

Urinary tract infection pocket card effect on preferred antimicrobial prescribing for cystitis among patients discharged from the emergency department

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Purpose. To evaluate the impact of a urinary tract infection (UTI) pocket card on preferred antibiotic prescribing for patients discharged from the emergency department (ED) with a diagnosis of cystitis.

Methods. A multicenter, retrospective, pre-post study was conducted to compare outcomes following the introduction of a UTI pocket card. The primary outcome was prescribing rates for institutional first-line preferred antibiotics (cephalexin and nitrofurantoin) versus other antimicrobials for cystitis. Secondary outcomes included prescriber adherence to recommended therapy in regards to discharge dose, frequency, duration, and healthcare utilization rates.

Results. The study included 915 patients in total, 407 in the preintervention group and 508 in the postintervention group. The frequency of preferred antibiotic prescribing was significantly increased after the introduction of a UTI pocket card compared to prior to its introduction (81.7% vs 72.0%, $P = 0.001$). Significant increases in prescribing of an appropriate antibiotic dose (78.0% vs 66.8%, $P < 0.0001$) and frequency (64.2% vs 47.4%, $P < 0.0001$) were also found post intervention. No significant differences were seen between the pre- and postintervention groups with regards to healthcare utilization rates.

Conclusion. A UTI pocket card increased preferred antibiotic prescribing for cystitis in the ED. This study provides data on a successful antimicrobial stewardship intervention in the ED setting.

Keywords:

Antibiotic prescribing in the outpatient setting is responsible for 80% to 90% of the volume of all human antibiotic consumption worldwide, resulting in prescribing of a total of 267.6 million oral antibiotic courses in the United States in 2017.¹⁻³ The Centers for Disease Control and Prevention (CDC) reported that 30% of all antimicrobial prescriptions during the period 2010-2011 were not required.⁴ Due to unnecessary utilization in combination with inappropriate selection, dosing, and duration, rates of inappropriate antibiotic use may be as high as 50%.⁵⁻⁷ Inappropriate antibiotic use is associated with increased antibiotic resistance, increased disease severity and duration, increased rates of adverse drug reactions and mortality, and increased healthcare costs.⁸

In 2014, the White House released the National Action Plan for Combating Antibiotic-Resistant Bacteria, highlighting the importance of implementing antibiotic stewardship programs in conjunction with the development, promotion, and implementation of activities to ensure the appropriate use of antibiotics.⁹ Antibiotic stewardship efforts have been proven to reduce antibiotic resistance, increase infection cure rates, reduce treatment failures, increase frequency of appropriate prescribing, reduce cost, and reduce rates of *Clostridioides difficile* (formerly *Clostridium difficile*) infections.¹⁰⁻¹³ However these outcomes are primarily associated with inpatient antibiotic stewardship efforts, and there is limited evidence on antibiotic stewardship in the emergency department (ED).¹⁴

The ED setting presents unique challenges such as rapid patient turnover, a large spectrum of patient acuity, the need for quick decision making, and a varied mix of prescribers, all of which make implementing antibiotic stewardship interventions

designed for inpatient use difficult. As such, novel approaches are necessary for ED implementation. A call to action for antimicrobial stewardship in the ED published by May et al¹⁵ highlights the importance of this setting for addressing inappropriate antimicrobial prescribing practices given the frequency of antibiotic use in both patients being admitted to the hospital and patients being discharged from the ED. The investigators suggested potential strategies and tools that could be implemented in the ED, including but not limited to ED-specific clinical guidelines, efforts to shorten duration of therapy, dose optimization, and ED antibiogram development. Novel antimicrobial stewardship interventions to address these areas in the ED are of great significance, potentially improving patient care.

Noting that ED physicians and ED advanced practice providers (APPs) often carried various resources with them throughout their shift, often in a white coat or scrub pocket, we sought to incorporate all of the above strategies in a pocket-sized guidance document, henceforth referred to as the UTI pocket card, that could be easily accessed when prescribing antibiotics for cystitis. The guidance document intervention in our study was intended to assist prescribers in selecting the most appropriate antimicrobial therapy, with a focus on agent selection, dose, and duration, based upon published literature and local susceptibility rates determined by an ED-specific antibiogram. The goal of the investigation described here was to evaluate the impact of the UTI pocket card on preferred antimicrobial prescribing for patients discharged from the ED with a diagnosis of cystitis; physician and APP adherence to recommended therapy in regards to discharge dose, frequency, and duration; and rates of healthcare utilization.

