Antibiotic Stewardship Interventions for Urinary Tract Infections

RCTs providing the strongest evidence for the effectiveness of the interventions are presented in **Table 1**. We excluded trials in which the comparator group included an intervention for improving medication prescribing for other conditions such as asthma[28–30] or sore throat, as the comparator intervention could have led to improved antibiotic prescribing in the UTI stewardship arm.[31] We found 5 RCTs in which the comparator group included usual care. All 5 studies were cluster-RCTs at the clinic level, implementing a UTI antibiotic stewardship intervention aimed to increase guideline-concordant antibiotic prescribing in primary care clinics. Four RCTs were performed in European countries[23–25,27] and one in Canada.[26] One trial included a single stewardship intervention (computer reminders to avoid fluoroquinolones for cystitis),[23] while 4 trials[24–27] included a multifaceted intervention (including workshops on national guidelines for antimicrobial prescribing, audit and feedback, clinical decision aids, and patient information leaflet). The trial outcomes included fluoroquinolone prescriptions for cystitis (n = 2),[23,27] proportion of prescriptions for recommended first-line antibiotics for UTIs (n = 2),[25,27] proportion of TMP-SMX for uncomplicated cystitis (n = 1),[24] prescription duration (n = 1),[26] and delayed antibiotic prescription (n = 1).[26] The intervention arms had a statistically significant improvement in guideline-concordant antibiotic prescribing in 3[23,24,27] of the 5 trials (see **Table 1**). Two trials were not successful at improving guideline-concordant prescribing for UTIs.[25,26] In the trial by McNulty and colleagues,[25] dispensing of nitrofurantoin (the desired outcome) was not significantly different in the intervention practices compared with control practices. In the trial by McIsaac and colleagues[26] which focused on antibiotic prescribing for UTIs and respiratory illnesses, the primary outcome of antibiotic prescribing for UTI did not decrease in the intervention group, although whether this is a desirable outcome is debatable. In this same trial, prescription of antibiotics for UTIs with a duration longer than 7 days was similar in the intervention and control clinics.[26]

The RCT that was exclusively focused on UTI antibiotic stewardship included 30 primary care practices in Ireland divided evenly between 2 intervention arms and 1 control arm and was successful at increasing guideline-concordant prescribing.[27] The clinicians in both intervention groups participated in an interactive workshop with information on the national antimicrobial prescribing guidelines and received monthly audit reports on their antimicrobial prescribing. In addition, for practices in both

Table 1
Randomized controlled trials of antibiotic stewardship interventions in the outpatient settings

First Author and year	Study Design and Sample Size	Country and Setting	Intervention	Study Outcomes	Key Findings
Martens et al,[23] 2007	cRCT, 14 practices were randomized into 2 study groups	The Netherlands, primary care clinics	Computer reminder system including reminders to avoid fluoroquinolones for cystitis (among other computerized reminders for non-antibiotic medications)	Fluoroquinolone prescriptions for cystitis	Lower prescription of fluoroquinolones in the intervention group compared with the control group
Vellinga et al,[27] 2015	cRCT, 30 practices were randomized into 3 study groups	Ireland, primary care clinics	Intervention arms 1 and 2: Workshop on national guidelines for antimicrobial prescribing followed by practice audit report Intervention arm 2: additional evidence on delayed antibiotic prescribing for UTIs	Proportion of prescriptions for recommended first-line antibiotics for UTIs	The proportion of antibiotic prescribing according to UTIs guidelines increased in both intervention arms relative to control arms
Hürlimann et al,[24] 2015	cRCT, 136 practices were randomized into 2 study groups	Switzerland, primary care clinics	Guidelines focused on restricting prescriptions to bacterial infections and preferential prescribing of narrow-spectrum antibiotics coupled with regular individual feedback on antibiotic prescribing (not specific to UTIs)	The percentage of TMP-SMX prescriptions for all treated uncomplicated cystitis	The percentage of TMP-SMX prescriptions for all treated uncomplicated cystitis was significantly higher in the intervention group

