Antibiotic Stewardship for Uncomplicated Urinary Tract Infection in an Urgent Care

Setting: A Quality Improvement Proposal

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Quality Improvement Proposal

Urinary tract infections (UTI) are a common cause of health care visits accounting for

approximately 7 million office visits each year in the US (Simmering et al., 2017). One in three

women will have at least one UTI in her lifetime by age 24 and 50% of women report at least

one UTI in their lifetime (Al-Badr & Al-Shaikh, 2013). Many females with uncomplicated UTIs

present to the urgent care setting routinely. The key stakeholders at an urgent care setting have

recognized the need for antibiotic stewardship as there is an over-prescribing of fluoroquinolone

as the first line of uncomplicated UTI treatment. The problem of unnecessary fluoroquinolone

prescribing results in an increase in antibiotic resistance and adverse reactions to a black box

warning medication. Moreover, there is a lack of education on the appropriate first line of

treatment based on evidence-based guidelines in this urgent care setting. In addition, education

should aim towards the recognition of uncomplicated UTI versus complicated UTI. The aim of

the quality improvement (QI) project is to develop a UTI policy and protocol to improve patient

outcomes.

Background

The pathogenesis of an uncomplicated UTI begins with the colonization of the vaginal

introitus by bacteria from fecal flora followed by bacterial ascension to the bladder. If bacterial

ascension involves the kidneys it is considered a complicated UTI (Hooten & Gupta, 2018). The

symptoms of an uncomplicated UTI consist of dysuria, urinary frequency, urinary urgency, and

suprapubic pain. UTIs are common in women due to the anatomy of the short distance from the

anus to the urethra. Therefore, UTIs are more common in women than in men. Risk factors for

uncomplicated UTIs include sexual intercourse with a history of UTIs and contraceptive device

usage (Hooten, Calderwood, & Bloom, 2018).   The microbial spectrum of uncomplicated UTIs

consists of Escherichia coli as the most frequent cause (75-95 percent of cases) with other

occasional Enterobacteriaceae or Staphylococcus species (Hooten & Gupta, 2018). According to

the Centers for Disease Control ([CDC], 2017), the first lines of treatment for uncomplicated

UTIs in non-pregnant adult women are nitrofurantoin and trimethoprim/sulfamethoxazole.

Fluoroquinolones (e.g. ciprofloxacin) should only be used in situations where other antibiotics

are not appropriate or in complicated UTIs (CDC, 2017).

Problem Statement

According to the CDC, there is an increasing trend of antibiotic resistance among

common uropathogens in cystitis and since antibiotic is second most common medication

prescribed in the U.S., there is a necessity for antibiotic stewardship (Hopkins et al., 2014).

Some experts believe that healthcare will enter a post-antibiotic era if we do not take actions now

to prevent antibiotic resistance increase (Hopkins et al., 2014). In the U.S., the resistance rate to

fluoroquinolones has increased from 3% to 17% between the years 2000 to 2010 (Hooton &

Gupta, 2018). In some parts of the US, there is a 10% to 30% increase of community-associated

Enterobacteriaceae resistance to quinolone (Spellberg & Doi, 2015). A recent study done in

India by Dasgupta et al. (2018) concluded a 50% E. coli resistance to ciprofloxacin (a

fluoroquinolone) because of gene mutation. Other research concluded the dramatic rise in

resistance is closely associated with the spread of a specific clone of E. coli, ST131-H30

(Spellberg & Doi, 2015).

Since 2016, fluoroquinolone has a black box warning issued by the U.S. Food and Drug

Administration (FDA) as it has disabling and potentially irreversible serious reactions such as

tendonitis, tendon rupture, peripheral neuropathy, central nervous system effects, and

exacerbation of muscle weakness in myasthenia gravis patients (FDA, 2016; Hooper, Calderwood, & Bond, 2018). In the project setting, the clinicians are not following the recommended guidelines for the treatment and management of uncomplicated UTIs in female adults. A US study done by Zatorski et al. (2016) identified similar issues as physicians were prescribing fluoroquinolone 63% of the time for uncomplicated UTI. The more times quinolones were prescribed per month causes a higher increase in resistance (Rath & Padhy, 2015).

The key stakeholders have identified that fluoroquinolones are prescribed in place of the recommended guidelines for the treatment of uncomplicated UTIs. There are no current clinical policies or practices to aid in the provider's decision making for the treatment of uncomplicated UTIs. There is no routine education implemented to keep providers up to date with evidence-based guidelines. This inconsistency in prescribing practices is also attributed to an uncertainty of what is considered complicated UTI versus uncomplicated UTI.

The detrimental effects of not practicing evidence-based guidelines will increase fluoroquinolones resistance rates and patients' adverse reaction events to fluoroquinolone prescribing (Renaurt et al., 2013).

Purpose Statement

The primary purpose of the UTI antibiotic stewardship quality improvement project in an urgent care setting is to develop a protocol for the treatment of uncomplicated adult UTI in females. The secondary purpose is to improve providers' education on appropriate first-line antibiotic treatment and to decrease the prescribing of fluoroquinolone for UTI if it is not appropriate. Providers' will have more knowledge of fluoroquinolone's adverse reactions and its rise in antibiotic resistance. Providers will have more knowledge of uncomplicated UTI versus complicated UTI.

Project Objectives

The objectives of this QI project include the following:

- Decrease the rate of unnecessary fluoroquinolone prescribing of uncomplicated adult UTI in women in an urgent care setting by 75% over a 6-week period.

- Develop and implement a policy and protocol on the management of uncomplicated adult UTI based on clinical practice guidelines in an urgent care setting.

- Increase the prescribing of appropriate first-line antibiotic treatment for uncomplicated UTIs by 100% over a 6-week period.

Project Question

Based on the purpose of this project, the following PICOT question was developed: For providers working in an urgent care clinic, does the implementation of an uncomplicated adult UTI treatment protocol and algorithm in comparison to no protocol, decrease the prescribing of fluoroquinolones over a span of 4 weeks?

Search Strategy and Terms

Databases searched to complete a thorough literature review included: the Cumulative Index of Nursing and Allied Health (CINAHL), Medline, Academic Search Complete, Academic Search Elite, PsycINFO, and Health Source: Nursing/Academic Edition cumulatively through EBSCOhost. Limits applied to the search included: studies that only peer-reviewed journals, available in full text, human subjects, the English language, and articles published after 2013.

The main keywords used during the searches include: cystitis, UTI, uncomplicated, United States, resistance, and fluoroquinolone. Combinations of keywords included UTI AND Uncomplicated AND U.S. Other combinations included cystitis AND resistance AND US AND

fluoroquinolone. Combinations of cystitis AND resistance AND fluoroquinolone yielded results as well. In EBSCOhost, the keywords UTI and uncomplicated were searched and yielded 149 results. The keywords were then combined with the US and yielded 7 results all from Academic Search Elite. In EBSCOhost, the combination of keywords cystitis, uncomplicated, and resistance yielded 2 pertinent journals both from Academic Search Elite. In EBSCOhost, the keywords fluoroquinolone and resistance yielded 1285 results with 114 from CINHAL, 573 from Academic Search Elite, 570 from Academic Search Complete, 27 from Nursing/Academic Edition, and 1 from PsycINFO. When keyword U.S. was added to fluoroquinolone and resistance it narrowed down the yield to 186. The combination of keywords fluoroquinolone and UTI yielded 131 results from EBSCOhost. Those keywords were then combined with the U.S and yielded 10 journals Academic Search Elite and 1 from CINHAL. The combination of the keywords cystitis, resistance, and fluoroquinolone yielded 5 peer-reviewed journals with 4 from Academic Search Elite and 1 from CINAHL. The combination of keywords systematic review AND uncomplicated UTI yielded only 2 results in full text that are 2013 to present and one of them being pertinent. The years had to be changed to 2010 to present which yielded 18 results and 4 pertinent systematic reviews including 2 from Academic Search Complete, 1 from CINAHL, and 1 from Medline.

Inclusions and Exclusions

Patients who are women with any of the following characteristics were excluded from the search: pregnancy, postmenopausal, complicated UTI such as structural or functional abnormality, patients on suppressive therapy, were currently on antibiotics, had a recent urologic procedure, indwelling catheter, immunocompromised, have diabetes, or has end-stage renal disease. Complicated UTIs were excluded from the search criteria. The inclusion of the

literature review with keywords fluoroquinolone and UTI was not limited to studies in the U.S. as there is a necessity to track quinolone resistance around the world to mutation patterns of E.coli. Three peer-reviewed articles on uncomplicated UTI, fluoroquinolone, and complicated UTI were picked from UpToDate, an evidence-based search engine, as it is the urgent care facility primary database and protocols are driven from this search engine.

Review of Literature

The aim of the literature review was to identify current evidence-based guidelines (EBG), on treatment and management of uncomplicated UTIs, the importance of provider education, the rise of antibiotic resistance, and to identify providers' barriers to change. Critical appraisal was essential to determine the weakness and strengths of the research studies involved.