Methods

The investigation was multicenter, retrospective, pre-post study comparing outcomes before and after the introduction of the UTI pocket card in May 2018. It was conducted at 4 EDs housed within hospitals and 2 freestanding EDs. These 6 EDs have a total of approximately 165,000 patient visits per year, with clinical pharmacists present during 64 (44%) of the combined total of 144 hours per day at the 6 EDs. There was no formal review of outpatient antimicrobial therapy in any of the participating EDs during the study period. The study was approved by the parent organization's institutional review board. Data were collected every third month from November 2016 through November 2019, excluding the month the UTI pocket card was implemented, for a total of 12 months. The designated preimplementation months were November 2016, February 2017, May 2017, August 2017, November 2017, and February 2018. The postimplementation months were August 2018, November 2018, February 2019, May 2019, August 2019, and November 2019.

Patients included in the study were 18 years of age or older and discharged from the ED with a documented International Classification of Diseases, 10th revision (ICD-10), code for acute cystitis without hematuria; acute cystitis with hematuria; other cystitis without hematuria; cystitis, unspecified without hematuria; cystitis, unspecified with hematuria; and/or urinary tract infection, site not specified.

Patients were excluded if they had an ED discharge diagnosis of pyelonephritis, an ED discharge diagnosis with another infectious pathology in addition to cystitis, hospital admission to a study facility or an outside facility on the day of the index ED visit, recurrent UTI (defined as UTI within the previous 3 months), or a urine culture positive for a multidrug-resistant organism (MDRO) within the 6 months preceding the index ED visit. Patients were most commonly excluded because an infectious etiology in

addition to cystitis was identified, followed by recurrent UTI, hospital admission, MDRO identification, and discharge diagnosis of pyelonephritis.

The foldable, 6-panel UTI pocket card (Figure 1) was distributed to ED physicians and APPs in May 2018. Information on its intended role and production was disseminated via a newsletter that was sent to all ED physicians, APPs, and pharmacists.

In conjunction with the parent organization's microbiology laboratory, an ED-specific antibiogram is produced annually. After review of the ED-specific antibiogram to determine susceptibility patterns for *Escherichia coli*, the pathogen most commonly implicated in UTI, treatment guidance was developed and approved for use by the antimicrobial stewardship committee. Available literature and committee member expertise were utilized to determine optimal agents, dosing, and duration. While the UTI treatment guidance is updated annually to reflect changing susceptibility rates, during the study period no changes in antibiotic recommendations for treatment of cystitis were made.

In addition to antibiotic treatment recommendations, the UTI pocket card provides education on adverse effects associated with fluoroquinolone therapy along with a listing of common pathogens implicated in community-acquired UTI.

Data were extracted from the electronic medical record (EMR) by investigators using an electronic standardized data collection form. ED diagnoses of cystitis were determined using ICD-10 codes. If cystitis was not defined as uncomplicated or complicated in the ED physician or APP note, it was considered uncomplicated if the patient was female, nonpregnant, and without known urologic malformation or abnormality.

Patient age and sex, discharge antibiotic prescribed, discharge antibiotic dose, discharge antibiotic frequency, discharge antibiotic duration, penicillin allergy status,

and cephalosporin allergy status were obtained from the hospital EMR, as were rates of healthcare utilization, defined as a return visit for UTI within 7 days of ED discharge, admission with a diagnosis of UTI within 7 days of ED discharge, admission with a diagnosis of pyelonephritis within 7 days of ED discharge, and admission with a diagnosis of sepsis with a urinary source within 7 days of ED discharge.

