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Impact of Board Certified Psychiatric Pharmacists on improving urinary tract infection antibiotic appropriateness at an acute psychiatric hospital

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Abstract

Introduction: Urinary tract infections (UTIs) are one of the most common indications for antibiotic use; patients with psychiatric disorders have a greater risk for UTI compared with patients without these disorders. However, there is little guidance on how best to manage antibiotic therapy in psychiatric hospitals. This study assessed the impact of a Board Certified Psychiatric Pharmacist (BCPP)–driven guideline on managing UTI treatment in an acute psychiatric hospital.

Methods: The guideline was developed by the psychiatric pharmacy team and distributed to internists, psychiatrists, and pharmacists. Preintervention data were assessed for patients admitted between November 30, 2019, and February 23, 2020; postintervention data were assessed from February 25, 2020, to April 24, 2020. All patients ages 13 years and older who were admitted and had orders for an antibiotic to treat a UTI were included in this study. Appropriate UTI management was defined as an appropriate agent, dose, route, and frequency per the treatment guideline. Additionally, the following criteria were to be ordered and assessed to be deemed appropriate: urinalysis, urine culture, complete blood count, basic or complete metabolic panel, temperature, and subjective symptoms.

Results: Before intervention, 19.0% of antibiotic orders were appropriate; after intervention, 46.7% of antibiotic orders were appropriate ($P = .048$).

Conclusion: The implementation of a BCPP-driven treatment algorithm was associated with a significant increase in appropriate antibiotic regimens for the treatment of UTIs in patients admitted to a psychiatric hospital.

Keywords: Board Certified Psychiatric Pharmacist, urinary tract infections, antimicrobial stewardship, impact

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Introduction

Urinary tract infections (UTIs) are one of the most common indications for antibiotic use[1]; more than 50% of women[2] and 13% of men[3] will experience a UTI in their lifetime. Patients with schizophrenia and those experiencing acute psychosis are more likely to experience UTIs compared with those without these disorders because of a multitude of factors.[4,5] Moreover, patients with serious psychiatric disorders (eg, schizophrenia, schizoaffective disorder, and bipolar disorder) are more frequently hospitalized for UTIs compared with the general population.[6] Appropriate antibiotic use is important to reduce morbidity, adverse drug reactions, and

the spread of drug-resistant organisms, as well as to optimize the care of patients with psychiatric disorders.[7]

The pathophysiology behind the increased infection rate in psychiatric populations is unclear. Some proposed mechanisms include poor hygiene and decreased self-care[4,5] or urinary retention as a side effect of some antipsychotic medications.[8] There is also some evidence to suggest UTIs can precipitate delirium and associated psychosis.[4,5] Nonetheless, in an acute psychiatric hospital, it is inevitable that an interdisciplinary care team will need to manage UTIs in its patients. Furthermore, there are several challenges in managing patients with serious psychiatric disorders, including difficulty gathering a complete medical history, poor medication adherence, and losing patients to follow-up.[9] These factors should be considered carefully when selecting a treatment regimen in patients with psychiatric disorders.

An uncomplicated UTI refers to a lower UTI in nonpregnant women that can often be managed with a short course of antibiotics. Complicated UTIs typically extend beyond the bladder, include fever or other systemic symptoms, and often require longer, more invasive treatment. UTIs in men are generally considered to be complicated but may be managed in an outpatient setting if symptoms are not severe. The Infectious Diseases Society of America, European Society for Microbiology and Infectious Diseases, and American College of Obstetricians and Gynecologists list nitrofurantoin, fosfomycin, and sulfamethoxazole-trimethoprim as the preferred agents in treating uncomplicated UTI. These antibiotics have superior efficacy compared with cephalosporins and have better tolerability than fluoroquinolones.[1,2] When formulating a guideline algorithm, formulary and medication cost should be considered. Other factors to consider when selecting the appropriate agent include local resistance patterns, as well as patient-specific parameters, such as renal function and prior antibiotic exposure.[1,2]

There is little guidance on how to best manage antibiotic therapy in psychiatric hospitals; however, studies show including a pharmacist in antimicrobial stewardship improves antibiotic appropriateness and cure rates.[10,11] Board Certified Psychiatric Pharmacists (BCPPs) are pharmacists who hold an additional credential that demonstrates their expertise and ability to interact with and treat patients with psychiatric disorders, working to ensure the safe, appropriate, cost-effective, and evidence-based use of medications.[12] They focus on the whole patient, not simply their mental health.[13–15] As such, BCPPs are an effective resource to assist in providing comprehensive medication management and addressing specific treatment considerations for patients with psychiatric disorders.

