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Impact of a urinary tract infection diagnostic and treatment algorithm for psychiatric inpatients with a communication barrier

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Abstract

Introduction: Differentiating between a urinary tract infection and asymptomatic bacteriuria is an important distinction to make, especially in noncommunicative patients. An algorithm meant to aid in the diagnosis and treatment of urinary tract infections in this population was implemented within a psychiatric emergency department in January 2019. The primary objective of this project was to assess the impact of the algorithm (the *intervention*) regarding symptom documentation and antibiotic use. Secondary objectives included assessing changes in inappropriate prescribing and urine culture orders.

Methods: Preintervention outcomes were measured from August 1, 2018, through November 30, 2018, while the postintervention cohort included patients admitted after January 31, 2019 and discharged before June 1, 2019. Adults admitted to psychiatry with a urinalysis ordered in the emergency department and an ICD-10 code representing dementia, delirium, autism spectrum disorder, or intellectual disability were included; pregnant patients were excluded.

Results: The preintervention (n = 56) and postintervention (n = 34) cohorts were well balanced with an average age of 66.5 and 70 years, respectively. Neurocognitive disorder was the diagnosis for inclusion in approximately two-thirds of both groups. Numerically, postalgorithm implementation, symptoms were documented more frequently (20.6% vs 10.7%, $P = .23$) and antibiotics used less often (2.9% vs 14.3%, $P = .15$). Inappropriate prescribing occurred in 12.5% of preintervention cohort compared to no patients postintervention ($P = .04$).

Discussion: The creation and implementation of an algorithm assisting in the diagnosis and treatment of urinary tract infections in noncommunicative patients was associated with a trend toward increased symptom documentation and decreased overall antibiotic use, and significantly increased appropriate antibiotic prescribing.

Keywords: algorithm, anti-bacterial agents, asymptomatic bacteriuria, ASB, antibiotic, autism spectrum disorder, ASD, cystitis, dementia, inappropriate prescribing, intellectual disability, ID, neurocognitive disorder, pyelonephritis, urinary tract infection, UTI

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Introduction

Differentiating between a urinary tract infection (UTI) and asymptomatic bacteriuria (ASB) is an important and often difficult distinction to make, particularly in patients who cannot communicate genitourinary symptoms. Elderly patients and patients with a primary psychiatric condition may be subject to over diagnosis of UTI when mental status changes occur.[1] Mental status changes alone are not sufficient to differentiate a UTI from ASB, however providers may be unable to determine genitourinary symptoms in patients who cannot communicate, such as those with dementia, autism spectrum disorder, or an intellectual disability. Despite the challenges of determining genitourinary symptoms in these patients, the Infection Diseases Society of America emphasizes the need to identify these symptoms to diagnose a UTI and initiate antibiotic therapy.[2]

Infection Diseases Society of America and the European Association of Urology agree that bacteriuria should not be screened for or treated in elderly patients, even in the presence of mental status changes, unless genitourinary symptoms are present.[2,3] Despite these recommendations, providers remain likely to screen for and treat bacteriuria in this patient population for mental status changes alone.[1,4] Reasons for overtreatment of ASB may include concern for worsening infection, misunderstanding of ASB, or inability to determine genitourinary symptoms.[4] D'Agata and colleagues[1] reported in a 2013 study that 74.5% of patients receiving antibiotics within 1 nursing home lacked symptoms to justify the therapy. In this study, change in mental status was the most frequently reported symptom.

Overtreatment of ASB is not without clinical consequences. Antibiotics should be avoided in ASB because of concern for adverse events related to antibiotic use such as *Clostridium difficile* infections and increasing antimicrobial resistance.[2] Increased resistance is a reality at our institution with rates of urinary *Escherichia coli* resistance to fluoroquinolones and sulfamethoxazole/trimethoprim exceeding 20%. The difficulty of accurately diagnosing a UTI in patients with a communication barrier coupled with the risks associated with overtreating ASB requires intervention.

The aim of this project was to study the effects of an algorithm meant to aid in the diagnosis and treatment of UTIs for psychiatric inpatients with a communication barrier.

Objectives

The primary objectives were to assess the effect of the algorithm on antibiotic use and symptom documentation for patients with a communication barrier and suspected UTI. Secondary objectives included evaluating the impact of the algorithm on urine culture orders and antibiotic prescribing patterns including appropriateness of therapy and agent selection.

Methods

An algorithm including diagnostic and treatment recommendations was created by 2 psychiatric pharmacists in collaboration with geriatric and emergency department (ED) psychiatrists, internal medicine physicians, urology providers, a microbiologist, and infectious disease physicians and pharmacists. (A copy of this algorithm is available in the companion article [figures 1 and 2].[5]) This algorithm was implemented within the psychiatric emergency department because of the work flow at our institution and the desire to pilot the algorithm in a small area to assess the impact prior to further expansion. Most patients admitted to a psychiatric service are first assessed in the medical ED where a basic workup is performed, often including a urinalysis (UA). If patients are deemed to require admission to a psychiatric service, they are then transferred to the psychiatric ED where further workup and treatment occur. This consists of interpreting and acting upon vital signs and laboratory analyses collected in the medical ED. At this point, a review of UA results occurs if applicable, and providers determine the necessity of antibiotic treatment.