Primary and secondary outcomes. The primary outcome was the prescribing rate for institutional first-line preferred antibiotics (cephalexin and nitrofurantoin) versus other antimicrobials for cystitis before and after the introduction of the UTI pocket card. Secondary outcomes included physician and APP adherence to recommended therapy in regards to discharge dose, frequency, and duration before and after the introduction of the UTI pocket card. Our comparison of rates of healthcare utilization in the preintervention and postintervention cohorts evaluated ED, urgent care, or other medical provider visits with chief complaints of UTI symptoms within 7 days of the index ED visit, as well as hospital admissions with diagnosis of UTI, pyelonephritis, or sepsis with a urinary source within 7 days of the index ED visit.

Statistical analysis. Descriptive statistics for categorical data were calculated as frequency and percentage, and comparisons between groups were completed using a chi-square test. Descriptive statistics for continuous data were analyzed as mean with associated standard deviation (SD), and comparisons between groups were completed using Student's *t* test. Analyses were completed using the software program Statistical Package for the Social Sciences, version 22.0 (IBM Corporation, Armonk, NY).

Results

A total of 1,321 patient charts were screened for inclusion, and a total of 915 patients were included (Figure 2). The average age of the entire cohort was 53.5 years (SD, 24.3 years), and 83.3% were female. The control group included 407 patients and

the intervention group consisted of 508 patients. Overall, the baseline characteristics were well balanced between groups (Table 1).

For the primary outcome, the rate of cephalexin or nitrofurantoin prescribing increased from 72.0% (293 of 407) prescriptions before the intervention to 81.7% (415 of 508) prescriptions after the intervention ($P < 0.001$) (Table 2). Preferred antibiotic prescribing rates over time can be viewed in Figure 3. These results were alongside decreased prescribing rates for sulfamethoxazole/trimethoprim (from 6.9% in the preintervention group to 3.0% in the postintervention group; $P = 0.007$) and fluoroquinolone antibiotics (from 17.9% before the intervention to 7.1% post intervention; $P < 0.001$). Increased prescribing of cefuroxime also occurred.

Secondary endpoints (ie, rates of appropriately prescribed antibiotic dose and appropriate dosing frequency on discharge) also improved from the pre- to the postintervention period, with rates of appropriate antibiotic dosing and appropriate frequency increasing from 66.8% to 78.0% and from 47.4% to 64.2%, respectively ($P < 0.001$ for both comparisons). Cephalexin was most frequently prescribed at 500 mg per dose (92.2% of prescriptions), and frequencies of twice daily or three times daily were specified in 66.9% of cases. When prescribed, nitrofurantoin was prescribed at 100 mg per dose, with a frequency of twice daily, in all cases. No significant difference between groups for the outcome of appropriate duration of antibiotic therapy prescribed at discharge was identified. Secondary endpoints related to rates of healthcare utilization within 7 days of initial ED treatment did not differ between groups, including ED revisits for UTI, hospital admission for UTI, hospital admission for pyelonephritis, and hospital admission for sepsis of urinary source (Table 2).

Discussion

The study sought to evaluate the impact of a UTI pocket card focused on appropriate antimicrobial prescribing for the treatment of cystitis in the ED. Overall, the intervention proved effective, significantly increasing appropriate antibiotic prescribing choices while concurrently decreasing inappropriate antibiotic choices, as measured by a shift towards greater prescribing of nitrofurantoin and cephalexin and a reduction in prescribing of sulfamethoxazole/trimethoprim and fluoroquinolones. The appropriateness of prescribed therapies also increased with regard to dose, frequency, and duration. Notably, outcomes related to rates of healthcare utilization did not differ significantly between groups.

In our experience, ED physicians and APPs tend to have educational resources that they have trained with, utilize often, and keep in a convenient location such as a scrub pocket or white coat pocket. Therefore, we designed our guidance document to be easily integrated with these already established educational resources. The UTI guidance document, specifically designed to fit into a pocket with other documents, is unique in its intended purpose: to be integrated into a commonly adopted workflow. Speed, convenience, and fluidity are important in many areas, especially the ED. Hence, it was decided to design a folding pocket card rather than a poster-sized guidance document that may not be present when and where treatment decisions are made.

