**The impact of a pharmacist on inpatient urinary tract infections**

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Abstract:

**Background**

About 150 million urinary tract infections (UTIs) occur globally every year.1 High prevalence of infection correlates with high antibiotic prescribing and the potential for antibiotic overuse. Inappropriate antibiotic use may approach up to 50%.2 The rapid, worldwide occurrence of antimicrobial resistance is endangering the efficacy of antibiotics and antibiotic overuse is a major cause.3 Pharmacists have the potential to play a role in reducing antimicrobial resistance by monitoring for appropriate antibiotic usage.4 There are different types of UTIs: pyelonephritis (involving the upper urinary tract) and cystitis (only involving the lower urinary tract).5 These types can be further broken down into uncomplicated (occurring in females, cystitis and lower urinary tract symptoms only) and complicated (occurring in males, pyelonephritis, and/or cystitis with one or more complicating factors).6,7 The recommended treatment for an uncomplicated UTI is 3 to 7 days of antibiotics.6,8 The recommended treatment for a complicated UTI is typically 5 to 14 days of antibiotics.9

**Methods**

This is a retrospective, quality improvement project at St. Rose Dominican Hospital-Siena campus. A pharmacy-driven antibiotic automatic stop protocol (See Appendix A) was accepted by The Pharmacy & Therapeutics Committee on September 28th, 2021 to evaluate the use of antibiotics for acute, uncomplicated cystitis. Due to low recruitment, the project was modified to include patients that were 18 years of age or older, had bacterial growth on their urine culture, were admitted to St. Rose Dominican-Siena Campus and had no other documented infection This became a retrospective, quality improvement project to assess antibiotic use for all urinary tract infections. The intervention group consisted of patients that had their antibiotics discontinued by a pharmacist and the control group consisted of patients that did not have their antibiotics discontinued by a pharmacist. The primary outcome was average antibiotic days of therapy. Secondary outcomes were length of stay and cost of therapy.

**Results**

The project was modified due to low recruitment into the hospital protocol. The project included 16 patients in the final analysis, 8 in each arm. In the intervention group, we found longer days of antibiotic therapy (4.63 versus 7.88, p = 0.03), longer lengths of stay (6.25 versus 33.25, p = 0.13), and higher therapy costs ($374 versus $552, p = 0.59).

**Conclusion**

Duration of antibiotic therapy in the pharmacist intervention group was longer and the difference was statistically significant. There were also longer lengths of stay and higher therapy costs in the intervention group, but these differences were not statistically significant. The findings of this project were limited due to the small sample size, changes in project methods, and the inability to control for confounding variables.

Keywords: urinary tract infection, antibiotic stewardship, pharmacist

1. Background

Urinary tract infections (UTIs) are one of the most frequent bacterial infections.1 About 150 million UTIs occur yearly in the world.1 High prevalence of infection correlates with high antibiotic prescribing and the potential for antibiotic overuse. Inappropriate antibiotic use may approach up to 50%.2 Antimicrobial resistance is on the rise.3 This is a rapid, worldwide occurrence that is endangering the efficacy of antibiotics.3 Antibiotic overuse is a major risk factor for antimicrobial resistance.3 Pharmacists have the potential to play a role in reducing antimicrobial resistance by monitoring for appropriate antibiotic usage.4 There are different types of UTIs: pyelonephritis (involving the upper urinary tract) and cystitis (only involving the lower urinary tract).5 These types can be further broken down into uncomplicated (occurring in females, cystitis and lower urinary tract symptoms only) and complicated (occurring in males, pyelonephritis, and/or cystitis with one or more complicating factors).6,7 The recommended treatment for an uncomplicated UTI is 3 to 7 days of antibiotics.6,8 Therapy options could include trimethoprim-sulfamethoxazole for 3 days, nitrofurantoin for 5 days, beta-lactams for 3 to 7 days, or 1 dose of fosfomycin.6,8 For the treatment of a complicated UTI, typically 5 to 14 days of antibiotics is recommended.9 Therapy options could include fluoroquinolones for 5 to 7 days, trimethoprim-sulfamethoxazole for 7 to 10 days or beta-lactams for 10 to 14 days.9

