Original Work

Implementation of an Educational Intervention in a Rural, Critical Access Health System to Improve Urinalysis Collection and Urinary Tract Infection Treatment in the Emergency Department And Ambulatory Care Settings

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Abstract

Objective: The objective of this project was to improve urinary tract infection treatment through optimization of urinalysis collection and antibiotic prescribing practices in the emergency department and ambulatory care clinics in a rural, critical-access health system through a pharmacist-led educational intervention.

Methods: An educational presentation and post-education reference materials were created to guide appropriate urinalysis collection and antimicrobial regimen selection by providers for emergency department and ambulatory care patients. Pre- and post-education retrospective chart reviews were performed on all adult patients in these settings who had provided a sample for a urinalysis during their visit between September 2022 and April 2023. The intention was to evaluate the effectiveness of staff education and reference materials on improving the following urinary tract infection (UTI)-focused antimicrobial stewardship outcomes: appropriateness of urinalysis collection, treatment regimen including evaluation of fluoroquinolone usage, and duration of therapy.

Results: A total of 1,644 retrospective chart reviews were assessed (868 pre-education and 776 post-education). Overall, there was a decrease in inappropriate urinalysis collection and suboptimal or inappropriate antimicrobial regimens (18.89% vs. 10.95%) following an educational intervention. There was a decrease in inappropriate urinalysis collection (7.72% vs. 4.12%); suboptimal use of first-line agents (2.65% vs. 1.80%), which included unnecessary use of fluoroquinolones (2.07% vs. 1.55%); and suboptimal dosing or duration of therapy (7.60% vs. 4.90%).

Conclusions: The implementation of an antimicrobial stewardship educational intervention is an effective strategy to decrease rates of unnecessary urinalysis collection and inappropriate or suboptimal treatment of urinary tract infections.

Improving antimicrobial stewardship efforts continues to be a significant priority in healthcare in the United States with a recent focus shifting towards outpatient prescribing practices.[1,2] In 2021, there were 636 antibiotic prescriptions per 1,000 people in the United States.[3] It is estimated that 28% of these prescriptions were ordered for patients with symptoms and illnesses that did not require antibiotics.[2] Inappropriate or excessive antibiotic use can increase the risk for undesirable consequences, such as subjecting patients to adverse effects secondary to antibiotic agents, increased risk for antibiotic resistance, and increased risk of developing secondary infections, such as *C. difficile*.[4,5] Common reasons that antibiotic prescriptions are considered suboptimal include the use of substandard agents, insufficient or excessive dosages, or inappropriate durations.[6] With high volumes of antibiotic prescriptions occurring in outpatient settings, it is appropriate to continue to focus efforts on the evaluation and improvement of prescribing practices.

Rural Health Systems

The location of a health care system may also directly affect the prescribing habits and antimicrobial stewardship efforts of health care professionals at a facility. Health care systems located in rural areas are predisposed to facing resource disparities when compared to their urban counterparts, which may affect their ability to improve antimicrobial stewardship efforts.[5] Additionally, rurality was associated

with higher likelihood of poor antimicrobial stewardship and inappropriate antimicrobial prescribing practices.[7,8] For example, it was found that patients located in rural areas with a diagnosis of uncomplicated urinary tract infections (UTIs) were more likely to be prescribed suboptimal regimens when compared to urban patients with the same diagnosis.[6]

Pharmacist Involvement

Pharmacists play a vital role in rural healthcare as valued members of the care team. Pharmacists have extensive knowledge of medications and treatment algorithms to assist with disease management and increase the quality of health care. Pharmacists have an important role in antimicrobial stewardship efforts and can promote the use of appropriate and optimized antimicrobial regimens, participate in efforts to reduce rates of infection transmission, and be involved in educational efforts.[9,10]

Urinary Tract Infections

Urinary tract infections (UTIs) are one of the most common outpatient infections.[11] Factors that can increase a patient's risk for developing UTIs include a history of previous UTI, young age or old age, pregnancy, recent sexual activity, structural abnormalities affecting the urinary tract, or poor hygiene.[12] However, many patients experience asymptomatic bacteriuria (ASB) and can be colonized chronically with bacteria in their urinary tract without an infectious process occurring.[13-16] This colonization increases a patient's risk for receiving inappropriate antibiotic treatment, because it results in a positive urinalysis and urine culture even if signs and symptoms of infection are absent. Risk factors for ASB include older age, female sex, the presence of chronic urinary catheters, a diagnosis of diabetes, or a history of spinal cord injury.[13-16] Given the risks of inappropriate treatment, it is imperative to focus on improving diagnosing and prescribing efforts for UTI.

This quality improvement project aimed to improve urinalysis collection and antibiotic prescribing to align with evidence-based practices in the emergency department and ambulatory care clinics in a rural, critical-access health system through a pharmacist-led educational intervention. Three pivotal steps were involved in the project design, including creation, education, and assessment.