This study took place at a county psychiatric hospital in southern California. This psychiatric hospital is part of a health system, with the main medical center located 22 miles away. The pharmacy team at this campus is composed of BCPPs, staff pharmacists, pharmacy residents, pharmacy students, and pharmacy technicians. The psychiatric campus does not have infectious disease specialists, internal medicine providers, or laboratory services readily available on site. As such, BCPPs monitor UTI treatment appropriateness for patients admitted at the psychiatric hospital. Noticing an opportunity to optimize UTI management in patients with psychiatric disorders, the BCPP team developed and implemented a treatment algorithm to guide UTI management. This study aims to assess the effect of a psychiatric pharmacist–developed algorithm and BCPP follow-up on antibiotic appropriateness for UTI treatment in an acute, psychiatric hospital.

Methods

A treatment guideline (Figure) was developed by a psychiatric pharmacy team to help guide treatment at an acute care psychiatric hospital. The guideline was peer reviewed by the institution's infectious disease physicians and infectious disease pharmacists. Major UTI guidelines,[1,2] local resistances for common urinary pathogens, and medical center formulary were considered in the development of the facility's guideline. Although considered a first-line option, fosfomycin is a nonformulary medication at this institution, and therefore it was omitted from this algorithm.

Following development by the psychiatry–infectious disease work group, BCPPs sought guideline approval by both the Department of Psychiatry and the institutional Pharmacy and Therapeutics Committee. BCPPs implemented the guideline via individually targeted in-service educational sessions to staff pharmacists, psychiatrists, and internists. Following BCPP-administered individual education, physical guidelines were laminated and displayed in each of the pertinent workstations, including the emergency treatment services, the inpatient treatment facility, resident and physician offices, and the pharmacy. BCPPs monitored every antibiotic order for UTI treatment, assessed for adherence to the treatment guideline, and sought out provider clarification for any inappropriate orders, including pursuing patient referral to internal medicine providers if needed.

The primary end point was appropriate initial antibiotic selection and was assessed via electronic medical record (EMR) chart review. Appropriateness was defined as an appropriate agent, dose, route, and frequency per the treatment guideline, or, alternatively, referral to the main medical campus for more complex UTI treatment. Additionally, the following labs and parameters must have been ordered and assessed in the patient's chart for care to be deemed appropriate: urinalysis, urine culture, complete blood count, basic metabolic panel or complete metabolic panel,

Type of Infection	Symptoms	Treatment
Uncomplicated Cystitis **Common organisms: *E. Coli*** **Other organisms: Proteus mirabilis, klebsiella pneumoniae, staphylococcus saprophyticus**	• Dysuria • Frequent/urgent urination • Nocturia • Suprapubic heaviness	**1st line** • **Nitrofurantoin*** (monohydrate) (Macrobid ™) 100 mg PO BID x 5 days **2nd line** • **Amoxicillin-clavulanate** (Augmentin™) - 500 mg – 1 tab PO BID x 5 to 7 days • Cefdinir (Omnicef™) 300 mg – 1 tab PO BID x 5 to 7 days • Cephalexin (Keflex™) 250 to 500 mg – 1 tab PO q6hr x 5 to 7 days **For medication allergies, please consult the clinical pharmacist**
Complicated Cystitis and pyelonephritis **Common organisms: *E. Coli*** **Other organisms: Proteus spp., klebsiella pneumoniae, pseudomonas aeruginosa**	• Above symptomology • Fever >99.9°F/37.7°C • Chills, rigors • Fatigue, malaise • Flank pain • Costovertebral angle tenderness • Pelvic or perineal pain in men	**1st line**** • **Ciprofloxacin** (Cipro™) 500 mg - 1 tab PO BID x 7 days • **Levofloxacin** (Levaquin™) 750 mg - 1 tab PO daily x 5 days **2nd line***** • **Amoxicillin-clavulanate** (Augmentin™) – 875mg – 1 tab PO BID x 10 to 14 days • Cefdinir (Omnicef™) 300 mg – 1 tab PO BID x 10 to 14 days • Cephalexin (Keflex™) 500 mg – 1 tab PO q6hr x 7 to 14 days **For medication allergies, please consult the clinical pharmacist**