Algorithm implementation included a brief educational slide-set presented to all providers that would be working in the psychiatric ED within the postintervention period. This group was composed of attending psychiatrists, resident physicians, nurse practitioners, and physician assistants and occurred approximately 6 times to ensure all providers received education. Education included an in-depth description of the content of the algorithm as well as general information related to treating UTIs. Specific details included the current institutional antibiogram, potential consequences of treating ASB, and empiric antibiotic recommendations including agents and doses based on renal function. The algorithm was also made available through an online file-sharing system and posted in the provider work room. Algorithm implementation was completed on January 31, 2019.

The primary endpoints included the change in percentage of patients receiving antibiotics as well as the frequency of UTI symptom documentation in the electronic health record before and after algorithm implementation. Secondary endpoints included the number of urine cultures ordered and rates of inappropriate antibiotic use between the 2 cohorts. Inappropriate antibiotic use was defined as prescribing an antibiotic to patients with no documented symptoms, selection of an empiric agent with $>$20% resistance to urinary *E coli* based on our institutional antibiogram, or incorrect dose based on renal function. Data collection pertaining to study outcomes were pulled only from the portion of a patient's admission when they were located in the psychiatric ED. The endpoints were assessed by comparing two 4-month time periods, henceforth referred to as preintervention and postintervention. We chose the time periods as the primary investigator was a second-year psychiatric

TABLE 1: Baseline characteristics of the study

	Preintervention (N = 56) No. (%)	Postintervention (N = 34) No. (%)	*P* Value
Age, median (interquartile range), y	67 (37 to 76)	70 (47 to 78)	.50
Female sex	33 (58.9)	19 (55.9)	.78
White	36 (64.3)	18 (52.9)	.29
Diagnosis for inclusion, neurocognitive disorder	37 (66.1)	23 (67.6)	.88

pharmacy resident and the project needed to be completed within the residency year.

Inclusion criteria for both cohorts included adults admitted to a psychiatry service with a UA ordered in the medical or psychiatric ED and an ICD-10 code (International Classification of Diseases, 10th revision) suggesting a communication barrier including neurocognitive disorder, delirium, intellectual disability, and autism spectrum disorder. Patients were excluded if they were pregnant or undergoing a urologic procedure during the admission as ASB should be treated in those populations.[2] The preintervention time period included patients discharged between August 1, 2018, through November 30, 2018. Postintervention data was collected on patients admitted after January 31, 2019 and discharged prior to June 1, 2019.

Fisher exact and χ^2 tests were used to analyze dichotomous variables while Mann-Whitney *U* tests were used for continuous variables. Statistical analyses were conducted using SPSS v22 (IBM Corp, Armonk, NY). Differences were considered significant for a *P* value $<.05$. This study was determined to be exempt from institutional review board submission based on institutional policies.

Results

A total of 90 patients were included in the analysis. Fifty-six patients met inclusion criteria in the preintervention cohort with an average age of 67. The remaining 34 patients were in the postintervention cohort with an average age of 70 years. Within both cohorts, 56% of patients were female and approximately two-thirds of each group had a primary diagnosis of a neurocognitive disorder (Table 1).

Regarding the primary outcomes, antibiotic use decreased nonsignificantly from 14.3% preintervention to 2.9% postintervention ($P = .15$; Table 2). Symptom documentation increased two-fold although this finding was not statistically significant (10.7% vs 20.6%, $P = .23$). Both secondary outcomes achieved statistical significance. Urine culture orders decreased after the intervention from 44.6% to 20.6% ($P = .02$), and inappropriate prescribing decreased from 7 patients (12.5%) in the preintervention cohort compared to 0 patients in the postintervention group ($P = .04$).