McNulty et al,[25] 2018	cRCT, 148 practices were randomized into 2 study groups	United Kingdom, primary care clinics	Workshop incorporated a presentation, reflection on antibiotic data and promotion of resources, clinical scenarios, and action planning to improve antibiotic prescribing (not specific for UTIs)	1. Total oral antibiotics dispensed 2. Dispensing of antibiotics typically prescribed for UTIs	1. No significant difference in antibiotic dispensing between the intervention and control clinics 2. No significant difference in dispensing of nitrofurantoin between the intervention and control clinics
McIsaac et al,[26] 2021	cRCT, 6 clinics were randomized into 2 study groups	Canada, primary care clinics	Clinician education, clinical decision aids for prescribing decisions, patient information leaflet, audit and feedback (not specific for UTIs)	1. Total antibiotic prescriptions 2. Delayed antibiotic prescription for uncomplicated cystitis 3. Prescription duration longer than 7 d	1. No reductions in total antibiotic prescriptions for cystitis 2. The odds of a delayed prescription was increased for acute cystitis in the intervention clinics 3. No reduction in prescription duration longer than 7 d

Abbreviations: cRCT: cluster-randomized controlled trial; TMP-SMX, trimethoprim-sulfamethoxazole; UTI, urinary tract infections; d, days.

intervention groups, whenever a consultation was coded as UTI, a reminder pop-up outlining antibiotic-prescribing guidelines appeared. One of the intervention groups also received reminder urging physicians to consider delayed prescribing. The patients in the intervention sites were twice as likely to receive a prescription for a first-line antibiotic for their UTIs as those attending a control site.[27] However, an unintended increase in antimicrobial prescribing was observed in the intervention groups relative to control, although the number of these prescriptions which represented delayed prescribing could not be measured.

Quasi-Experimental Studies of Antibiotic Stewardship Interventions for Urinary Tract Infections in Emergency Department Settings

Table 2 presents quasi-experimental studies using antibiotic stewardship interventions for UTIs in the ED settings. These interventions included diverse strategies such as guideline implementation,[32,33] provider education,[33,34] development of best-practice algorithms,[34,35] electronic UTI order sets,[33,36] institution-specific recommendations based on ED-specific antibiogram,[32,37] audit and feedback,[32,33,36] FDA warnings added to all oral fluoroquinolone orders in the EMRs,[38] as well as selective reporting of antibiotic susceptibilities by the laboratory.[38] Five[32,33,35–38] out of 7 studies were performed in the United States. All of these studies were successful at improving at least one of the antibiotic stewardship outcomes such as reduction of fluoroquinolone use for uncomplicated cystitis,[33–38] adherence to guidelines for both antibiotic choice and duration,[33,36] use of first-line agents,[32,35,37] and treatment duration.[32] These studies included multifaceted interventions and could not assess the effectiveness of each of the intervention components. Most importantly, all studies used pre-intervention and post-intervention comparison without a contemporaneous control group, the least rigorous design for quasi-experimental research.[39]

Quasi-Experimental Studies of Antibiotic Stewardship Interventions for Urinary Tract Infections in Primary Care Settings

Table 3 presents quasi-experimental studies using antibiotic stewardship interventions for UTIs in primary care settings. Six out of 8 studies were performed in the United States, one was performed in the United Kingdom and one in France. Five studies used an uncontrolled pre-intervention and post-intervention comparison,[38,40–43] while 3 studies used a more rigorous study design (interrupted time series (ITS)[44,45] and pre-intervention/post-intervention with contemporaneous control group[46]).