Use of cephalexin or nitrofurantoin as a first-line agent in the treatment of uncomplicated cystitis increased significantly following the implementation of a UTI pocket card. Local ED-specific antibiogram data indicate that rates of susceptibility to cephalexin and nitrofurantoin for *E.coli* isolates cultured from urine collected in ambulatory care settings are 92% and 98%, respectively. Cephalexin and nitrofurantoin are well tolerated, have few serious adverse effects, and can safely be used in

pregnancy. They also have relatively narrow spectrums of activity compared to other potential therapies for uncomplicated UTI. For these reasons, cephalexin and nitrofurantoin were listed as preferred agents for uncomplicated UTI on our treatment guidance document.

Fluoroquinolone and sulfamethoxazole/trimethoprim prescribing for cystitis significantly decreased after the introduction of the UTI pocket card. Local ED-specific antibiogram data indicate *E.coli* susceptibility rates of 78% for sulfamethoxazole/trimethoprim and 88% for ciprofloxacin, though these rates were calculated prior to adoption of the new Clinical and Laboratory Standards Institute breakpoints for fluoroquinolones and hence were likely significantly higher than the actual susceptibility rates.¹⁶⁻¹⁸ Fluoroquinolones have been associated with QT interval prolongation, *C. difficile* infection, decreased seizure threshold, peripheral neuropathy, adverse psychiatric effects, glucose abnormalities (including both hypoglycemia and hyperglycemia), gastrointestinal perforation, tendinopathy, retinal detachment, aortic dissection, and aortic aneurysm.¹⁹ Sulfamethoxazole/trimethoprim has been associated with hyperkalemia; severe dermatologic reactions, including Stevens-Johnson syndrome and toxic epidermal necrolysis; acute kidney injury; blood dyscrasias; and hypoglycemia.²⁰ Fluoroquinolones may also be involved in dangerous drug-drug interactions, such as that of ciprofloxacin increasing the area under the curve (AUC) of tizanidine approximately 10-fold, leading to an increased risk of hypotension and extreme sedation.²¹ Similarly, sulfamethoxazole/trimethoprim is implicated in severe drug-drug interactions with commonly prescribed medications, including anticoagulants, spironolactone, and angiotensin-converting enzyme inhibitors.²⁰ For these reasons, fluoroquinolones and sulfamethoxazole/trimethoprim were relegated to

the bottom of each recommendation table and one of the 6 panels was dedicated solely to spelling out the negative aspects of fluoroquinolones in a clear and concise manner.

Our findings of an increase in preferred antimicrobial prescribing coupled with a decrease in rates of prescribing of nonpreferred antimicrobials are similar to findings in a retrospective cohort study involving a pocket card intervention conducted by Jorgensen et al.²² Methodologically, there were a few notable differences. The primary outcome of our study was preferred antimicrobial prescribing, with patient-oriented endpoints as secondary outcomes. Jorgensen et al specified the coprimary outcomes of “bug-drug” mismatches and return visits to the ED within 30 days. They defined exclusion criteria less stringent than those used in our study, as they included patients with histories of recurrent UTI and MDRO infection, pyelonephritis, and concomitant infections, which in turn led to a higher rate of complicated UTI in their cohorts compared to our population. Aside from this, other baseline patient characteristics were comparable in our study and that of Jorgensen and colleagues. Their treatment guidance reflected the susceptibilities indicated by the local antibiogram, which demonstrated higher rates of *E. coli* cephalosporin resistance than our antibiogram, and thus the content of the pocket cards differed. During implementation of the intervention, those researchers conducted a more intensive educational campaign to increase awareness and encourage the use of their document. Our educational campaign was limited to the dispersal of the UTI pocket cards along with a concomitant newsletter article, suggesting the pocket card’s impact was unabated with minimal applied resources. And lastly, Jorgensen et al. studied a postintervention cohort out to 3 months after implementation of their document. Our postintervention cohort included a larger time frame of (18 months from implementation), suggesting the effects are sustainable over a longer duration.