* Avoid nitrofurantoin if early pyelonephritis is suspected. Avoid if CrCl < 30 ml/min OR in patients older than 65

** If local E. Coli resistance exceeds 10%, ceftriaxone 1g IM x1 should be given before the PO regimen; at time of writing this algorithm, E. Coli resistance at this institution is <10%

*** Administer ceftriaxone 1g IM x1 before one of the following regimens

Avoid Bactrim (sulfamethoxazole/trimethoprim) for *empiric coverage* if used for UTI in previous 3 months or if local resistance prevalence is known to exceed >20%; at time of writing this algorithm, E. Coli resistance is >20% at this instutuion. **Sulfamethoxazole/trimethoprim still a viable option if urine culture shows sensitivity**

All medications must be adjusted for renal function

FIGURE: Treatment algorithm for urinary tract infection for the psychiatric hospital

temperature, and subjective symptoms. If the patient was discharged prior to course completion, the EMR was checked to see if an appropriate regimen was prescribed for the remainder of the treatment duration.

Inclusion criteria were patients ages 13 years and older who received at least 1 antibiotic for the treatment of a UTI. Exclusion criteria were pregnant patients, UTIs associated with prostatitis, and patients younger than 13 years. Using the EMR, data were collected on all patients who had orders for antibiotic therapy. These charts were reviewed to identify an indication for each antibiotic. If the indication was UTI, charts were reviewed and data collected on antibiotics (including dose, frequency, and duration), urinalysis (urine color or clarity, leukocyte esterase, nitrite, urine white blood cells, and bacteria count), urine cultures and sensitivity, urinary symptoms, white blood cells, serum creatinine, creatinine clearance, and temperature.

A power analysis was performed using G*Power, and a sample size of 36 was needed to detect a statistically significant difference between cohorts. Therefore, data collection was halted after reaching 36 patients. A preguideline cohort included patients admitted to the psychiatric medical

TABLE 1: Summary of baseline characteristics

	Preintervention (n = 21)	Postintervention (n = 15)	*P* Value
Mean age (SD), y	42 (20.0)	39.8 (20.9)	.75
Female, n (%)	20 (95.0)	14 (93.0)	.42
Primary diagnosis, n (%)			
Affective disorders	7 (33.3)	10 (66.7)	.03
Psychotic disorders	14 (66.7)	5 (33.3)	
Ethnicity, n (%)			
White	16 (76.2)	7 (46.7)	—
Hispanic	4 (19.0)	6 (40.0)	—
African American	1 (4.8)	2 (13.3)	—
Prescribed psychotropic, n (%)			
Antipsychotics	17 (80.9)	12 (80.0)	—
Antidepressants			
SSRI	6 (28.6)	1 (6.7)	—
SNRI	7 (33.3)	3 (20.0)	—
Trazodone	2 (9.5)	5 (33.3)	—
Mirtazapine	0 (0)	1 (6.7)	—
Mood stabilizers			
Valproic acid derivatives	6 (28.6)	3 (20.0)	—
Lithium	2 (9.5)	0 (0)	—
Antihistamines	6 (28.6)	11 (73.3)	—

SNRI = serotonin-norepinephrine reuptake inhibitors; SSRI = selective serotonin reuptake inhibitor.

campus between November 30, 2019, and February 23, 2020, and a postguideline cohort included patients admitted to the psychiatric medical campus between February 24, 2020, and April 24, 2020. Fisher exact with mid–*P* value adjustment was used for categoric variables, and independent *t* tests were used for continuous variables. Statistical analysis was conducted using Microsoft Excel and OpenEpi software, and statistical significance was established at $P < .05$. Appropriate Institutional Review Board approval was obtained.

Results

There was a total of 36 patients included in this study: 21 patients in the preguideline cohort and 15 in the postguideline cohort. Cohorts were well-balanced in age (42 versus 39.8 years) and in sex (95% female vs 93% female). However, primary psychiatric diagnosis differed. For the preguideline group, approximately 33.3% of patients had affective disorders and 66.7% had psychotic disorders. For the postguideline group, 66.7% had affective disorders and 33.3% psychotic disorders (Table 1).