Urinary tract infections in females are common reasons for office visits and account for 8.1 million visits each year and there is an increasing trend in antibiotic resistance (Velez at al., 2017; Price et al., 2016; Hopkins et al., 2014). It is necessary for prescribers to have good antibiotic stewardship as antibiotics are the second most commonly prescribed medication in the U.S. (Hopkins et al., 2014). It is estimated that by 2050, antibiotic resistance will account for 10 million deaths per year globally; the National Institute of Health supports the practice of decreasing inappropriate antibiotic prescribing by 25% (Velez et al., 2017). It is crucial for providers to know the appropriate first-line therapy for uncomplicated UTI treatment. A 2010 systematic review of 6,016 patients in 21 studies on uncomplicated treatment for UTI by Zalmanovici Trestioreanu and associates published in the Cochrane Database concluded that Bactrim and Macrobid was the most effective short-term antibiotic for uncomplicated UTI.

Evidence-Based Guidelines

Current guidelines agree with Zalmanovici Trestioreanu et al. (2010) systematic review findings. The American Urological Association ([AUA], 2018), the CDC (2017), and the UpToDate (2018) guidelines all recommend the first line of antimicrobial treatment for uncomplicated UTI include nitrofurantoin (Macrobid) 100 mg twice daily for five days or trimethoprim-sulfamethoxazole (Bactrim DS) twice daily for three days as a safe and effective strategy (AUA, 2018; CDC, 2017; Hooten et al., 2018). Similar findings reiterate that Bactrim DS recommendation was limited to areas where Bactrim DS resistance rates for uropathogens of uncomplicated UTI was less than 20% (Hecker et al., 2014; CDC, 2017; AUA, 2018). The Infectious Disease Society of America (ISDA) recommends fosfomycin and pivmecillinam as the first line of antibiotic therapy but fosfomycin is only available in Europe and the U.S. Food and Drug Administration reports pivmecillinam as inferior to other first-line antibiotic choices (Hopkins, McCroskey, Reeves, & Tanabe, 2014).

The Need and Importance of Provider Education

Two studies were selected because emergency settings are similar to urgent care settings as they take same day appointments. A prospective single-center observational study by Zatorski et al. (2016) in the US collected over 2 years in an emergency department (ED) to examine physician adherence to UTI 2010 International Clinical Practice Guideline (ICPG) resulted in 103 criteria-met cases showing 63% of patients receiving non-adherent treatment and the most commonly used antibiotic was fluoroquinolone (98%) in cystitis cases. The limitation of this study was the small sample size of 103 physicians interviewed and lack of double-blind study as when physicians were aware the study was going on, it may have caused more adherence than expected. Nonetheless, the conclusion of the study supports the need for physician education on

evidence-based guidelines regarding uncomplicated cystitis treatment to aim for a decrease in broad-spectrum use and drug resistance of uropathogens (Zatorski et al., 2016).

A similar study done by Hecker et al. (2014) in another U.S. ED emphasized baseline adherence to uncomplicated UTI guideline was only 44% and after implementation of an electronic health order set with audit and feedback the adherence to UTI guidelines increased to 82% after a 2-month period with a sample size of 200 cases. The implementation of an electronic health order set decreased unnecessary fluoroquinolone prescribing from 44% to 13% (Hecker et al., 2014). Fluoroquinolones (e.g. ciprofloxacin) should only be used in situations where other antibiotics are not appropriate or in complicated UTIs (CDC, 2017). The overprescribing and inappropriate use of antibiotics led to the emergence of drug-resistant strains of uropathogens (Velez et al., 2017). Literature review and current needs assessment of the urgent care facility concluded the need for provider education on appropriate first-line uncomplicated UTI treatment is valid.

Approach to Provider Education

There are a variety of approaches to provider education such as handouts, interactive meetings, emails, electronic health order set, and one-on-one education (Arnold &Straus, 2009; Hecker et al., 2014; Hopkins et al., 2014). A quality improvement project implemented by Hopkins et al., (2014) in an urgent care setting sent emails to providers as the first step of education followed by three days of face to face education and passing out laminated pocket clinical protocol guidelines (CPG) cards found statistical significance in improvement by 30% in adherence to the first-line antibiotic for UTI treatment after the implementation of CPG. The study was limited due to its small sample size of 82 and not a double-blind study, therefore, the awareness of study could have changed the compliance results. A systematic review conducted

by Arnold & Straus (2009) from the Cochrane Database assessed the effectiveness of different

educational interventions to improve the prescribing of first-line antibiotics for multiple

conditions including UTI. The use of printed materials or audits and feedback alone resulted in

no changes to providers prescribing. Interactive educational meetings appeared to be more

effective than lectures (Arnold & Straus, 2009). The literature review supports that the

improvement project should focus on interactive educational meetings or one-on-ones while

providing an algorithm handout on UTI treatment for the providers to use as a reference.

Recognition of UTI Symptoms

A barrier to appropriate prescribing of antibiotics for uncomplicated UTI is the provider's

diagnostic accuracy and recognition of complicated versus uncomplicated UTI (Zatorski et al.,

2016). A 2010 systematic review conducted by Giesen and colleagues (2010) included 3,711

patients in sixteen studies concluded that the presence of dysuria, frequency, nocturia, and

urgency all increases the probability of UTI. The probability of UTI increases to 75% if there

was hematuria. When hematuria is combined with positive dipstick nitrite the probability

increases to >90%. There are several limitations to this study as there was no age restriction or

sex restriction in the meta-analysis; the systematic review included pregnant women, men, and

females over 65 years old.

On the contrary, a 2011 systematic review and meta-analysis conducted by Medina-

Bommbardo and Jover-Palmer concluded that clinical findings are not helpful for UTI diagnosis

in females and urine dipstick test was the most reliable tool. The presence of nitrites or

leukocytes along with dysuria is useful in the diagnosis of UTI (Medina-Bommbardo & Jover-

Palmer, 2011). The authors did point out the difference between their systematic review versus

Giesen et al. (2010) meta-analysis as Giesen's calculated confidence intervals with random

effects model while Medina-Bommbardo and Jover-Palmer used fixed effects. Both systematic

reviews pointed out the presence of vaginal discharge may decrease the diagnosis of UTI and the

variability of diagnostic accuracy is high due to non-randomized samples, sensitivity changes the

course of illness, or referral filter bias (Medina-Bommbardo & Jover-Palmer, 2011). UpToDate

algorithm for simple UTI includes classic symptoms such as dysuria, urinary frequency, urinary

urgency, and /or suprapubic pain or atypical urinary symptoms with pyuria (Hooton & Gupta,

2018). The presence of temperature more than >99.9, flank pain, or symptoms of systemic

illnesses will change the patients a *complicated* UTI. The implementation of an algorithm

handout will help providers recognize highly sensitive and specific symptoms of an

uncomplicated UTI based on UpToDate guidelines and systematic review.

Cultural Barriers

A systematic review by Charani et al. (2011) has shown that the cultural and behavioral

factors on the prescribing behaviors of providers affect the organization. Novice providers tend

to follow the practices of the senior staff when it comes to prescribing etiquette which results in a

hesitancy to adhere to EBP guidelines (Charani, et al., 2011). Education should be the focus on

all providers including the senior staff to set EBP examples for other colleagues.

Antibiotic Stewardship

The observational study done by Zatorski et al. (2016) concluded that fluoroquinolone

was prescribed for 97.6% of the 100 uncomplicated cystitis cases. In certain parts of the US,

there is a 10% to 30% increase of community-associated Enterobacteriaceae, such as E.coli,

resistance to fluoroquinolone (Spellberg & Doi, 2015). The literature review confirmed higher

rates (>50%) in other parts of the world such as India (Dasgupta et al., 2018; Spellberg & Doi,

2015). In addition, the literature review emphasizes the sensitivity and efficacy of nitrofurantoin.

A prospective cohort study in a European city still shows E.coli sensitivity to nitrofurantoin at

98% while a retrospective study in Botswana of a large 744 samples concluded the overall E.coli

resistance to nitrofurantoin was less than 10% (Renuart et al., 2013; Seitz, Stief, & Waidelich,

2017). Identifying current resistance and susceptibility trends around the world will help identify

antimicrobial mutations and solidify the necessity of abiding by current EBP guidelines.

The Conclusion to Literature Review

Observation studies have concluded there is a need for provider education as patients are

receiving nonadherent treatments (Hecker et al., 2014; Zatorski et al., 2016). Systematic review

findings along with accredited associations all supported Bactrim and Macrobid as the first line

of uncomplicated urinary tract infections (Hecker et al., 2014; CDC, 2017; AUA, 2018;

UpToDate, 2018; ISDA, 2018). The adherence to current EBP guidelines will decrease

antibiotic resistance trends as evident in peer-reviewed journals that identified the current

increase of antibiotic resistance all around the world (Renuart et al., 2013; Spellberg &Doi,

2015; Dasgupta et al., 2018). Systematic reviews have observed multiple barriers to providers'

guidelines adherence for the treatment of uncomplicated UTI such as cultural, behavioral, and

diagnostic inaccuracy (Giesen et al., 2010; Charani et al., 2011; Medina-Bommbardo & Jover-

Palmer, 2011; Zatorski et al., 2016). Other systematic reviews have identified successful

approaches to provider education for adherence improvements such as handouts, interactive

meetings, emails, and one-on-one education (Arnold &Straus, 2009; Hecker et al., 2014;

Hopkins et al., 2014). Successful provider education will lead to protocol adherence and

decrease fluoroquinolone prescribing. The literature review has supported the implementation of

an uncomplicated UTI treatment protocol in the urgent care setting.