Our study also produced findings similar to those of Percival et al²³ in regards to increasing preferred antibiotic prescribing for UTI via antimicrobial stewardship intervention. Percival et al provided face-to-face education to medical residents, and the medical director of the ED provided education to all ED physicians and APPs via email, contrasting with our previously described limited education methods. Education is extremely important in antimicrobial stewardship, and developing modalities that limit the amount of resources required to demonstrate benefit is critical in times of limited reimbursement and staffing limitations. The UTI pocket card is an intervention that, once established, improves antibiotic prescribing without time-intensive education being required regularly, thereby allowing antimicrobial stewardship programs to allocate more resources in targeting other opportunities for improvement.

Our UTI treatment guidance document was demonstrated to influence prescribing habits. This is of note, in part, because there is a high frequency of inappropriate outpatient antibiotic prescribing and effective antimicrobial stewardship interventions are scarce in the ambulatory care setting, particularly in the ED. The ability to influence prescribing of antibiotics that are narrower in spectrum, safer, and more efficacious has been associated with many improvements in patient-centered outcomes. Improvements in mortality, cost, ED length of stay, and readmission to the ED have all been associated with antimicrobial stewardship efforts in the ED.¹⁴ In other settings, antimicrobial stewardship interventions and programs have been shown to improve infection cure rates, adverse effect rates, and *C. difficile* infection rates and to decrease emergence of antimicrobial resistance.

The UTI pocket card was demonstrated to improve preferred antibiotic prescribing. However, to maximize improvement in patient outcomes, the document must be populated with appropriate antibiotic choices; collaboration between an ED

and an antimicrobial stewardship committee is imperative to ensuring this occurs. If not already included in the antimicrobial stewardship committee, the microbiology laboratory should be involved in the development of the document as well. Similar UTI pocket card formats could be utilized in varying locations around the country, or the globe, and take on many iterations, although all would have the common purpose of helping ensure use of the most appropriate antibiotics in regard to spectrum, efficacy, and safety to target the most common pathogens for cystitis.

Limitations

Given that the study was retrospective in nature and unblinded (the individuals collecting data required information regarding the preintervention or postintervention group status of a patient), there was the potential for selection bias.

Antibiotic treatment of asymptomatic bacteriuria is a common infectious diseases issue and therefore a target for antimicrobial stewardship programs.²⁴ Our study identified patients through review of ICD-10 codes and did not take patient-reported urinary symptoms into account. Consequently, our study potentially included asymptomatic patients who may not have been appropriate candidates for antibiotic therapy. However, our study aimed to determine if a UTI pocket card would improve preferred antimicrobial prescribing in the ED once a diagnosis of UTI was made, not to discourage antibiotic prescribing for asymptomatic bacteriuria. Ideally antimicrobial stewardship can have a positive impact in both of these areas, though multiple interventions may be required to do so.

While the study was a multicenter study, all centers involved were in a similar geographical location and used the same ED-specific antibiogram. Different geographical locations are likely to have different resistance patterns, potentially

limiting the external validity of our study; however, it is primarily the specific antibiotic choices that are limited, not the UTI pocket card itself. Use of a UTI pocket card that has been updated with specific antibiotics according to local susceptibility data may produce results similar to those of our study.

Only 6.8% percent of the study population was categorized as having complicated cystitis, potentially limiting the applicability of the study findings to this population. This number was surprisingly low, perhaps secondary to our narrow criteria for deeming a patient as having had complicated cystitis.

While our study found no statistically significant differences in reported penicillin allergy or cephalosporin allergy at baseline, we did not report data on how these allergies may have potentially affected antimicrobial prescribing. Available literature suggests that patients with these allergies listed are at higher risk for methicillin-resistant *Staphylococcus aureus* (MRSA) infection, *C. difficile* infection, and infection-related mortality.^{25,26} However, to our knowledge there are no published data on whether documentation of those allergies is associated with rates of preferred antimicrobial prescribing in the ED. Future research is needed in this area.

Resource limitations prevented the inclusion of all patients within the 36-month data collection period, which could potentially skew the results of the study. The decision to collect data every third month was made so as to maximize the number of patients included given the resource constraints of the study, as well as to maintain random patient selection, and to evaluate the intervention effect over a longer time frame.