Deciding when to treat a urinary tract infection depends on a urinalysis (UA), a urine culture and patient presentation.10,11 Patients may have what is considered a positive UA and/or a positive urine culture, but, in most cases, antibiotics should not be prescribed for these patients unless they have other signs and/or symptoms of infection.10,11 A positive UA and/or urine culture without other signs and/or symptoms of infection is known as asymptomatic bacteriuria.12 A UA is usually considered positive when there are greater than 10 white blood cells per high-power field, presence of leukocyte esterase, presence of nitrites and presence of bacteria.10 A urine culture that is considered positive usually shows >100,000 colony forming units (CFU)/mL of a midstream species or >100 CFU/mL of a catheterized species.11

This project compares the outcomes of hospitalized patients with urinary tract infections, with and without pharmacist intervention on their antibiotics.

**2. Methods**

This was a retrospective chart review of records from November 1st, 2020 to March 30th, 2022. If a patient met the criteria listed in the Data Collection section, it was determined who discontinued the antibiotics (i.e. a pharmacist or any other provider). This was done by looking through the patient’s electronic medical record.

***2.1 Data Collection***

*Original Methods:*

* Inclusion criteria: women hospitalized at St. Rose Dominican Hospital-Siena Campus
* Exclusion criteria: acute kidney injury, fever, health-care associated infection, history of renal transplantation, history of recurrent UTI, admission to the intensive care unit, immunosuppression, calculi, indwelling catheters, infectious disease consultation, male gender, multi-drug resistant organism, positive culture at any other site, pregnancy, pyelonephritis, urinary tract obstruction, urinary retention secondary to neurologic disease, worsening clinical status and/or any additional documented infection
* Age Range: ≥ 18 years of age with no maximum age

See Appendix A for further information.

*Modified Methods:*

* Inclusion Criteria: ≥ 18 years of age with no maximum age, bacterial growth on the urine culture and admitted to St. Rose Dominican-Siena Campus
* Exclusion criteria: other documented infection

The primary outcome was average antibiotic days of therapy (DOT). Secondary outcomes were length of stay (LOS) and cost of therapy.

***2.2 Data Analysis***

Continuous outcomes were analyzed using t-tests. Categorical outcomes were analyzed using chi-squared (χ²) tests. A p-value less than 0.05 denoted statistical significance.

**3. Results**

In total, 16 patients met the inclusion criteria and were included in the following analysis. Baseline characteristics were similar and are listed in Table 1. In the intervention group, we found longer days of antibiotic therapy (4.63 versus 7.88, p = 0.03), longer lengths of stay (6.25 versus 33.25, p = 0.13), and higher therapy costs ($374 versus $552, p = 0.59). All outcomes can be found in Table 2 and an illustration of the primary outcome can be found in Figure 1.