Theoretical Framework

A theory or framework can help one guide his or her DNP project from a new perspective and have a deeper understanding of existing relationships between phenomena (Grimm, 2016). Evidence-based practice models propose a framework to guide healthcare organizations and the healthcare team on the implementation of evidence-based policies, protocols, and guidelines. The Model for Improvement (MFI) by Associates in Process Improvement is developed by the Institute for Healthcare Improvement (IHI) in 1996 to guide healthcare quality improvement projects. The MFI uses rapid cycle processes Plan-Do-Study-Act (PDSA) cycles to test the effects of small changes within the microsystem (Agency for Healthcare Research and Quality [AHRQ], 2013; Hall & Roussell, 2016). PDSA cycle provides a structure for designing, applying, measuring, and disseminating quality improvement work (Hall & Roussell, 2016).

Historical Development of the MFI

The MFI developed by Langley et al. (1994) is a simple, yet powerful tool to accelerate improvement (Toncich et al., 2000; IHI, 2018). The foundation of the model started around 1870 with Charles Pierce and William James philosophy of pragmatism (Moen, 2010). Pragmatism is an approach to assess the truth of the meaning of theories or beliefs in terms of the success of their practical application (Merriam-Webster, 2018). Their work guided other pragmatists, such as Clarence Lewis, who added to the foundation of pragmatism. Lewis had a huge influence on Dr. Walter Shewart and Dr. W. Edwards Deming who brought the PDSA cycle into the 20th century. Earlier days of the model were known as the Shewart cycle which was later changed to be named the PDSA cycle by Dr. Deming in 1993. It was a flow diagram for learning and for improvement of a product or a process. In 1994, Langley et al. added the three fundamental questions to Deming's PDSA cycle and developed the MFI (Moen, 2010).

Applicability of Theory to Current Healthcare Practice

The MFI is the most commonly used QI approach in healthcare to systematically advance the way care is delivered to patients (AHRQ, 2013). Dr. Deming was a statistician who used a statistical process control tool to study quality assurance and efficiency while eliminating waste (AHRQ, 2013; Hall & Roussell, 2016). According to Hall and Roussell (2016), "Through the use of statistical process control, healthcare processes can be quantified and outcome variation can be studied" (p.214-215).

The Major Tenets of the MFI Framework

The model has two parts: three fundamental questions and the Plan-Do-Study-Act (PDSA) cycle to test changes in the actual work settings (see Appendix A). PDSA cycles may guide the change and help determine if the change is an improvement (IHI, 2018). The major tenets of the three questions include setting aims, establishing measures, selecting changes, testing changes, implementing changes, and finally spreading change. The other tenets of the MFI framework are components of the PDSA cycle.

The first three questions from the MFI are:

1) What are we trying to accomplish?

2) How will we know that the change is an improvement?

3) What change can we make that will result in improvement?

Forming the team. A team consisting of the right people is critical to a successful improvement effort. The team must consist of key stakeholders that may provide leadership and resources to the staff.

Setting aims. After asking the first question of the model, aim or aims should be identified. Aims should be time specific, population or system affected clearly defined, and measurable (IHI, 2018).

Establishing measures. Per the second question of the model, the team will need to know if the change is an improvement. The team must create quantitative measures to determine if the specific change actually leads to an improvement.

Selecting changes. Ideas of change may come from those who work in the system or from the experience of others who had successful improvements.

Testing changes. The Plan-Do-Study-Act cycle is shorthand for testing a change in the real work setting by planning, doing, observing the results, and acting on what is learned. This is the scientific method for action-oriented learning (IHI, 2018).

Implementing changes. The PDSA cycles are used iteratively in rapid cycles to explore the improvement and testing of the ideas (Hall & Roussell, 2018).

Spreading changes. After successful implementation of the change or group of changes for a pilot population, the team can spread the changes to other parts of the organization.

Major Tenets of the PDSA Cycle

Plan. The key task of this phase is to develop a written charter and the formation of a team. The charter is the written formalization of the necessary work to be done for the achievable goal. It will define the aim of the project, the timeline of the cycle, the measurable standards, the resources needed, and the staffs required to complete the tasks (Hall & Roussell, 2018). The team must include key stakeholders who share a common vision for the aim of the project. The aim should be quantifiable and measurable. In addition, the Plan Phase will include defining the resources available for leadership and support.

Do. The second phase executes the plan. To implement the project, the team will assign specific tasks to each member. Tools may be used to collect information or data on the improvement process or the implementation. Examples of such tools are Lean and Six Sigma methods (Hall & Roussell, 2016). Education is a key component of the Do Phase as the lack of education leads to project failure. Educational content specific to the implementation must be established and conveyed to the target audience.

Study. The Study Phase is an analytical phase. Quantitative and qualitative data is collected and assessed for the process improvement changes. In QI, it may be creating rates and reviewing percent change or as complex as statistical process control with control charts (Hall & Roussell, 2016). The outcome of the process change will be compared to the aim that was originally set for the project.

Act. The final phase of the PDSA cycle will result in dissemination of the tested change in the microsystem. During this phase, one will review the failures or successes to determine the next step for distribution to the macrosystem (Hall & Roussell, 2016). This phase requires effective change management skills and knowledge. Effective management will involve staying on tasks, meeting deadlines, identify delays, and removing barriers (Hall & Roussell, 2016).

Application of Theory to DNP Project

The three fundamental questions to the IHI Model for Improvement framework will be discussed. The first aim of the quality improvement (QI) project is to develop a UTI policy and protocol to improve patient outcomes. The second aim is to decrease the rate of unnecessary fluoroquinolone prescribing of uncomplicated adult UTI in women in an urgent care setting by 75% over a 6-week period. A UTI policy and protocol will be implemented to improve patient outcomes. Data will be collected over a four week period to measure the effectiveness of the

UTI protocol on the reduction of fluoroquinolone as an unnecessary first-line treatment. Data will be collected to measure the increase prescribing of appropriate first-line antibiotic treatment for uncomplicated UTIs by 100% over a 6-week period.

The change will be implemented with PDSA cycles. After implementation, the change will be evaluated for macrosystem implementations. The UTI treatment protocol will be geared toward a small sample size of providers first to observe for successful change before implementing it for the whole organization.

PDSA Cycle

Plan. The first step is to state the objective of the cycle; the team will make predictions about what will happen and why. The team must consist of key stakeholders such as the DNP student, the medical director, and the DNP supervisors. They DNP supervisors and DNP student will provide support and leadership to the staff providers. The team will develop a plan for the change: the who, what, where and why. A written charter will be made and tasks will be assigned. The timeline of the cycle will be projected with measurable standards. Data will be collected on random days at all 11 urgent care to prevent provider bias who routinely works at one site. Charts of uncomplicated UTI treatment for females age 18-65 will be analyzed. Data will be collected before implementation and for 6 weeks after provider education implementation. The implementation phase will be a 4 weeks process of provider education.

Do. The two main tenets of the Do Phase are education and execution. The team will assign specific tasks to each team member before implementing the change. The DNP student will focus on provider education of UTI treatment protocol on a small sample size first. The DNP student will collect data; tools may be used for data collection and analysis such as an Excel sheet. The DNP student will document unexpected observations and scenarios.

Study. The DNP student will analyze the data and compare them to predictions. The

DNP student will summarize what was learned. The DNP student will analyze the data with the

team and compare data to prediction followed by a summary (IHI, 2018)

Act. Effective management is important in the act phase. The DNP student will review

the failures and successes of the cycle to identify barriers and delays. The DNP student may

make modifications to the next PDSA cycle; he or she will decide what else to change in the next

cycle to make sure the team is staying on task and meeting deadlines.

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Project Design

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The following project will utilize a quality improvement (QI) design to implement an

uncomplicated UTI protocol in an urgent care setting. The primary purpose of this QI project is

to develop a protocol for the treatment of uncomplicated adult UTI in females. The QI approach

was selected because it has been shown to improve patient outcomes and the workflow process

(Moran et al., 2017). The PDSA method will guide the DNP project. The initiative of a UTI

protocol will support the continuing education of providers and their adherence to EBP

guidelines to improve patient care and outcomes. The project is focused on standardizing the

practice of infectious disease management for UTI in women. The design will include a

PowerPoint presentation, laminated pocket handouts, informed consent for providers to

participate in the data collection, pre-education questionnaire of clinical knowledge on UTI

treatment, fluoroquinolone serious reactions, symptoms of complicated UTI, and

fluoroquinolone resistance rate followed by an educational presentation to providers to review

current clinical guidelines for uncomplicated UTI treatment. The QI protocol will be emailed

and distributed to the providers at the urgent care setting. An in-service will be given at the

urgent care site on the protocol. All the providers who rotate through the practice site will sign

an acknowledgment of the protocol. A post-education questionnaire will be given 6 weeks after

the educational program. The questionnaire will be emailed back or hand given to the project

lead. Excel will be used for data collection. The project will not involve direct patient care.