Methods

Phase I: Creation

First, 150 preliminary chart reviews via electronic health record were completed to help understand the current practices regarding the assessment and treatment of UTIs. This process helped identify institution-specific areas of potential improvement and guide the learning objectives for this project. From there, three resources were created to assist with the optimization of prescribing practices. This included an educational presentation and two reference guides, composed of a urinalysis collection guide and an antimicrobial agent selection and dosing guide.

The web-based educational presentation covered topics such as risk factors for ASB, signs and symptoms consistent with UTI, how to address and identify intolerances versus allergies to antimicrobial agents, appropriate regimens including dosing and durations, and consequences of inappropriate or non-optimized treatment of UTIs.[1-4,11-19] Additionally, at the end of each major topic, there was an example patient case identified during the preliminary chart reviews with either inappropriate urinalysis collection or

TABLE 1. Criteria for Appropriateness for Urinary Tract Infection (UTI) Assessment and Treatment

Objective	*Qualifying Criteria*	*Disqualifying Criteria*	*Exceptions*
Presence of symptoms consistent with UTI[12-15]	• Presence of dysuria, hematuria, urinary frequency, urinary urgency, flank pain, pelvic discomfort, altered mental status in absence of other causes • Part of assessment for ASB in pregnancy	• Changes in urine quality alone • Assessing for ASB or UTI in patients with a urinary catheter without reasonable suspicion for infection	Alternative indications for urinalysis such as ketonuria, bilirubinuria, poisonings, or by request of an outside source such as employment physicals
Use of first-line agents[13, 17]	Empiric therapy utilized first-line agents noted in the dosing guide	• Avoidance of first-line agents based on mild intolerances • Utilization of fluoroquinolones in absence of known or suspected *Pseudomonas* infections	• Known anaphylactic or IgE-mediated allergies • History of resistance or growing bacteria not susceptible to first-line agents • Drug interactions or renal function limitations
Use of recommended duration[13,17]	• Following agent-specific recommendations based on: » Patient sex » Complicated vs. uncomplicated infection	Utilization of a duration outside of recommendations	Documented rationale for an extended duration
Susceptibility based on urine culture results	Bacterial isolate(s) were susceptible to antimicrobial agent(s) prescribed (whether empirically or after regimen change following culture results)	Regimen not adjusted or incorrectly adjusted based on susceptibility results	N/A

ASB = Asymptomatic bacteriuria; UTI = Urinary tract infection

suboptimal antimicrobial therapy. This allowed for institution-specific feedback in reviewing how each case could have been better optimized.

The reference materials were created to be simple, single-paged guides to be utilized as quick resources after the web-based educational presentation aligning with evidence-based practices. The urinalysis guide outlined signs and symptoms consistent with UTI, when to consider ASB versus UTI, and a urine culture interpretation guide.[12-15] The dosing guide segmented medication choices into tiers, and prioritized them by listing first-line therapies at the top followed by alternative agents, with the goal of assisting providers with regimen selection. First-line therapies were identified using guideline-based recommendations, as well as through data extracted from the institution-specific antibiogram. It also included indication and sex-specific durations for therapy and dose adjustments based on renal function.[13,17] The dosing guide discouraged fluoroquinolone use except in cases of true allergies to other antimicrobial agents or in the setting of known or suspected *Pseudomonas* infections.

Phase II: Education

A web-based educational presentation was provided to all prescribers and nursing staff located in the emergency department and ambulatory care clinics. The educational presentation slide set was provided in a virtual format to facilitate learning for all included staff members while working around scheduling conflicts. Staff had one month to complete the learning module. Additionally, providers in the ambulatory care clinics and nurses in both the emergency department and ambulatory care clinics were required to complete and score 100 percent on a five-question quiz that aligned with the learning objectives of the presentation in order to demonstrate adequate understanding of the material. The emergency department providers were exempt from completing the quiz due to logistics related to their employment and access to the institution's virtual educational platform. Instead, they were provided the learning materials via email and expected to review them.

TABLE 2. Comparison of Pre-Education and Post-Education Data

	Pre-Education			Post-Education		
	Month 1	Month 2	Month 3	Month 1	Month 2	Month 3
Total urinalyses collected	316	281	271	244	263	269
Total inappropriate urinalyses	17	30	20	9	10	13
Total inappropriate use of non-first-line agents (including unnecessary fluoroquinolone use)	11	8	4	7	3	4
	7	8	3	7	2	3
Total suboptimal doses or durations	24	26	16	11	18	9
Total regimens not appropriately adjusted based on susceptibility results	3	3	2	0	1	0
Monthly percentage of non-optimized encounters (%)	17.41	23.84	15.50	11.06	12.17	9.67