Interventional Studies Using Interrupted Time Series and Controlled Pre-Intervention/Post-Intervention Designs in Primary Care

The intervention used in one of the ITS studies in France included mailing new UTI guidelines to the participating general practitioners, training sessions including didactic lectures, actual clinical examples, and information on antibiotic use and resistance.[44] The recommendations pointed to 2 main messages: (1) fluoroquinolones should not be used for uncomplicated acute cystitis and (2) fosfomycin or nitrofurantoin should be the preferred first-line agents for uncomplicated UTIs. The segmented regression analysis showed an increase in the number of nitrofurantoin and fosfomycin prescriptions and a decrease in norfloxacin prescriptions.[44] Another ITS study was performed in the United States and included 2 phases.[45] In the first phase, a clinic-specific antibiogram, guidelines, and education were provided. In the second phase, education and provision of clinic-specific and provider-specific feedback were implemented. Overall, there was a 52.1% relative reduction in fluoroquinolone use. The

Table 2
Quasi-experimental studies of antibiotic stewardship interventions in the emergency department settings

First Author and year	Study Design and Sample Size	Country	Intervention	Key Findings
Landry et al,[34] 2014	Pre/post, chart review of patient visits, 96 pre-intervention and 76 post-intervention	Canada	Best-practice algorithm presented at monthly meeting and posters displayed throughout the ED	Significant increase in the proportion of empiric orders that adhered to best practice. Decrease in ciprofloxacin orders and increase in orders for nitrofurantoin.
Hecker et al,[36] 2014	Pre/post, chart review (n = 200 baseline, period 1 and period 2)	USA	Implementation of electronic UTI order set (period 1) followed by audit and feedback (period 2)	Increased adherence to uncomplicated UTI guidelines and reduction in fluoroquinolone therapy for cystitis
Percival et al,[32] 2015	Pre/post, chart review, 174 pre-intervention and 176 post-intervention)	USA	Institution-specific recommendations based on ED-specific antibiogram and guidelines delivered during monthly meeting and by email. Audit of empiric prescribing 2 months into intervention period and feedback emailed to providers.	Antibiotic selection improved but antibiotic duration did not change significantly.
Hudepohl,[37] 2015	Pre/post, chart review of prescriptions, 437 pre-intervention and 325 post-intervention	USA	Antibiotic resistance data for *Escherichia Coli* were sent to all providers by email and posted in ED. The message included a recommendation to consider nitrofurantoin in the absence of contraindications.	Fewer prescriptions for ciprofloxacin and TMP-SMX and more prescriptions for nitrofurantoin in the post-intervention period
Jorgensen et al,[35] 2018	Pre/post, chart review patients, 401 pre-intervention and 351 post-intervention	USA	Development and implementation of a UTI treatment algorithm; education to increase awareness of the algorithm, and audit and feedback	Increased empiric nitrofurantoin use and reduced cephalosporin use in the post-intervention period

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Table 2
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First Author and year	Study Design and Sample Size	Country	Intervention	Key Findings
Lin et al,[38] 2020	Pre/post, chart review of fluoroquinolone prescriptions across three time periods (n = 191, n = 145 and n = 132)	USA	FDA warning added to all oral fluoroquinolone orders in the electronic medical record and education regarding risks of fluoroquinolones given to providers; Ciprofloxacin susceptibilities were suppressed by the laboratory when organisms were susceptible to third-generation cephalosporins and EMR order sets to assist providers in the selection of guideline-recommended antibiotics	Decrease in inappropriate fluoroquinolone prescribing. Cystitis remained the most frequent indication for fluoroquinolones
Zalmanovich et al,[33] 2021	Pre/post, chart review, pre-intervention (n = 177), intensive intervention (n = 156) and late follow-up (n = 94)	Israel	Dissemination of guidelines, short lectures, incorporation of order sets into electronic charts, and weekly personal audit and feedback	Increase in antibiotic prescription adherent with the institutional protocol regarding antibiotic choice and duration and significant decrease of fluoroquinolone prescriptions at discharge

Abbreviations: ED, emergency department; EMR, electronic medical record; TMP-SMX, trimethoprim-sulfamethoxazole; UTI, urinary tract infections.