There will be no coercing of any providers for the study. There will be no loss of benefit for

refusal to participate in this project. The proposed outcome is to increase the use of first-line

antibiotics in an urgent care setting following the implementation of the QI protocol for the

treatment of uncomplicated UTI in females.

Population of Interest and Stakeholders

      Population of interest. The direct population of interest is the primary care practitioners

such as nurse practitioners and medical doctors. The providers are the focus of this project since

they will be responsible for initiating the evidence-based UTI guidelines. The inclusion criteria

include all full-time providers. The exclusion criteria consist of per-diem providers who are only

at the urgent care twice to four times a month. This will exclude all urgent care sites except for

Huntington Beach urgent care to prevent data bias as there are multiple providers rotating

through all 11 urgent care sites.

      Stakeholders. The key stakeholders are the medical director, the DNP supervisors, the

project lead, and the providers. The reason for the UTI protocol project is due to the NP

supervisor's interview at the beginning of the project. They have recognized the need for

antibiotic stewardship in UTI management as providers were not prescribing the recommended

first-line therapy.   The project was then discussed with the medical director who supports this

project. The current UTI protocol does not show recommended treatments for complicated UTI

versus uncomplicated UTI. The medical director will allow the project lead to do a pilot study at

one urgent care site first. A UTI protocol initiative will be implemented at Huntington Beach

urgent care. A PowerPoint presentation will be presented to key stakeholders including the

medical director and the NP supervisors to get a confirmation for the project before the

dissemination to the health care providers.

Project Setting

The organization consists of 11 urgent care sites with 50 providers rotating through each

site on a daily basis**.** Each provider works three 12 hour shifts a week for full-time status. Due

to the time constraints and different scheduling, the project will be implemented at one urgent

care site**.** The project setting will be at the busiest urgent care site. The following urgent care site

treats about 50 to 80 patients a day. It is open 7 days a week, with the exception of major

holidays, from 8 am to 8 pm on weekdays and 8 am to 5 pm on weekends. The urgent care site

commonly has two providers consisting of one MD and one NP or PA. There are three medical

assistants helping the providers with one front desk clerk.

Recruitment Methods

Knowledge levels. An email with a PowerPoint presentation will be distributed to all

providers on the new UTI protocol initiative and how a pilot protocol initiative will be done at

the Huntington Beach urgent care. All providers will be required to sign an acknowledgment

form to state they are aware of the new protocol. A sample of five providers will be studied for

pretest and posttest questionnaire instead of all 50 who are employed at the urgent care sites due

to time constraints and scheduling.   Recruitment methods for participants will be through emails

and face-to-face in-service with a mixture of providers made up of nurse practitioners, physician

assistants, and medical doctors who rotate through Huntington Beach urgent care clinic. If email

is not effective in recruiting, the project lead will approach each provider personally to recruit

participants for the pre and post questionnaire. No incentive will be used as the project is not approved for continuing education credits.

Chart audits. The project lead will be doing a retrospective chart audit of 25 charts and a post-implementation chart audit of 25 charts at the project site. Charts will be collected on a daily basis by the project lead on female patients' age 18 to 65 years old with UTI who meet inclusion criteria to see if the appropriate antibiotic was given before and after the protocol initiative at the project site. An Excel sheet will be used to record data on how many charts the providers gave the appropriate or inappropriate antibiotic to before and after implementation. The inclusion criteria for patients include women ages 18 to 65 years old with UTI symptoms including dysuria, increased frequency of urination, hesitancy to urinate, and those with positive urine dipstick ordered (positive pyuria and/or nitrite). Exclusion criteria will include women who were previously treated for a UTI within the past 3 months to exclude possibility of treatment failure, women who are currently on antibiotics, and women who have severe comorbidities including immunocompromised patients, diabetes mellitus, end-stage renal disease, urological procedures, or indwelling catheter (Zatorski et al., 2016). Complicated UTI patients will be excluded such as patients with symptoms of UTI and fever, chills, rigors, marked fatigue, flank pain, and costovertebral angle tenderness (Hooton & Gupta, 2018). The charts will be coded with assigned numbers to maintain the patient's privacy and confidentiality.

Tools/Instruments

The UpToDate algorithm will be used as guidance for protocol initiative. A laminated pocket handout will be given to all providers on the symptoms of complicated UTI versus uncomplicated UTI and the currently recommended guideline treatments for uncomplicated UTI (see Appendix B). The algorithm begins by asking the provider if there are symptoms of

uncomplicated UTI or complicated UTI. If it is truly an uncomplicated UTI, the next question in

the algorithm is if there is a risk for multidrug resistance (MDR) gram-negative infection. If

there is a risk then a urinary culture is recommended. The algorithm then discusses the first line

agent for uncomplicated UTI in females.

The medical director requests the QI project to utilize UpToDate as a reference for the

QI protocol initiative. UpToDate search engine updates new evidence and recommendations

every business day, therefore, it is a credible and valid source (Wolters-Kluwer, 2018a).

UpToDate has unique grading guidelines for each evidence-based practice recommendation with

1A grade as a strong recommendation of high-quality evidence from well-performed randomized

controlled trials (Wolters-Kulwer, 2018b).

SPSS software will be used to analyze data collection pre-test and post-test. A

knowledge assessment questionnaire was developed with a content validity index (CVI) of more

than 0.80. Multiple choice questions will be used to assess the recruited five provider's

comprehension of the current guidelines and antibiotic stewardship (see Appendix C). After the

announcement of the pilot QI initiative at the project site and its implementation of PowerPoint

emails and laminated handouts, participants should have an increased understanding of the

appropriate diagnosis and treatment of uncomplicated UTIs as well as increased understanding

between complicated UTIs vs uncomplicated UTIs. Multiple choice questionnaires will be used

as post-test questions.

Data Collection

Knowledge Levels

All patients and participants data will be coded in an excel document in a password-

protected computer to maintain privacy and confidentiality. The sample size will consist of all

providers comprising of MD, PA, and NPs from 25 pretest and 25 posttest charts. They will

become categorical data of providers who did give the right antibiotic to providers who did not

give the right antibiotic.

Protocol Compliance

The retrospective chart audit will collect 25 charts that are eligible for inclusion criteria

on uncomplicated UTI in female adults' age 18 to 65 years old. The chart will be coded as

patient 1, patient 2, patient 3 and so forth to maintain confidentiality. The demographic variable

code for patients will only be patient's age (age). No other demographic will be collected to

maintain confidentiality. Post-implementation data collection will be 25 charts that are eligible

for inclusion criteria of female adults, ages 18-65 years old. The only demographic variable

collected will be the patient's age.

Data collection and analysis will consist of provider demographics (see Appendix D),

patient age demographic, providers' knowledge level based on CVI questionnaire, and providers'

adherence. Retrospective audits were conducted on all the providers at Huntington Beach urgent

care to determine the current adherence rate to evidence-based guidelines with 25 charts. This

categorical data will be used to compare pre-implementation adherence to guidelines with post

education adherence rate to guidelines for statistical significance. The providers will be

categorized into two categories: one who did provide the right antibiotic based on protocol and

one who did not provide the right antibiotic based on the protocol (see Appendix F).

Fluoroquinolone Prescribing

The number of patients who were prescribed fluoroquinolone for the first line treatment

of uncomplicated UTI will be tracked to the codebook as a numerical rate from the 25 charts and

will be compared to the post-test numerically of the next 25 charts. The goal is to decrease

fluoroquinolone prescribing by 75 percent after a 4-week period of QI initiative.

Intervention and Project Timeline

Week	Activity
1	- March 13th, 2019: Send out PowerPoint Presentation on UTI protocol with an email regarding UTI protocol initiative. - March 13th, 2019: Distribute informed consent on day 1 of 3 weeks education program to all providers rotating through the project site. - Distribute knowledge pre-questionnaire to the five recruited providers. - March 15th, 2019: Provide in-service on UTI protocol and hand out laminated pocket cards for reference.
2	- March 18th, 2019: Provide in-service on UTI protocol and hand out laminated pocket cards for reference to all providers at the project site. - March 19th, 2019 start data collection on UTI treatment pre-education - March 20th, 2019: Do weekly rounding to answer questions on protocol and continue data collection. Continue handing out laminated pocket cards for reference to providers who have not received them. - March 20th, 2019: Start data collection on UTI treatment post-education
3	- March 25th, 2019: Do weekly rounding to help with protocol compliance and continue data collection. Continue handing out laminated pocket cards for reference to providers who have not received them. - March 29th, 2019: Do final rounding to ensure protocol compliance and continue data collection. - Distribute knowledge post-questionnaire to the same five recruited providers.
4	- April 1st, 2019 use SPSS software to compare pre and post data. Run a Chi-Square test to measure data for statistical significance. - April 9th, 2019 continue distributing post-questionnaire to the same five recruited providers.