For the primary end point (Table 2), 4 of 21 antibiotic orders for UTIs were appropriate preguideline, with 7 of 15 appropriate postguideline (19% versus 46.7%, $P = .048$). Preguideline, 52.9% of orders were inappropriate because of an incorrect treatment duration or frequency; postguideline, 37.5% of orders were inappropriate for incorrect duration or frequency. Inappropriate agent or dose accounted for 23.5% and 25.0% of inappropriate preguideline and postguideline orders, respectively. Antibiotic selections preguideline and postguideline were similar: cephalexin (52% versus 53%), sulfamethoxazole-trimethoprim (14% versus 13%), and nitrofurantoin (29% versus 27%). Lack of renal function assessment was the reason for inappropriateness in 23.5% of preguideline and 50% of postguideline orders. Missing urinalysis or lack of urine culture assessment was the reason for inappropriateness in 47.1% of preguideline and 37.5% of postguideline orders. Subjective UTI symptoms were documented in 42.9% of patient charts preguideline and in 66.7% of patient charts post-uideline.

A subanalysis of antibiotic orders based on provider type was conducted. Preguideline, internists wrote 8 of the antibiotic orders, of which only 1 was appropriate (12.5%), and psychiatrists wrote 4 antibiotic orders, of which 3 were appropriate (75%). Nine additional antibiotic orders were continued from home, all of which were inappropriate. Postguideline, internists wrote 7 antibiotic orders, 6 of which were appropriate (85.7%), and psychiatrists wrote 5 antibiotic orders, 1 of which was appropriate (20%). Orders were continued from home 3 times postguideline, and they remained appropriate 0% of times in both the preguideline and postguideline cohorts. Each inappropriate order contained multiple deviations from the institutional guideline, with no difference between the preimplementation and postimplementation groups.

Discussion

The implementation of a treatment guideline was associated with a 27.8% absolute increase in appropriate antibiotic regimens for the treatment of UTIs in patients with serious psychiatric disorders admitted to a psychiatric hospital during an initial 2-month period. Although overall antibiotic appropriateness still remains suboptimal, improvements were seen in

TABLE 2: Primary outcome and collected descriptive statistics

	Preintervention (n = 21)	Postintervention (n = 15)	*P* Value
Appropriate antibiotic orders, n (%)	4 (19.0)	7 (46.7)	.048
Appropriate orders/total orders by provider type, n (%)			
Internist	1 of 8 (12.5)	6 of 7 (85.7)	—
Psychiatrist	3 of 4 (75.0)	1 of 5 (20.0)	—
Continued	0 of 9 (0.0)	0 of 3 (0.0)	—
Inappropriate orders[a] by categoric type, n			
Incorrect duration or frequency	9	3	—
No renal assessment	4	2	—
Inappropriate agent or dose	4	4	—
No urinalysis or urine culture	8	3	—

[a]Orders could be inappropriate for multiple reasons.

antibiotic duration and frequency. The results of this study suggest that in a setting without infectious disease specialists on site, BCPPs may fill the role of antibiotic stewards in UTI management. The initial improvement observed in this study supported the continued efforts of BCPPs and the pharmacy team to attempt to improve UTI antibiotic appropriateness at this site. These results reaffirm a similar study conducted in a psychiatric emergency department that showed a BCPP-developed algorithm helped significantly improve UTI antibiotic appropriateness.[16] Although antibiotic appropriateness was defined differently, both studies showed an increase in appropriate orders.

Although our guideline included first-, second-, and third-line options, there was no effect on antibiotic choice after the algorithm. Physicians were educated that nitrofurantoin had superior efficacy, better tolerability, and easier dosing compared with cephalexin. However, in seeking a rationale for guideline deviation for each inappropriate order, personal preference and anecdotal evidence were common reasons for favoring cephalexin despite a recommendation for nitrofurantoin.