The study population was primarily female (82.9% in the preintervention group and 83.8% in the postintervention group). A mostly female population is in line with

reported epidemiology of UTIs; however, this limits the application of the study results to the male population.

Lastly, our UTI pocket card is a physical document, as opposed to a digital one. We chose this format because we observed prescribers routinely using physical references, but we acknowledge its limitations. As more prescribers use electronic references, it may be best to transition to that format to increase engagement and preferred antimicrobial prescribing. Additionally, unlike dissemination of physical cards, use of an electronic format may allow for real-time updates.

Conclusion

The ED is an important location for application of antimicrobial stewardship initiatives given the high volume of antibiotics prescribed. The implementation of a pocket-sized UTI treatment guidance document can increase preferred antibiotic prescribing patterns and decrease inappropriate antibiotic prescriptions for cystitis by ED providers among patients being discharged. Prescribing cephalexin and nitrofurantoin in preference to fluoroquinolones and sulfamethoxazole/trimethoprim potentially avoids a host of complications while increasing effectiveness for the treatment of cystitis, without altering rates of healthcare utilization.



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Figure 1. Component panels of 6-panel pocket card with recommendations for emergency department prescribing for urinary tract infection (UTI). BID indicates twice daily; QID, 4 times daily; TID, 3 times daily.

Figure 2. Flowchart of patient selection, application of exclusion criteria, and study group formation.

Figure 3. Preferred antibiotic prescribing during the preimplementation months (solid bars) and postimplementation months (cross-hatched bars).

Key Points

- Use of a pocket card as an antimicrobial stewardship tool increased the rate of preferred antibiotic prescribing for cystitis by emergency department prescribers in a multicenter study.
- Statistically significant increases in the proportions of antibiotics prescribing at appropriate doses and frequencies were noted after the introduction of the pocket card.
- No significant differences in healthcare utilization were noted between the pre- and postintervention groups.

Table 1. Baseline Patient Characteristics by Study Group^a

	Control	Intervention	
	(n = 407)	(n = 508)	P Value
Age, mean (SD), y	53.8 (24.4)	53.3 (24.3)	0.775
Female	341 (83.8)	421 (82.9)	0.722
Penicillin allergy	71 (17.4)	88 (17.3)	>0.999
Cephalosporin allergy	20 (4.9)	25 (4.9)	>0.999
Complicated UTI	90 (22.1)	113 (22.2)	>0.999

Abbreviations: SD, standard deviation; UTI, urinary tract infection.

^aAll data are number (percentage) of patients unless indicated otherwise.

Table 2. Outcomes of UTI Pocket Card Intervention by Study Group

Outcome	Control (n = 407)	Intervention (n = 508)	P Value
Discharge antibiotic			
Amoxicillin/clavulanate	5 (1.2)	5 (1.0)	0.724
SMX/TMP	28 (6.9)	15 (3.0)	0.007
Cefdinir	2 (0.5)	10 (2.0)	0.076
Cefpodoxime	2 (0.5)	2 (0.4)	0.824
Cefuroxime	3 (0.7)	22 (4.3)	0.001
Cephalexin	241 (59.2)	330 (65.0)	0.086
Ciprofloxacin	54 (13.3)	30 (5.9)	<0.0001
Doxycycline	1 (0.2)	0 (0)	0.264
Fosfomycin	0 (0)	3 (0.6)	0.120
Levofloxacin	19 (4.7)	6 (1.2)	0.002
Nitrofurantoin	52 (12.8)	85 (16.7)	0.113
Cephalexin or nitrofurantoin as discharge antibiotic	293 (72.0)	415 (81.7)	0.001
Appropriate dose	272 (66.8)	396 (78.0)	<0.0001
Appropriate frequency	193 (47.4)	326 (64.2)	<0.0001

Appropriate duration	87 (21.4)	134 (26.4)	0.087
7-day ED revisit for UTI	13 (3.2)	17 (3.3)	>0.999
7-day hospital admission for UTI	3 (0.7)	4 (0.8)	0.931
7-day hospital admission for pyelonephritis	0 (0)	1 (0.2)	>0.999
7-day hospital admission for sepsis of urinary source	2 (0.5)	2 (0.4)	>0.999

ED, emergency Department; SMX/TMP, sulfamethoxazole/trimethoprim; UTI, urinary tract infection.