The project is focused on a protocol initiative to standardize practice in infectious disease

management for UTI. The design of the DNP project includes:

1) Pre-test questionnaire: After recruitment of the five providers, an informed consent

   (Appendix E) will be handed out to practitioners. Informed consent for providers to

   participate in the data collection, pre-education questionnaire of clinical knowledge

on UTI treatment, fluoroquinolone serious reactions, symptoms of complicated UTI, and fluoroquinolone resistance rate.

2) A pre-education questionnaire will be given to five providers to review the current clinical knowledge (Appendix C). The providers will drop them off without any names or identity indicators in a lockbox in the manager's office.

3) An introductory email with a PowerPoint presentation attached to the new UTI protocol (Appendix D) will be sent out.

4) Acknowledgment of email on new protocol sent back from each provider.

5) Laminated pocket handouts for the providers to reference to (Appendix B).

6) An in-service will be given at the urgent care site on the UTI protocol.

7) Weekly rounding will be implemented at the project site to ensure protocol compliance and continue to hand out laminated references.

8) A post-education questionnaire will be given 6 weeks after the educational program to the 4 providers and the providers will drop them off in a locked box in the manager's office.

9) Excel will be used for data collection and codebook.

10) SPSS Software will be used to run statistical analysis.

The post education questionnaire, the same as the pre-test question, will be administered 6 weeks after the protocol implementation and educational session. The questionnaire will be given to the five volunteering prescribers consisting of NP, PA, and MD and the providers will be instructed to voluntarily leave the completed questionnaire in a locked collection box in the manager's office at the urgent care site. The questionnaire will be destroyed at the conclusion of the project. The practitioner will be asked to complete the questionnaire without adding their

identification on the paper.   The questionnaires will be compared for improvement in providers

prescribing habits and provider UTI protocol knowledge regarding the first line treatment of

uncomplicated UTI. Adherence data to the clinical guideline will be collected through the use of

All Scripts, the urgent care electronic health record, one month before and during the 6 weeks

after the education and distribution of the clinical guideline. A timeline was developed to ensure

the completion of the project as anticipated (Appendix F).

Ethics and Human Subjects Protection

Ethics and human subject protection is an essential process that must be taken in any

project or research activity. Confidentiality will be maintained by not limiting personal

identifiers on the questionnaires and data collected on UTI patients will be kept confidential by

the project lead as data was de-identified by removing the name, date of birth, and medical

record number. The codebooks will be kept in the password-protected laptop that only the

project lead has the password to. The project will not involve direct patient care. Institutional

Review Board (IRB) approval will not be required for this project. Since the following project is

considered a QI initiative, IRB exception will be granted after formal nursing faculty review of

the project proposal and supporting material. The initial email about the UTI protocol

implementation explained how the protocol will be implemented and what will be asked from the

providers. Five providers will be asked to participate in the pre-test and post-test to evaluate the

prescribing habits of providers and the current treatment knowledge on uncomplicated UTI in

females. A letter of informed consent was distributed to all staff at the practice site to

acknowledge that the QI improvement project is being implemented. The informed consent will

be signed by all providers rotating through the project site. The providers will be informed that

there is no coercing of any providers to participate in the study. There will be no compensation

for participating in the project and it is on a volunteer basis. There will be no loss of benefit for refusal to participate in the project.

Plan for Analysis and Evaluation

Knowledge Levels

A pre-test and post-test questionnaire on current knowledge will be administered to the five providers. The Wilcoxon Ranked test will be used to measure the increase in the right answers after 4 weeks of QI initiative as the test can measure two different points in time before QI and after QI based on the five providers pre-test and post-test answers.

Protocol Compliance

The Chi-square test for independence will be used to compare the pretest group of UTI treatment adherence and posttest group after UTI protocol implementation. The providers will be dependent categorical variables of yes/no to the adherence to UTI protocol (see Appendix F). The independent variable will be the UTI treatment protocol as it influences different dependent variables such as fluoroquinolone prescribing, recognition of uncomplicated UTI vs complicated UTI, and adherence to evidence-based guidelines.

Changes in Percentage of Fluoroquinolone Prescription

The Chi-square analysis will be used to compare the percentage of patients from the 25 charts who were prescribed fluoroquinolone before QI to the 25 charts 6 weeks after QI implementation. The continuous variable is the percentages whereas the categorical variable is before QI and after QI. The goal is to decrease fluoroquinolone prescribing by 75 percent after four weeks of QI implementation.

Significance for Nursing

There is a necessity for antibiotic stewardship due to increasing trends of antibiotic resistance to common uropathogens seen in UTI as we may enter a post-antibiotic era (CDC, 2017; Hopkins et al., 2014). In certain parts of the US, there is now a 10% to 30% increase of community-associated Enterobacteriaceae resistance to quinolone (Spellberg & Doi, 2015) and literature review has identified that more than 60 percent of providers do not adhere to current UTI treatment guidelines (Zatorski et al., 2016). In addition, ciprofloxacin, a black box warning drug, is a common treatment being used for uncomplicated UTI that is not adhering to clinical guidelines. The problem of unnecessary fluoroquinolone prescribing results in an increase in antibiotic resistance and adverse reactions. Previous UTI protocols have aided providers to change their prescribing patterns into using appropriate evidence-based first-line therapy as high as 30% statistically significant increase to adherence (Hopkins et al., 2014). If the project site shows an improvement in adherence to guidelines, it will decrease the rate of antibiotic resistance in the overall community.

Project Proposal: Analysis

Pre-Implementation Data Findings

A retrospective chart review was done one month before implementation. There were 27 female patients who were treated for UTI within two weeks of chart review. The inclusion criteria for patients included women ages 18 to 75 years old with UTI symptoms including dysuria, increased frequency of urination, hesitancy to urinate, or those with positive urine dipstick ordered (positive pyuria and/or nitrite). Exclusion criteria included women who were previously treated for a UTI within the past three months to exclude possibility of treatment failure, women who were currently on antibiotics, and women who had severe comorbidities

including immunocompromised patients, diabetes mellitus, end-stage renal disease, urological

procedures, or indwelling catheter (Zatorski et al., 2016). The age for inclusion criteria was

widened to 18 to 75 years of age as further research findings established that age or medical

complexity did not result in reduced sensitivity of E.Coli to Bactrim DS or nitrofurantoin

(Grover et al., 2009; Mody, 2019). UpToDate recommended the same guidelines for

uncomplicated UTI treatments in the elder (Mody, 2019). One patient was excluded due to the

age of 86 years old and another patient was excluded due to current pregnancy status. A total of

25 patients met the inclusion criteria. Twenty-four percent of patients (6 out of 25) were not

treated with the first line recommended treatment for uncomplicated UTI; 2 charts (8%) were

given cephalexin while 4 charts (16%) were given fluoroquinolone. Pre-implementation data

concluded that providers are prescribing first-line antibiotic UTI treatment 76% of the time. The

goal was to decrease fluoroquinolone prescribing by 75% and increase the prescribing of

appropriately first-line antibiotic treatment by 100% for uncomplicated UTI after a 4-week

implementation phase.

Post-Implementation Data Findings

Over the past 30 days, 36 charts were collected, reviewed and analyzed. Of the 36 charts,

7 were excluded due to age and 4 excluded due to having a complicated UTI. A total of 25

charts met the inclusion criteria including women ages 18 to 75 years old with UTI symptoms or

those with positive urine dipstick ordered (positive pyuria and/or nitrite). All analyses were

conducted using SPSS Version 25 (Armonk, NY: IBM Corp.) and statistical significance was

assumed at an alpha value of 0.05.

Protocol Compliance. Chi-square statistics were used to compare the pre-

implementation and post-implementation periods on categorical outcomes (yes/no to protocol

adherence). Assumptions have not been violated as 0 cells have expected count less than 5 and

all expected cells are greater than 5 (5.50) (Pallant, 2013).   Chi-square analysis found a non-

significant difference between the pre-implementation and post-implementation on protocol

adherence, $\chi2(1) = 0.12$, $p = 0.73$ (see Appendix G, figure 1). Before implementation, 76% (19

out of 25) followed recommended UTI first-line antibiotic treatment such as prescribing Bactrim

DS or Macrobid. After implementation, 80% (20 out of 25) followed UTI protocol guidelines.

The goal of UTI protocol compliance was to increase the prescribing of appropriately first-line

antibiotic treatment by 100% for uncomplicated UTI after a 4-week implementation phase; the

goal was not met as results indicated 80% followed UTI protocol. Perhaps, the pilot study must

have a longer implementation phase for the goal of 100% protocol compliance to be met. Below

are the Chi-Square test results for protocol compliance. There was a non-significant difference

in protocol adherence, $p = 0.73$.