TABLE 3. Comparison of Emergency Department and Ambulatory Care Data

	Emergency Department		Ambulatory Care Clinics	
	Pre-Education	Post-Education	Pre-Education	Post-Education
Total urinalyses collected	506	457	362	319
Patients with suboptimal encounter	86	48	78	37
Total inappropriate urinalyses	58	30	9	2
Total inappropriate use of non-first-line agents (including unnecessary fluoroquinolone use)	4	4	19	10
	3	3	15	9
Total suboptimal doses or durations	19	13	47	25
Total regimens not appropriately adjusted based on susceptibility results	5	1	3	0

Phase III: Assessment

Retrospective chart reviews were completed via electronic health record by a single reviewer to assess encounters for all adult patients who were seen in the emergency department and ambulatory care clinics who provided a urine sample for a urinalysis in the 3 months before and after the completion of the educational intervention. Each encounter was evaluated for the presence of UTI symptoms, utilization of first-line agents, utilization of indication- and sex-specific durations, and as-needed adjustments to the regimen based on susceptibility results. Further information regarding the criteria is outlined in Table 1. Additional deviations not specifically noted in Table 1 were considered individually based on patient-specific factors, such as contraindications or provider discretion. If these criteria were not met, then encounters were classified as non-optimized or inappropriate.

Results

Descriptive statistics were used for reporting results. A total of 1,644 retrospective chart reviews were performed

in the emergency department and ambulatory care clinics for adult patients who had provided a sample for urinalysis between September 2022 and April 2023. A total of 868 samples were collected prior to education and 776 were collected following education. Of these, 18.89% of pre-education urinalysis encounters were deemed inappropriate or non-optimized in comparison to 10.95% of all post-education encounters. There was an improvement in all assessed categories between pre-education and post-education when averaged over each three-month period (Table 2). This included indication for urinalysis (7.72% vs. 4.12%); suboptimal use of first-line agents (2.65% vs. 1.80%), which included unnecessary use of fluoroquinolones (2.07% vs. 1.55%); deviation from recommended durations (7.60% vs. 4.90%), and regimens not appropriately covering the infectious organism(s) (0.92% vs. 0.13%).

The emergency department collected more samples for urinalyses in comparison to the ambulatory care clinics in both the pre-education (506 vs. 362) and post-education (457 vs. 319) groups (Table 3). The emergency department most often inappropriately collected urinalyses in the absence of appropriate symptoms or other reasonable suspicion. This was consistent between pre- and post-education data, with the incidence decreasing following education. The ambulatory care clinics frequently prescribed longer-than-recommended antimicrobial therapy durations to patients without reasonable cause. This also was consistent between pre- and post- education data, and its incidence also decreased following education. Overall, results demonstrated a trend towards improvement following the educational intervention.

Discussion (Including Limitations)

Though the objectives were the same for both the emergency department and ambulatory care clinics, each practice area demonstrated sub-optimization in different areas. The emergency department predominantly collected more inappropriate urinalyses compared to the ambulatory care clinics. This was likely because patients commonly present with non-specific symptoms leading to increased frequency of ordering urinalyses. Patients presenting to the ambulatory care clinics with concerns of UTI had symptoms that were more straightforward, such as dysuria, urinary frequency, or urinary urgency. The ambulatory care clinics were more likely to prescribe non-optimized durations than the emergency department; specifically, they were noted to prescribe extended durations to mostly female patients. Usually in these cases, the female patients were prescribed male-recommended durations despite not having indications or documentation to support the extended durations. This could be due to several reasons, such as personal provider preferences or due to pre-selected prescription favorite lists in the electronic health record.

To support continuous improvement, this project could be developed into an annual or semi-annual institution continuing education module to be updated as needed. There could also be additional tools created and implemented within the organization to support appropriate UTI treatment, such as the creation of order sets or including electronic health record alerts when medications such as fluoroquinolones are used. Additionally, pharmacists within the institution could become involved with the interpretation of culture results and regimen adjustment based on organism susceptibilities to ensure all patients are appropriately treated.

There were a few limitations to this project. First, the emergency department providers were unable to take the required learning assessment quiz due to technical limitations associated with their employment contract. It was expected that they would review the educational presentation, but the project facilitators were unable to formally confirm that they thoroughly reviewed the material.

Education was distributed to providers and nurses in a virtual format to accommodate scheduling and support participation. Though both live and virtual modalities are deemed acceptable for education for improving antimicrobial stewardship,[18,19] it may have been beneficial to complete education in person to allow for more conversation regarding the information, including facilitating discussion about the material. No formal feedback was requested from participants, but this could be done in the future to improve the presentation and experience.

Overall, results were limited due to the nature of retrospective chart review. The documentation provided for the encounter may have had incomplete or inaccurate information, resulting in an encounter being counted as inappropriate or suboptimal when it may not have been. There was also only a single chart reviewer. Though there were defined criteria for assessment, chart review was still relatively subjective and this could have introduced a risk for bias.

Conclusions

Pharmacist-led educational interventions can promote the improvement of UTI antimicrobial stewardship practices in rural health systems.

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