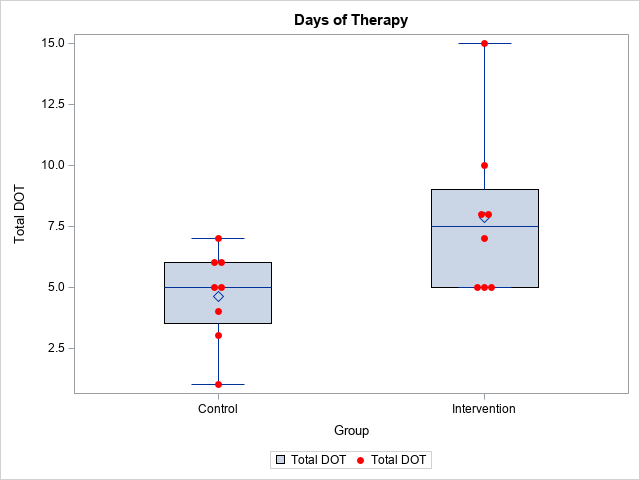
Table 1: Baseline Characteristics

|  |  |  |  |
| --- | --- | --- | --- |
|  | Control group (N=8) | Intervention group (N=8) | p-value |
| Age - mean years (SD) | 78.88 (13.16) | 73.50 (20.39) | 0.54 |
| Female - n (%) | 5 (62.5) | 5 (62.5) | 1 |
| UTI Symptoms - n (%) | 7 (87.5) | 6 (75) | 0.52 |
| Readmission within 30 days- n | 0 | 0 | 1 |

Table 2: Outcomes

|  |  |  |  |
| --- | --- | --- | --- |
| Outcome | Control group (N=8) | Intervention group (N=8) | p-value |
| DOT – mean days (SD) | 4.63 (1.92) | 7.88 (3.40) | 0.03 |
| LOS - mean days (SD) | 6.25 (4.59) | 33.25 (47.83) | 0.13 |
| Total Cost - mean price (SD) | $374 (678) | $552 (621) | 0.59 |

Figure 1: Primary Outcome



**4. Discussion**

In the intervention group, patients experienced longer days of antibiotic therapy and this difference was statistically significant. The intervention group also had longer lengths of stay and higher therapy costs. These differences were not statistically significant.

***4.1 Limitations***

The limitations of this project include the small sample size, the project being a retrospective chart review and confounding variables that were not controlled for. Examples of some impactful confounding variable include baseline patient severity and reason for admission. Lastly, outliers in the intervention group increased the average DOT, LOS and cost of therapy. The longest DOT and LOS for the intervention group were longer than those of the control group (15 and 147 versus 7 and 17, respectively). It is also important to note that pharmacists intervened *after* the appropriate duration of antibiotic therapy was surpassed, therefore contributing to the longer DOT in the intervention group. The appropriate duration of antibiotic therapy was usually considered 5 days. Pharmacist interventions were delayed if the patient was still symptomatic.

**5. Conclusion**

The benefit of pharmacist intervention was unclear from this project alone. The longer duration of therapy, length of stay and cost of therapy were to be expected due to the pharmacist intervening after the appropriate duration if therapy has been surpassed. As UTIs are often treated outpatient, there is limited opportunity for intervention and future research should include pharmacist influence of discharge antibiotics for UTIs and/or infections that must be treated inpatient.

Conflicts of Interest

The author declares no competing interests.

Acknowledgements

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**Appendix A**

 **POLICY/PROCEDURE**

CATEGORY: Clinical/Pharmacy Page 1 of 3

SUBJECT: **Evaluation of Antibiotic Therapy for Acute Uncomplicated Cystitis in Adults**

ORIGINATED: N/A EFFECTIVE: 09/21 SUPERSEDES: N/A

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* 1. **PURPOSE**
  2. Scope – To define the process for the evaluation and discontinuation of antibiotic therapy for adult hospitalized non-ICU status patients at Dignity Health St. Rose Dominican (SRD) – Siena Campus with acute, uncomplicated cystitis.
  3. Objective – To provide guidelines for discontinuation of antibiotic therapy for acute, uncomplicated cystitis in hospitalized patients.

1. **RESPONSIBILITIES**
   1. Licensed Independent Practitioner (LIP) – who are credentialed and privileged to do so, are responsible for initiating antibiotics on patients as needed according to diagnosis and risk factors.
   2. Pharmacist – are responsible for reviewing antibiotic orders for acute, uncomplicated cystitis for appropriate duration of therapy based on the patient’s diagnosis and risk factors.
   3. Registered Nurses (RN) – are responsible for the administration of antibiotics and monitoring of patients on these medications.