Table 3
Quasi-experimental studies of antibiotic stewardship interventions in the primary care settings

First Author and year	Study Design and Sample Size	Country	Intervention	Key Findings
Eudaley et al,[40] 2003	Pre/post, chart review of 98 visits for uncomplicated UTIs	USA	Clinical decision support tool that incorporated a clinic-specific antibiogram	Fluoroquinolone and TMP-SMX use decreased, nitrofurantoin use increased, and guideline-directed duration of therapy increased after the intervention
McNulty et al,[41] 2011	Pre/post, surveys on antibiotic prescribing (338 pre-intervention and 359 post-intervention)	UK	Susceptibility to cefalexin was reported in place of susceptibility to co-amoxiclav	Cefalexin and cephalosporin prescribing increased when cefalexin susceptibility was reported and co-amoxiclav prescribing decreased when co-amoxiclav was not reported by the laboratory.
Slekovec et al,[44] 2012	Interrupted time series of 12-month pre-intervention period and 20 month post-intervention period, mean monthly number of antibiotic prescriptions in a French eastern region	France	New guidelines mailed to providers and available on the website and training sessions related to these guidelines.	Nitrofurantoin and fosfomycin prescriptions increased while norfloxacin prescriptions decreased after the intervention.
Lin et al,[38] 2020	Pre/post, chart review of fluoroquinolone prescriptions across 3 time periods (n = 112, n = 112 and n = 61)	USA	FDA warning added to all oral fluoroquinolone orders in the electronic medical record and education regarding risks of fluoroquinolones given to providers; Ciprofloxacin susceptibilities were suppressed by the laboratory when organisms were susceptible to third-generation cephalosporins and EMR order sets to assist providers in the selection of guideline-recommended antibiotics	Decrease in inappropriate fluoroquinolone prescribing. Cystitis remained the most frequent indication for fluoroquinolones.

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Table 3
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First Author and year	Study Design and Sample Size	Country	Intervention	Key Findings
Giancola et al,[42] 2020	Pre/post chart review of uncomplicated cystitis cases, 787 pre-intervention and 862 post-intervention	USA	Revising or adding prefilled, but modifiable, default prescribing instructions in the electronic health record for targeted antibiotics	Increased adherence to recommended duration of therapy after the intervention
Grigoryan et al,[46] 2021	Pre/post with contemporaneous control group (chart review of 932 visits for uncomplicated cystitis)	USA	Didactic lecture (including teaching cases to address specific clinical scenarios), decision algorithm and personalized audit and feedback	The intervention clinic had a significantly larger increase in adherence to the UTI guidelines than the control clinic
Funaro et al,[45] 2021	Interrupted Time Series, UTI encounters (primary care, n = 857 and urgent care, n = 4165)	USA	Development of clinic-specific antibiogram and guideline, education, provision of provider-and clinic-specific feedback	Reduction in fluoroquinolone use after the intervention Increase in guideline-concordant prescribing after the intervention
Cubillos et al,[43] 2023	Pre/post, (electronic health record extraction, n = 3741 pre-intervention and 3752 post-intervention)	USA	Antimicrobial stewardship bundle including development of an antimicrobial stewardship team, educational presentation for prescribers, a fluoroquinolone stewardship dashboard, allowing for blinded peer comparison reports of prescribing patterns	A significant decrease in the percentage of UTI visits at which fluoroquinolone prescriptions were issued was found in all 23 clinics after the intervention

investigators also studied secondary outcomes such as treatment failure and adverse effects on a random subset of chart reviews. Importantly, they found low incidence of treatment failure with guideline-concordant antibiotic prescribing.[45]

The intervention used in the controlled pre-intervention and post-intervention study performed in the United States included interactive case-based training lecture, pocket cards with algorithms, and audit and feedback sessions.[46] The difference-in-differences analysis showed that this multifaceted intervention was associated with increased guideline adherence for antibiotic choice and duration in greater magnitude than similar trends at the control site.[46]

Interventional Studies Using Uncontrolled Pre-Intervention/Post-Intervention Designs In Primary Care