Preguideline, orders were most commonly inappropriate because of an incorrect duration or frequency. Postguideline, lack of a renal function assessment was the most common reason for inappropriateness. Although duration and frequency inappropriateness were easier to address by pharmacist intervention with the providers, there were barriers preventing appropriate renal function assessment. Psychiatric patients often declined blood draws that were necessary to make an appropriate assessment. Patients declining blood draws is a pivotal shortcoming because there is no laboratory located on the study premises. The phlebotomist visits the campus a limited number of times, and if the patient refuses during that visit, the team must wait an additional day to reattempt the blood draw. Antibiotic regimens would be initiated, and as delays occurred in obtaining blood draws or urinalysis, patients would commonly complete their antibiotic course or be discharged before antibiotic course completion without ever accepting lab draws. Therefore, appropriate renal function monitoring, or even obtaining and processing urine cultures, became beyond of the scope of capabilities for pharmacists at this site.

There was an increase in appropriate internist orders and a decline in appropriate orders from psychiatrists. Although the psychiatrist is the primary caregiver, workflow at this institution funnels adjustments on nonpsychiatric medication orders to an internist, which is dependent on a psychiatry referral to internal medicine. Intervening pharmacy team members had much greater success in optimizing inappropriate orders when the psychiatry team accepted pharmacy recommendations to place an internal medicine consult. Thus, the increased monitoring from BCPPs led to more frequent interactions with the internist to make appropriate recommendations regarding antibiotics. Considering this fact, it is not surprising to see the increased trend in internist orders. However, despite pharmacists' efforts, internal medicine was not always available to adjust medication orders prior to a patient's discharge, particularly within the psychiatric emergency department setting. Additionally, suboptimal medication reconciliation and unit transfer processes led to oversights on antibiotic treatment regimens. Improving medication reconciliation and patient handoff processes present an additional opportunity for psychiatric pharmacist–driven quality improvement measures at this institution.

Another trend was seen in patients whose orders were continued from another facility or from a patient's home prescription. Both preguideline and postguideline, these orders were deemed inappropriate. There was a combination of reasons for this, including inappropriate duration, frequency, and drug, as well as lack of renal assessment. Theoretically, antibiotic resistance to pathogens at outside local institutions should be similar to patterns seen within the study institution. It is possible that a medication started at another institution was appropriate according to their resistance patterns but was deemed inappropriate by the acute care team. Additionally, there were no urinalyses or cultures. Labs and cultures may have been collected at previous institutions and relayed to ordering physicians at the study

institution, though charts did not indicate such. More thorough chart noting may clarify some of these issues.

There are limitations to this study that are inherent in the nature of the study design. The reliance on retrospective chart review for the preguideline cohort does not allow for complete case assessment that was possible in the prospective cohort. Important assessments may have not been included in chart notes but may have been considered by ordering clinicians. In the prospective cohort, this information could be collected during rounds and discussions with the ordering physician. Differences in psychiatric disorders may have impacted outcomes as well. Although poor adherence is present in both affective and nonaffective disorders, anecdotally clinician explicit and/or implicit bias toward patient may have influenced prescribing practices.[17] Additionally, a small sample size decreases reliability of this study, although we attempted to account for this using a mid-*P* adjustment in statistical analysis.

Despite these limitations, this study has several strengths. The use of a stringent definition of antibiotic appropriateness increased the probability of detecting actual changes in ordering practices, as opposed to changes that occurred by chance. Moreover, there is little evidence on this topic, so this study may serve as foundational data for other studies related to this subject. Overall, positive results of this study indicate pharmacy-led stewardship should be further investigated for other infectious diseases in an inpatient psychiatric hospital. Results are corroborated by other studies, although studies in a psychiatric setting in other infectious disease states is lacking. Larger and more robust studies in managing UTIs in a psychiatric inpatient population are warranted as well.

Although the appropriateness rate showed some improvement, the rate of antibiotic appropriateness for management of UTIs was still suboptimal, leaving much room for improvement. Change in culture takes time and persistence. A statistically significant difference within the first 2 months was encouraging. Results from this pilot study supported continued efforts from the BCPP-led pharmacy team in monitoring UTI management at this institution, and to date, the percentage of appropriate antibiotic prescribing has continued to exponentially improve, consistently surpassing 80% appropriateness. As a result, this BCPP-led initiative is now included in the institution's antimicrobial stewardship program. This study demonstrated the impact that BCPPs can have on the complete medication management of a patient, beyond their psychotropic medications.

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