Chi-Square Tests for Protocol Compliance Comparison

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.117[a]	1	.733		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.117	1	.733		
Fisher's Exact Test				1.000	.500
Linear-by-Linear Association	.114	1	.735		
N of Valid Cases	50				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.50.
b. Computed only for a 2x2 table

Fluoroquinolone prescribing. The goal of fluoroquinolone prescribing post-

implementation was to decrease fluoroquinolone prescribing by 75% after four weeks of QI

implementation. The percentage outcome comparison between the two groups is categorical and

chi-square analysis was used to calculate the relative risk of being prescribed the drug (with a

95% confidence interval). Fisher's exact test was used from one of the cells of the 2x2 table

used for chi-square which had less than five (5) observations (see Appendix G, figure 2). In pre-

implementation data, 4 out of 25 patients (16%) were prescribed fluoroquinolone for

uncomplicated UTI treatment. In post-implementation data, 0 out of 25 patients were prescribed

fluoroquinolone for uncomplicated UTI treatment. Fisher's Exact test found a statistically non-

significant difference between the intervention periods for the use of fluoroquinolones, $\chi2(1) =$

4.35, $p = 0.11$. However, the goal was met to decrease fluoroquinolone prescribing by 75% as

protocol decreased fluoroquinolone prescribing from 16% to 0%. Below are the Chi-Square test

results for fluoroquinolone prescribing. There was a non-significant difference in

Fluoroquinolone prescribing, p = 0.11, using Fisher's Exact test.

Chi-Square Tests for Fluoroquinolone Prescribing

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.348[a]	1	.037		
Continuity Correction[b]	2.446	1	.118		
Likelihood Ratio	5.893	1	.015		
Fisher's Exact Test				.110	.055
Linear-by-Linear Association	4.261	1	.039		
N of Valid Cases	50				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.00.
b. Computed only for a 2x2 table

Figure 2. There was a non-significant difference in Fluoroquinolone prescription, p = 0.11, using
Fisher's Exact Test.

Knowledge level assessment. The content validity index (CVI) for the pre and post

questionnaire on provider knowledge assessment has been revised and is approved by all three

experts panel with a mean CVI of 1.00 for 10 multiple choice questionnaire (Appendix C). Five

providers were recruited for the pre-implementation and post-implementation knowledge

assessment. The questionnaire was collected pre-implementation and 4 weeks after post-

implementation. Descriptive statistics were run and the assumption of normality for both

distributions using skewness and kurtosis statistics were checked and because both values are

below an absolute value of 2.0, then normality assumption is met (Appendix G, figure 3). This

allows for a more powerful repeated-measure t-test for the purpose of testing the hypothesis of

increase provider knowledge rather than using the Wilcoxon ranked test. The repeated-measures

t-test found a statistically significant increase in knowledge scores across time, $t(4) = -4.75$, $p =$

0.009. Provider's knowledge goal was met as more knowledge was gained about uncomplicated

UTI and complicated UTI after implementation. The overall findings are presented as follow:

Descriptive Statistics for Between-Subjects Comparisons

Outcome	Pre-intervention	Post-intervention	p-value
Knowledge*	3.20 (1.30)	7.60 (1.52)	0.009
Protocol Adherence**	19 (76.0%)	20 (80.0%)	0.73
Fluoroquinolones**	4 (16.0%)	0 (0.0%)	0.11

Note: * *M* (SD), ** Frequency (percentage)

Discussion

There is a rising trend of antibiotic resistance among common uropathogens in UTI since antibiotic is the second most common medication prescribed (Hopkins et al., 2014). In certain parts of the US, the resistance rate of uropathogens to fluoroquinolone has increased to as a high as 30% (Spellberg & Doi, 2015). Moreover, fluoroquinolone has a black box warning issued by the FDA due to its disabling serious reactions. It is imperative for providers to gain knowledge on the recommended first-line uncomplicated UTI treatment and to decrease the prescribing of fluoroquinolone. Previous research has identified the need for provider education as physicians were prescribing fluoroquinolone 63% of the time for uncomplicated UTI (Zatorski et al., 2016). The primary purpose of the UTI antibiotic stewardship QI project in an urgent care setting is to develop a protocol for the treatment of uncomplicated adult UTI in females. The secondary purpose is to improve providers' education on appropriate first-line antibiotic treatment and to decrease the prescribing of fluoroquinolone for UTI if it is not appropriate. The goal of the UTI protocol compliance was to increase the prescribing of appropriate first-line uncomplicated UTI antibiotic treatment by 100% after a 4-week implementation phase which was not met as results indicated 80% followed UTI protocol (Chi-square, p=0.73). Perhaps, the pilot study must have a longer implementation phase for the goal of 100% protocol compliance to be met. Fisher's Exact test found a statistically non-significant difference between the intervention periods for the use of fluoroquinolones, $\chi2(1) = 4.35$, $p = 0.11$. Nevertheless, the goal was of decreasing fluoroquinolone prescribing by 75% was met as fluoroquinolone prescribing decreased from 16% pre-implementation to 0% post-implementation. Observation studies have concluded there is a need for provider education as patients are receiving nonadherent treatments (Hecker et al., 2014; Zatorski et al., 2016). The literature review supports that the improvement project should focus on interactive educational meetings or one-on-ones while providing an algorithm handout

on UTI treatment for the providers to use as a reference as based on the QI project

implementation phase of one-on-one education and quick pocket handouts. The repeated-

measures t-test found a statistically significant increase in knowledge scores across time, $t(4) = -$

4.75, $p = 0.009$. Provider's knowledge goal was met as more knowledge was gained about

uncomplicated UTI and complicated UTI after implementation.

Limitations

As with the majority of improvement projects, the QI project is subject to limitations.

The limitations in terms of project design, data recruitment, collection methods, and data analysis

will be discussed.

Project Design. The project utilized a convenience sample of 50 patients and the small

sample size does not promote generalizability of the adult population with UTIs. In addition, a

sample size calculation was not performed during the project design. Convenience sampling or

failing to perform sample size calculations can lead to projects that do not achieve statistical

significance (Nayak, 2010). There were resource limitations to the study because of access to

time and participants. The project had to meet the institution's deadline and did not have any

funding which resulted in a relatively short project time of four weeks; therefore, statistical

significance could not be established for protocol compliance outcomes (Statistics Solutions,

2019). The lack of funding limits the DNP project to a short period of time as well. Another

limitation to the project was that there was no guarantee that the providers used the pocket

reference handout on UTI protocol provided to them during the implementation phase.

Generalizability will need to be confirmed with duplication of the project, perhaps with a larger

sample and longer project time.

       Data Recruitment. Participant recruitment is vital to the success of a QI project. Due to

the lack of resource and time, only 5 providers were recruited which were made up of one MD,

three NPs, and one PA. Future QI projects should develop strategies to ensure all potentially

eligible participants are invited to participate such as getting approved funding for a recruitment

team to recruit more providers to make up a larger sample size (Newington & Metcalfe, 2014).

       Collection Methods. Not all prescribers who were recruited saw an equal number of

uncomplicated UTI patients due to schedule conflicts; therefore, the adherence rate to protocol

compliance may not be reflective of the behavior patterns of all the recruited providers. Other

limitation includes the Hawthorne effect as it influenced the antibiotic prescribing behaviors of

prescribers as they were aware that inappropriate UTI management was being measured. The

Hawthorne Effect is the tendency for people to modify their behavior because they know they

are being studied and may misrepresent the research findings (Payne & Payne, 2004).

       In some cases, after the interpretation of findings, one may regret not including a specific

question to the survey (University of Southern California Libraries, 2019). The provider

knowledge questionnaire should have included education about when to order urine cultures as

90 percent (40 out of 50 patients) from the inclusion criteria of uncomplicated UTI had urine

cultures ordered that were not necessary. Future QI projects should include urine culture

questionnaires into the knowledge assessment.

       Data analysis. The integrity of data analysis could have been compromised by the

environment in which data was collected because the project lead handed the post-questionnaire

out during the in-service rounding (The Office of Research Integrity, 2005). There was no other

limitation to data analysis.

Dissemination of Findings and Sustainability

It is realistic to assume the project will be an ongoing QI initiative within the

organization as there was statistical significance with improving provider knowledge on UTI

management and the goal of decreasing fluoroquinolone prescribing by 75% was met per initial

project goals. Factors that promote project sustainability of evidence-based QI project include

strong leadership, support of stakeholders, nurse leaders, and continual project reevaluation that

are in alignment within the organization's vision and goals (Chambers, 2015). The UTI protocol

is aligned with the organization's goals of antibiotic stewardship and improving patient's

outcome. These findings of the DNP project may convince key stakeholders to approve it for an

organization-wide local ongoing protocol to all the other 11 urgent care sites to reach statistical

significance on protocol compliance.

The next step for local dissemination includes a PowerPoint presentation on the project

and its findings to the school institution and the urgent care organization. Key stakeholders

including the medical director and the NP/PA supervisors will be notified of the project findings;

the project lead will present the findings during the urgent care bi-yearly meetings to all the staff

and providers. The QI protocol will reach the target population of all 50 providers in the urgent

care setting on the importance of uncomplicated UTI protocol as it is mandatory for all providers

to attend. For the providers who missed the presentation, an email will be sent out to them on

the findings.