The interventions in 5 other studies using uncontrolled pre-intervention and post-intervention study design included a clinical decision support tool that incorporated a clinic-specific antibiogram,[40] replacing reporting susceptibility to co-amoxiclav with susceptibility to cefalexin by the laboratory,[41] FDA warning added to all oral fluoroquinolone orders in the EMR together with provider education, suppression of ciprofloxacin susceptibilities, EMR order sets,[38] prescribing instructions in the EMR for targeted antibiotics,[42] and antimicrobial stewardship bundle including development of stewardship team, and a fluoroquinolone stewardship dashboard, allowing for blinded peer comparison reports of prescribing patterns.[43] All studies were successful at improving at least one of the antibiotic stewardship outcomes such as reduction of fluoroquinolone use for uncomplicated cystitis,[40] and the use of first-line agents,[40]

Outpatient Antibiotic Stewardship Interventions for Urinary Tract Infections Using Case Vignettes

Table 4 shows outpatient stewardship interventions for UTIs using case vignettes. In these studies, providers were given surveys with case vignettes and asked to choose therapy for these hypothetical cases. Three randomized case vignette studies in primary care clinics in France assessed the impact of selective reporting of antibiotic susceptibility data on intended antibiotic prescriptions for UTIs.[43,47,48] The appropriateness of intended antibiotics for UTIs were improved in the intervention groups of 2 studies,[48,49] while no significant difference was found in 1 study.[47] An important limitation of these studies is that the outcome measured included intended prescribing instead of actual prescribing of antibiotics.

DISCUSSION

Our review of interventional studies aimed at improving UTI antibiotic stewardship in the outpatient setting found that most studies used a pre-intervention and post-intervention comparison, the least rigorous study design for comparative effectiveness research.[50] A randomized, controlled design was used by 5 studies,[23–27] but only one of them was exclusively focused on UTI stewardship.[27] Three studies were also aimed at improving antibiotic stewardship for respiratory infections[24–26] and 1 study targeted prescribing of non-antibiotic medications.[23] In the single RCT focused on improving prescribing for UTI, audit and feedback reports, including practice-specific information, were part of their effective intervention at changing prescribing behavior.[27] Audit and feedback has been also effective in other studies, including multifaceted interventions aimed at improving UTI antibiotic stewardship in the outpatient[24,32,33,35,36,45,46] and other settings.[51,52] However, individualized audit and feedback is labor intensive and time consuming, and therefore creates sustainability

Table 4
Studies of antibiotic stewardship interventions in the outpatient settings using case vignettes

First Author and year	Study Design	Country, Setting and Study Participants	Intervention	Key Findings
Piet et al,[47] 2023	Case vignette randomized study, general practitioners were randomized to intervention (n = 391) and control (n = 424) arms	France, general practitioners in primary care clinics	Comments from microbiologists on interpreting the antimicrobial susceptibility testing profile to improve the appropriateness of prescribing	Intervention did not improve the appropriateness of the targeted antibiotic for any of the UTI syndromes in case vignettes (asymptomatic bacteriuria in pregnancy, uncomplicated pyelonephritis, complicated pyelonephritis, cystitis in women, male UTIs, and bacteriuria associated with an indwelling catheter).
Coupat et al,[49] 2013	Case vignette randomized study, general practice residents were randomized to intervention (n = 157) and control (n = 169) arms	France, residents in primary care clinics	Selective reporting of antibiotic susceptibility data	Improved appropriateness of antibiotic prescriptions for 4 UTI scenarios in the intervention group
Bourdellon et al,[48] 2017	Case vignette randomized study, general practitioners randomized to intervention A (n = 64) and intervention B (n = 67)	France, general practitioners in primary care clinics	Selective reporting of antibiotic susceptibility data	Improved appropriateness of antibiotic prescriptions for UTI scenarios in the intervention clinics

challenges. Automated audit and feedback generated using electronic data presents an opportunity to improve UTI stewardship and facilitate scale-up and sustainability. Studies assessing the feasibility of automated audit and feedback to improve guideline concordance are needed in primary care.