1. **DEFINITIONS** 
   1. Acute, uncomplicated cystitis – a medical condition diagnosed by lower urinary tract symptoms, a positive urinalysis and lack of upper urinary tract symptoms and/or symptoms of systemic infection.
   2. Acute Kidney Injury – an increase in the serum creatinine level by 0.3 mg/dL or more within 48 hours or a serum creatinine increase to 1.5 times baseline value or more within the last seven days or urine output of less than 0.5 mL/kg/hour for six hours.
   3. Duration of Therapy – the length of time antibiotics are being used for the treatment of an infection.
      1. Appropriate duration of therapy for acute uncomplicated cystitis is defined as three to five (3 – 5) days. (See Reference 7.1)
   4. Immunosuppression – patients receiving high-dose corticosteroids (greater than 2 mg/kg of body weight or 20 mg/day or prednisone or equivalent), currently receiving chemotherapy, radiation therapy or other immunosuppressive therapy
   5. Multi-Drug Resistant Organism (MDRO) – an organism not-susceptible to greater than or equal to one agent in greater than or equal to three antimicrobial categories.
2. **POLICY**
   1. If antibiotic therapy for acute, uncomplicated cystitis reaches 5 days and the patient does not meet any exclusion criteria, the pharmacist will discontinue the antibiotic order. (See Attachment A)
      1. Patients with any of the following criteria will be excluded from the automatic discontinuation of antibiotics and will continue on their prescribed antibiotic therapy: (See References 7.1 & 7.2)
         1. Acute kidney injury (AKI)
         2. Fever (temperature greater than or equal to 38 oC)
         3. Health-care associated infection
         4. History of renal transplantation
         5. History of recurrent urinary tract infections (UTI) as documented in the electronic health record (EHR)
         6. ICU status
         7. Immunosuppression
         8. Individuals with risk factors that predispose to persistent or relapsing infection, e.g., calculi, indwelling catheters or other drainage devices
         9. Infectious disease consult has been ordered
         10. Less than 18 years of age (< 18 years old)
         11. Male gender
         12. MDRO
         13. Positive culture at any other site
         14. Pregnancy
         15. Pyelonephritis
         16. Urinary tract obstruction
         17. Urinary retention secondary to neurologic disease
         18. Worsening clinical status
         19. Any additional documented infection
   2. **PROCEDURES**
   3. The pharmacist will review patients on greater than five days of antibiotic therapy for the treatment of acute, uncomplicated cystitis to determine if the patient meets criteria for the automatic discontinuation of the antibiotic therapy. (See Attachment A)
      1. If the patient meets criteria, the antibiotic therapy ordered for the treatment of acute, uncomplicated cystitis will be discontinued by the pharmacist.
         1. The pharmacist will choose *No Cosignature Required* as the communication type. (See Reference 7.3)
3. **DOCUMENTATION**
   1. The pharmacist will process order(s) in the patient’s EHR and document the intervention. (See Reference 7.4)
4. **REFERENCES** 
   1. Gupta K, Hooton TM, Naber KG, et al. International clinical practice guidelines for the treatment of acute uncomplicated cystitis and pyelonephritis in women: A 2010 update by the Infectious Diseases Society of America and the European Society for Microbiology and Infectious Diseases. *Clin Infect Dis*. 2011;52(5):e103-e120. doi:10.1093/cid/ciq257.
   2. Lee H and Le J. Urinary tract infections. *Pharmacotherapy Self-Assessment Program (PSAP)*. 2018;1:7-28.
   3. *Elements of Medication Orders*, SRD Clinical/Pharmacy Policy #Pharm 07-33.
   4. *Medication Ordering and Transcription*, SRD Clinical policy #NS-M1.2250.
5. **ATTACHMENTS**
   1. *Evaluation of Antibiotic Therapy for Acute, Uncomplicated Cystitis Protocol*, Attachment A

**Revision Reviewed/Approved:**

Pharmacy and Therapeutics Committee, approved

Medical Executive Committee, approved

Multidisciplinary Policy & Procedure Committee, approved

**Author/Owner:** Pharmacy Department