It was found that most patients received sulfamethoxazole/trimethoprim (50%) preintervention followed by cephalexin (25%), while nitrofurantoin was the agent used for the 1 patient who received antibiotics postintervention. Nearly 63% of patients prescribed an antibiotic in the preintervention group had no documented symptoms of a UTI (Table 2). Additionally, 25% of the antibiotics ordered initially were incorrectly dosed based on the patient's renal function. In the postintervention cohort, only 1 patient received antibiotics and this order was considered

TABLE 2: Primary and secondary outcomes

	Preintervention (N = 56) N (%)	Postintervention (N = 34) N (%)	*P* Value
Documented symptoms	6 (10.7)	7 (20.6)	.23
• Genitourinary	5	7	...
• Systemic and genitourinary	1	0	...
Urine cultures	25 (44.6)	7 (20.6)	.02
Any antibiotic used	8 (14.3)	1 (2.9)	.15
Inappropriate antibiotic use	7 (12.5)	0 (0)	.04
Reason for inappropriate antibiotic use, n (% of antibiotics ordered)			
• Total	7 (87.5)	0 (0)	...
• No symptoms documentation	5 (62.5)	...	...
• Insufficient renal function	2 (25)	...	...

appropriate as the patient had clearly documented genitourinary symptoms and adequate renal function for the agent and dose selected. It is important to note that no patients developed severe systemic infections during the study period despite a decrease in antibiotic use.

Discussion

The algorithm was created to assist providers in the evaluation of patients admitted to psychiatry with a communication barrier and a change in mental status that may or may not be related to a UTI. Because of the difficulty of this clinical scenario coupled with the risks of overtreating ASB, it was critical that the intervention be well received by providers to make an impact on factors related to UTI diagnosis and treatment. Comparing 2 brief periods of equal time before and after the intervention occurred allowed us to begin assessing the effects of the algorithm within the psychiatric ED.

The baseline characteristics within both cohorts were well balanced with the exception of sample size. Although both periods spanned 4 months, the postintervention cohort was smaller than the preintervention cohort. The difference in sample size is explained by a lower census within the psychiatric ED during 2 months of the postintervention time period. Additionally, it could be speculated that fewer UAs were ordered postintervention because of the algorithm implementation. Approximately two-thirds of each cohort was diagnosed with a neurocognitive disorder while the remaining patients had a diagnosis of intellectual disability or autism spectrum disorder.

The elderly patient population, especially those with a neurocognitive disorder, is most commonly discussed in the literature when addressing concerns over UTI diagnosis and changes in mental status. In fact, most evidence and guidance on the topic is based on studies done in long-term care facilities and nursing homes, suggesting that prescribers may feel compelled to prescribe antibiotics if mental status changes occur even in the absence of genitourinary symptoms.[1,4,6-9] The algorithm attempts to bridge this gap by suggesting symptoms that can be assessed without relying on patient report.

Neither primary outcome met statistical significance; however, this may be related to the short duration and small sample size. An 11.3% decrease in antibiotic use in 4 months where only 1 patient received antibiotics postintervention could be considered clinically significant. Additionally, a doubling of symptom documentation suggests a trend of increased provider comfort with symptom assessment in this patient population. Furthermore, when manually reviewing progress notes to assess symptom documentation it was noted by the authors that the algorithm was cited in many notes as justification for ruling out UTI as a cause of mental status changes.

The secondary outcomes were both found to be statistically and clinically significant. A decrease in the number of urine cultures ordered is potentially based in the fact that our institution does not automatically reflex UAs to a urine culture, meaning providers typically order and interpret a UA to determine the need for a urine culture rather than the microbiology lab setting automatic parameters. By including guidance on UA interpretation early in the algorithm, providers were likely better able to recognize UA results that did not represent a UTI. Additionally, having a better understanding of symptoms may have enabled providers to feel more comfortable excluding UTI from the differential and foregoing a culture. Decreasing the number of cultures ordered represents a potential cost savings to the patient and the institution. A significant decrease in inappropriate antibiotic use may also be attributed to the algorithm. By including detailed guidance on empiric antibiotic use specific to our institution, providers more consistently selected an appropriate agent and dose. Also, multiple providers expressed appreciation for inclusion of antibiotic guidance in the algorithm and the education provided.

Strengths of this project include analyzing a unique approach to a common, difficult clinical situation as well as the provision of standardized education to all providers practicing in the postintervention period. Ensuring each provider received the same training makes this reproducible in other settings. Furthermore, assessing multiple patient populations that may have a communication barrier outside of a neurocognitive disorder, suggests the algorithm could be further expanded to patients with communication barriers for a variety of reasons.

The short duration and small sample size limited our ability to show statistical significance. Additional limitations include the institutional specificity of this algorithm limiting generalizability to outside facilities without revision. Although diagnoses for inclusion were carefully chosen to include a variety of patients with a potential communication barrier, the possibility exists we may have failed to include patients with alternative diagnoses that impacted their ability to communicate or included patients with the selected diagnoses that had no communication barrier. Another potential limitation of this study was that since education was required to implement the intervention, it poses a risk that practice may drift back toward preintervention practice and the effect may diminish without continued education.

Conclusion

The creation of an algorithm assisting in the diagnosis and treatment of UTIs in patients with a communication barrier had many important impacts within our institution. The intervention was associated with a trend toward decreased antibiotic use and a significant reduction of inappropriate antibiotic use, as well as better recognition of UTI as evidenced by decreased urine culture orders and a nonsignificant increase in symptom documentation.

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