Multiple other multifaceted interventions were successful at improving UTI antibiotic stewardship in outpatient settings. The components of these interventions included computerized reminders to avoid fluoroquinolones for cystitis,[23] implementation of electronic UTI order sets,[33,36] institution-specific recommendations based on local antibiogram,[32,37,45] development and implementation of a UTI treatment algorithm,[34,35,45] FDA warnings added to all fluoroquinolone orders,[38] suppression of ciprofloxacin susceptibilities,[38] clinical decision support tool incorporating a clinic-specific antibiogram,[40] and selective reporting of antibiotic susceptibility data and comments from microbiologists on interpreting these data.[47–49] However, these findings are mostly based on studies using uncontrolled pre-intervention and post-intervention comparison.

Two studies were not successful at improving UTI stewardship[25,26]; both also focused on respiratory infections. As the number of patients treated for UTIs was small, these trials may have been underpowered to detect a significant difference for UTI-relevant outcomes between the intervention and control clinics.[26] Additionally, in both of these trials, total antibiotic prescriptions was the primary outcome, and whether reducing antibiotic prescriptions for women diagnosed with cystitis is an appropriate target is unclear.

Besides lack of RCTs to assess the effectiveness of UTI antibiotic stewardship interventions in outpatient settings, the evidence on this topic is undermined by the lack of implementation research focusing on outcomes such as intervention uptake, fidelity, satisfaction, and costs.[53] Hybrid designs focusing on both clinical and implementation outcomes can address this gap.[54] In addition, these future studies need to be based on a conceptual framework guiding research on prescribing behavior change.

Future work on antibiotic stewardship for UTIs should also study appropriate prescribing for complicated UTIs and UTIs in men. These patient subgroups were usually excluded in the previous studies due to lack of evidence-based guidelines. However, guidance for these patient subgroups may be included in updated UTI guidelines, providing a basis for inclusion of these subgroups in UTI research. Diagnostic stewardship and decreasing treatment of asymptomatic bacteriuria in outpatient settings are additional areas in need of study.

SUMMARY

Most of the studies on improving antibiotic stewardship for UTI in outpatient setting were uncontrolled pre-intervention and post-intervention comparison studies and were successful at improving at least one of the antibiotic stewardship outcomes such as reduction of fluoroquinolone use for uncomplicated cystitis,[33–38] adherence to guidelines for both antibiotic choice and duration,[33,36] the use of first-line agents,[32,35,37] and treatment duration.[32] Intervention strategies included: audit and feedback, computerized decision support systems to improve antibiotic prescribing, provider education, electronic order sets, local susceptibility reports and institution-specific recommendations based on local antibiogram, and selective reporting of antibiotic susceptibilities. However, the strength of the evidence for any 1 technique is weak because all interventions were multifactorial and were mostly based on pre-intervention/post-intervention studies. In addition, out of 5 RCTs on UTI outpatient stewardship,[23–27] only one was specific to UTI.[27] Three trials also focused on reducing

antibiotic use for respiratory infections which may represent a different cognitive challenge for practitioners.

General take-away messages are that most of these studies were successful at improving UTI stewardship. Some of the successful interventions, such as audit and feedback, were labor intensive, probably unsustainable, and not suitable for scale up. Audit and feedback works through delivering targeted education in an interactive format that is specific to the behavior of the person receiving the feedback. In other words, audit and feedback, when done well, will help providers avoid cognitive short-cuts that lead to inappropriate prescribing in the future.[55] Additional studies to map the future of antibiotic stewardship for UTI in primary care should explore sustainable approaches to audit and feedback, as a component of a theory-based study that measures both effectiveness and implementation.

CLINICS CARE POINTS

- When prescribing antibiotics to treat UTIs in outpatients, the provider should take care to ensure that both the choice of antibiotic and the duration are appropriate and consistent with guidelines.
- Improving antibiotic prescribing in terms of antibiotic choice and duration of therapy is an important component of outpatient antibiotic stewardship.
- Most of the studies that have been successful at improving antibiotic prescribing for UTIs in outpatient settings employed a multifaceted intervention.

DISCLAIMER

The contents presented herein do not represent the views of the US Department of Veterans Affairs or the United States Government.

DISCLOSURE

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