In addition, the project is sustainable to other urgent care sites nationwide as it is cost-effective by having one nurse leader as a project lead and utilizing simple pocket handouts with protocol algorithms. The knowledge questionnaire has a perfect CVI score for the dissemination of knowledge for UTI. Perhaps, future knowledge questionnaire should include information about the necessity of ordering urine cultures. The fact that the protocol uses evidence-based guidelines makes it more valuable and sustainable as well. The goal of decreasing inappropriate fluoroquinolone prescribing promotes patient safety and prevents the human population from the rising trend of antibiotic resistance.

In order to reach the target population of other urgent care sites nationwide, the QI project paper will be submitted to the Journal for Nurse Practitioners (JNP) for manuscript review and acceptance of project findings. It is a viable project as the algorithm along with the in-service and questionnaire approach has the potential to reduce unnecessary fluoroquinolone prescribing, decreasing adverse antibiotic reactions, and decreasing antibiotic resistance nationwide.

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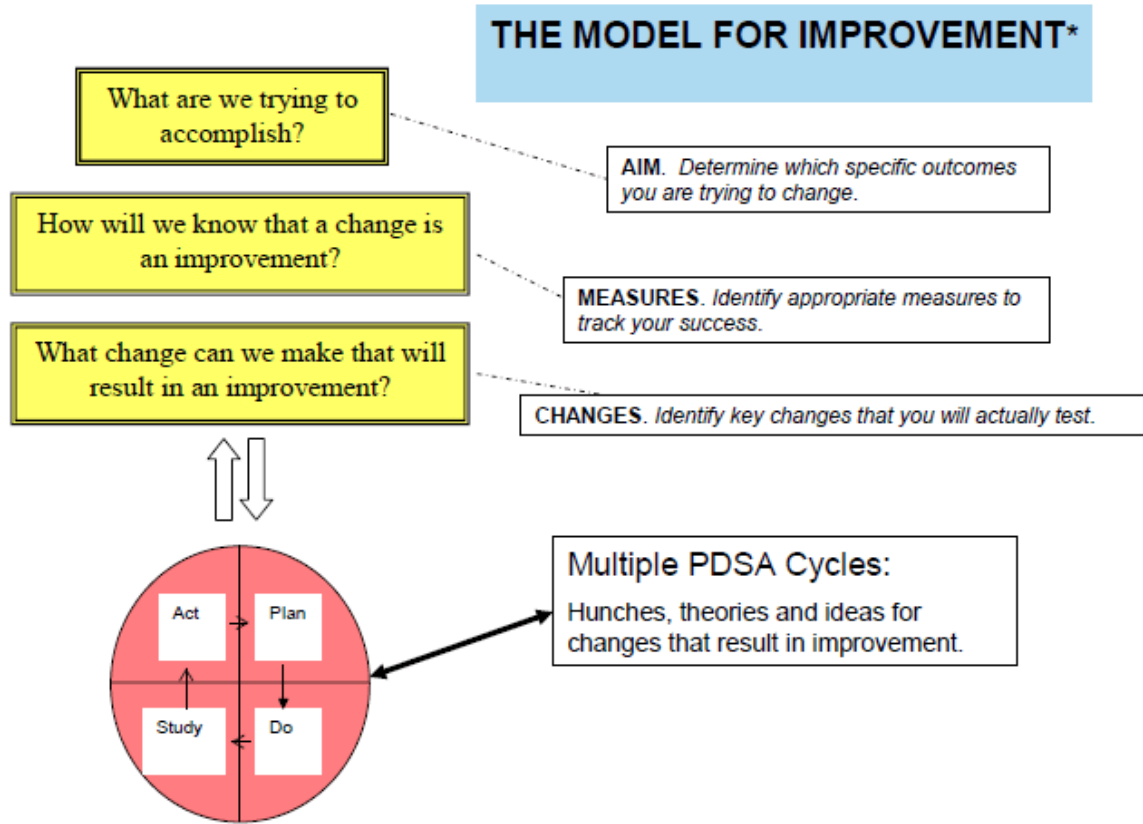**Appendix A**

The Model for Improvement

Figure 1. The Model for Improvement developed by the IHI (AHRQ, 2013).

Appendix B

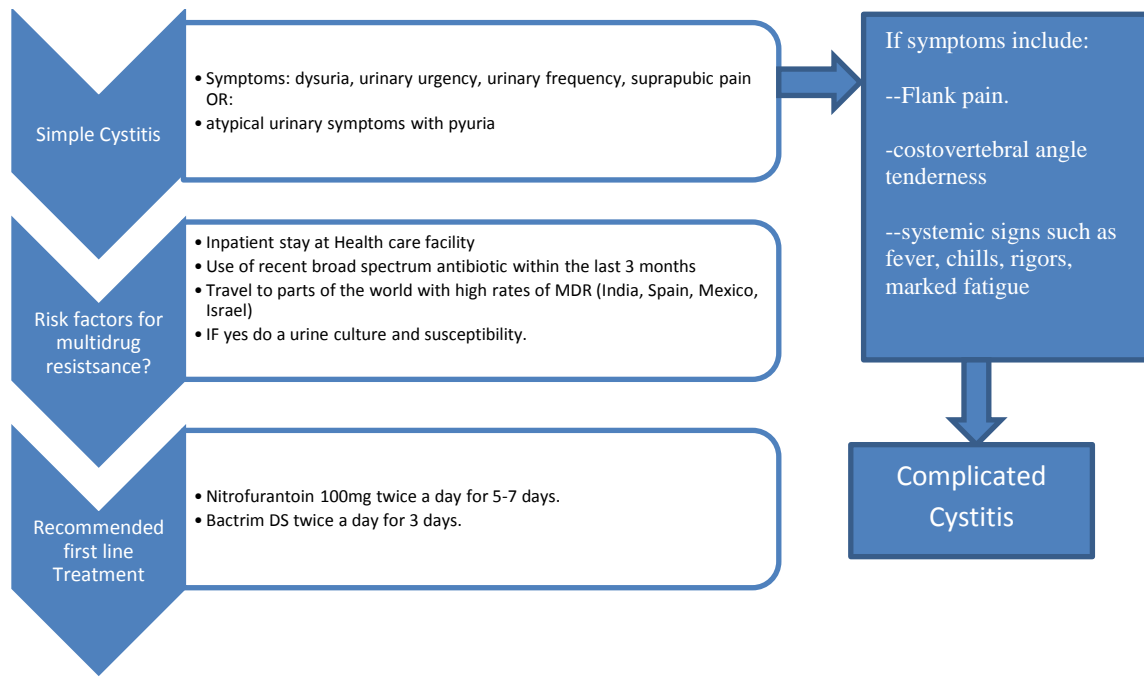| Simple Cystitis	• Symptoms: dysuria, urinary urgency, urinary frequency, suprapubic pain OR: • atypical urinary symptoms with pyuria	If symptoms include: --Flank pain. -costovertebral angle tenderness --systemic signs such as fever, chills, rigors, marked fatigue
Risk factors for multidrug resistsance?	• Inpatient stay at Health care facility • Use of recent broad spectrum antibiotic within the last 3 months • Travel to parts of the world with high rates of MDR (India, Spain, Mexico, Israel) • IF yes do a urine culture and susceptibility.	
Recommended first line Treatment	• Nitrofurantoin 100mg twice a day for 5-7 days. • Bactrim DS twice a day for 3 days.	Complicated Cystitis

Figure 2. Laminated pocket handouts for providers based on UpToDate Algorithm on Empiric antimicrobial selection for women with acute simple cystitis (Hooton & Gupta, 2018).

Appendix C

Test Construction

Purpose

Learning Objectives

Upon successful completion of this PowerPoint presentation, you will be able to:

- Differentiate between complicated UTI versus uncomplicated UTI.

- Recognize the first line of antibiotic therapy for uncomplicated UTI.

- Recognize the black box warning side effects of fluoroquinolone.

- Recognize the increase in antibiotic resistance rate to fluoroquinolone.

Population

The population is the nurse practitioners and medical doctors in an urgent care setting.

Length of the Test

The optimum length of the test is 10 questions.

Difficulty and Discrimination Levels of Test Items

According to Oermann and Gaberson (2017), a criterion-reference test is often used in clinical settings to measure set standards instead of the actual score itself. Due to the fact that this test is used for continuing education, low level to moderate difficulty questions should be used.

Scoring Procedures to be Used

The goal is to use a separate answer sheet that will later be used to develop a computer-generated item analysis report.

Item Format

The test will be a selected response multiple choice format.

Test Blueprint

Content	Level of Cognitive Skill				
	K	C	AP	AN	Total
Signs and Symptoms of uncomplicated UTI.					
Signs and symptoms of complicated UTI.					
Recommended first-line therapy for the treatment of uncomplicated UTI.					
Recognition of black box warning side effects of fluoroquinolone.					
Recognition of an increase in antibiotic resistance rate to fluoroquinolone.					
Total					

Questions

1) What is the current recommended first-line therapy for the treatment of uncomplicated UTIs in nonpregnant women?
   a) Bactrim DS twice a day for 5 days.
   b) Ciprofloxacin 250mg twice a day for 5 days.
   c) Nitrofurantoin 100mg twice a day for 5 days.
   d) Augmentin 875mg twice a day for 3 days.
   e) C and D.
   f) All of the above.