^aAll data are number (percentage) of patients.

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Uncomplicated Cystitis

Agent/dosing*		E. coli susc. †
1st line	Nitrofurantoin 100mg BID x 5 days	98%
2nd line	Cephalexin 500mg BID-TID x 3 – 5 days	92%
Other options	Cefuroxime 250mg BID x 3 – 5 days	93%
	Cefdinir 300mg BID x 3 – 5 days	93%
	Bactrim DS 1 tab BID x 3 days	79%
	Cipro 250mg BID x 3 days Levaquin 250 daily x 3 days	88%

* Dosing assumes normal renal function; consult PharmD for renal dose adjustments
† Per 2019 antibiogram ED urinary isolates

Complicated Cystitis

Agent/dosing*		E. coli susc. †
1st line	Nitrofurantoin 100mg BID x 5 days‡	98%†
2nd line	Cephalexin 500mg TID x 7 days	92%
Other options	Cefuroxime 250mg BID x 7 days	93%
	Cefdinir 300mg BID x 7 days	93%
	Bactrim DS 1 tab BID x 5-7 days	79%
	Cipro 250mg BID x 5-7 days Levaquin 250mg daily x 5-7days	88%

* Dosing assumes normal renal function; consult PharmD for renal dose adjustments
† Per 2019 antibiogram ED urinary isolates
‡ Avoid use in men

Agent/dosing*		E. coli susc. †
1st line	Cefuroxime 500mg po BID x 10-14 days	93%
Other options	Cefdinir 300mg BID x 10-14 days	93%
	Bactrim DS 1 tab BID x 14 days	79%
	Cephalexin 500mg QID x 10-14 days	84%
Cipro 500mg BID x 7 days Levaquin 750mg daily x 5 days		88%

* Dosing assumes normal renal function; consult PharmD for renal dose adjustments
† Per 2019 antibiogram ED urinary isolates

UTI: Empiric Coverage of Pseudomonas

Agent/dosing*	
Uncomplicated	Cipro 250mg BID x 3 days Levaquin 250mg daily x 3 days
Complicated	Cipro 250mg BID x 5-7days Levaquin 250mg daily x 5-7 days
Pyelonephritis	Cipro 500mg BID x 7 days Levaquin 750mg daily x 5 days

* Dosing assumes normal renal function; consult PharmD for renal dose adjustments

Pseudomonas spp. risk factors include but not limited to:

- 1.) Urine culture with *Pseudomonas spp.* within 4 weeks
- 2.) Hospitalized within 90 days
- 3.) Reside in nursing home/LTAC
- 4.) Receive hemodialysis
- 5.) Antibiotics or chemotherapy within 30 days

A note about Fluoroquinolones

FQs carry multiple boxed warnings and have been associated with many severe adverse reactions:

Commonly Known Adverse Effects	Lesser Known Adverse Effects
QT prolongation	GI perforation
<i>Clostridium difficile</i> infection	Aortic aneurysm/dissection
Tendinopathy	Retinal detachment
Peripheral neuropathy	Hypo/hyperglycemia
	Seizures

- FQs have a low barrier to resistance.
- Resistance rates to FQs have increased rapidly.
- Ciprofloxacin and levofloxacin are our only oral agents with reliable activity against *Pseudomonas spp.*
- FQs should be reserved for a few clinical scenarios where other antibiotics are not safe or feasible.

Likely Pathogens: Community Acquired UTI

Uncomplicated Cystitis	<ul style="list-style-type: none"> • E. coli (75-95%) • Other Enterobacteriaceae • S. saprophyticus
Complicated Cystitis	<ul style="list-style-type: none"> • E. coli (65%) • <i>Klebsiella spp.</i> (8%) • <i>Pseudomonas spp.</i> (2%) • Gram-positive cocci (10-12%)
Pyelonephritis	<ul style="list-style-type: none"> • E. coli (70-95%) • Other Enterobacteriaceae • S. saprophyticus

Pyelonephritis