   Answer: E. The current recommended guidelines based on IDSA (Hopkins, McCroskey, Reeves, & Tanabe, 2014) and CDC (2017). Bactrim DS twice a day for 3 days is appropriate, also.

2) What is the recommended antibiotic therapy for complicated UTI in nonpregnant women?
   a) Bactrim DS twice daily for 7 days.
   b) Ciprofloxacin 500mg twice daily for 7 days.
   c) Augmentin twice daily for 10 days.
   d) Cefdinir 300mg twice daily for 10 days.
   e) All of the above.
   f) B and C.

Answer: E. Based on the recommended guidelines of Up To Date for complicated UTIs in an outpatient setting.

3) What are the symptoms of a complicated UTI in a woman?
   a) Fever of 100F or higher.
   b) Flank pain
   c) Costovertebral angle tenderness.
   d) Chills, fatigue, systemic changes.
   e) B & C.
   f) All of the above.

Answer: F. Based on UpToDate, a complicated UTI may present with all of the above symptoms.

4) What is the highest rate of ciprofloxacin resistance in certain parts of the United States for UTI?
   a) 10%
   b) 20%
   c) 30%.
   d) 40%

Answer: C. In the U.S., the resistance rate to fluoroquinolones has increased from 3% to 17% between the years 2000 to 2010 (Hooton & Gupta, 2018). In some parts of the US, there is a 10% to 30% increase of community-associated Enterobacteriaceae resistance to quinolone (Spellberg & Doi, 2015).

5) What special populations may have unique management considerations in the management of uncomplicated UTI?
   a) Pregnant women
   b) Renal transplant recipients
   c) Patients with poorly controlled diabetes
   d) Patients who have underlying urologic abnormalities
   e) Patients who are immunocompromised such as HIV patients.
   f) All of the above
   g) A and B only

Answer G. Per Up To Date, only pregnant women and renal transplant recipients have unique management and are not included in the categorization of Complicated UTI.

6) What makes ciprofloxacin a black box warning drug?
   a) Tendon rupture
   b) Peripheral neuropathy
   c) Myasthenia gravis exacerbation

    d) CNS effects
    e) All of the above
    f) A & B

Answer E. All of the above serious reactions make fluoroquinolone a black box warning drug based on UpToDate (Hooper, Calderwood, & Bond, 2018).

7) When should nitrofurantoin (Macrobid) be avoided?
    a) In patients with renal insufficiency with a creatinine clearance of <30ml/min.
    b) In patients with pyelonephritis
    c) In pregnant patients at 38 weeks or more gestation.
    d) A & B
    e) All of the above

Answer: E. Macrobid should be avoided in all of the above situations. Nitrofurantoin only achieves therapeutic concentrations in the lower urinary tract; it is a poor choice for upper urinary tract infections (pyelonephritis). According to Epocrates (2019), nitrofurantoin should be avoided in pregnancy at 38-42 weeks gestation and in patients with renal insufficiency.

8) A urine dip stick evaluation for predicting UTI in patients with symptoms may show which results?
    a) Pyuria
    b) Hematuria
    c) Nitrite
    d) All of the above
    e) A and C only

Answer: D. All of the above results indicate a UTI either when seen alone or in combination. Hematuria only is not a sensitive indicator for UTI in the absence of symptoms. Urine dip stick test with positive leukocyte or nitrite has 75 percent sensitivity and 82 percent specificity for predicting UTI.

9) When is it necessary to send out a urine culture after the prediction of a UTI?
    a) A urine culture should be sent out for all UTI.
    b) Recent antibiotic use within the last 3 months.
    c) Recent inpatient stays at a health care facility.
    d) Traveling to parts of the world with high rates of multidrug resistance such as Mexico.
    e) B and C only
    f) B, C, and D

Answer F. Protocol discussed when to send out a urine culture.

10) When would you see a positive nitrite in a urine dipstick test?

1) When gram-negative bacteria are present, such as Enterobacteriaceae.
2) In the presence of both gram-negative and gram-positive bacteria.
3) When the patient has ingested chemical dye or food that turns the urine red.
4) A & C
5) All of the above.

Answer: D. Only gram-negative bacteria converts' nitrates to nitrite, if the UTI was caused by a gram-positive organism, nitrite would not be present. False positive is possible if patients have ingested chemical dye or food that turns the urine red.

Appendix D

Urgent Care Providers,

A Quality Improvement Protocol will be implemented at Huntington Beach urgent care regarding the treatment of uncomplicated urinary tract infections (UTI) in adult females.   You will receive a current clinical guideline for the treatment of uncomplicated UTI and there will be an in-service on the new protocol. A laminated pocket guide will be handed out to all providers. Prescriptions for UTI will be studied through All Scripts one month before and 6 weeks after the education and distribution of the new UTI protocol guidelines. A survey will be left in the Huntington Beach manager's office for 4 volunteer providers to fill out before the protocol education and 6 weeks after the protocol education. I am looking for one MD, two NPs, and one PA to participate.   Your pre-test and post-test questionnaire will remain anonymous. The questionnaires will be destroyed at the end of the project. The outcome will be to increase the use of first-line antibiotics in an urgent care setting following the implementation of the QI protocol for the treatment of uncomplicated UTI in females. There will be no coercing of any prescribers to participate in this study. There will be no compensation for participating in this project. There will be no loss of benefit for refusal to participate in this project. The results of this study will be presented for a Doctor of Nursing Practice Project at Touro University.

Sincerely,

My Phuong Nguyen, MSN, FNP-C, DNP student
(714) 757-353

Appendix E

Informed Consent

The Impact of a UTI Protocol Initiative for the Management of Uncomplicated Urinary Tract Infections in an Urgent Care Setting

You are being asked to participate in a quality improvement project to evaluate the prescribing habits of providers for uncomplicated urinary tract infections in adult females in the urgent care setting. You will be given a pre-questionnaire to voluntarily fill out and leave in a locked box. You will then be given the UpToDate guidelines for the treatment of urinary tract infection for review in a form of laminated handouts, in-service, and PowerPoint presentation email. After a 6 week period of time, you will be given a post-questionnaire to voluntarily and anonymously fill out and leave in a locked box in the manager's office at urgent care. The questionnaires will be compared for improvement in prescribing habits and provider knowledge base regarding the recommended first-line treatment of uncomplicated urinary tract infections. Prescriptions for urinary tract infections will be studied through the use of All Scripts, the urgent care electronic health record, one month before and 6 weeks after the education and initiation of the UTI protocol. The surveys will be left in the manager's office for five providers who volunteer and the five providers will be instructed to voluntarily leave the completed questionnaire in a locked collection box in the manager's office. The surveys will be destroyed at the conclusion of the project. The outcome will be to increase the use of first-line antibiotics in an urgent care setting following the implementation of the QI protocol for the treatment of uncomplicated UTI in females. There will be no coercing of any prescribers to participate in this study. There will be no compensation for participating in this project. There will be no loss of benefit for refusal to participate in this project. The results of this study will be presented for a Doctor of Nursing Practice Project at Touro University.

All of my questions have been answered to my satisfaction and if I have any further questions I may call My Phuong Nguyen, MSN, FNP-C, DNP Student, myphuong.nguyen@hoag.org or call 714) 7571.

Statement of consent: I have read the above information and I volunteer consent to take part in this project.
Your signature_____ Date_____
Your name printed_____
Investigator signature_____ Date_____
 Investigator printed _____

Appendix F

Code Book/UTI Algorithm and Treatment Protocol

Item	Variable Code	Response Code	Compliance Supporting Code
Of the 25 patients, was patient treated with the right antibiotic per UTI protocol pre-test?	Pretest	1= yes 2= no	1=19 2= 6
What did the 25 charts show for what was given for uncomplicated UTI?	preant	1= Ciprofloxacin 2= cephalosporin 3= Bactrim 4= Macrobid 5=Augmentin	1=2 2=4 3=0 4=19 5=0
Of the 25 patients, was patient treated with the right antibiotic per UTI protocol post-test?	posttest	1= yes 2= no	1=20 2= 5
What did the 25 charts show for what was given for uncomplicated UTI?	postant	1= Ciprofloxacin 2= cephalosporin 3= Bactrim 4= Macrobid 5=Augmentin	1=0 2=5 3=2 4=16 5=2
What is the current recommended first-line therapy for the treatment of uncomplicated UTIs in nonpregnant	Q1	a) Bactrim DS twice a day for 5 days. b) Ciprofloxacin 250mg twice a day for 5 days. c) Nitrofurantoin 100mg twice a day for 5	1=0 2=0 3=3

women?		days. d) Augmentin 875mg twice a day for 3 days. e) C and D. f) All of the above.	4=0 5=2 6=0
What is the recommended antibiotic therapy for complicated UTI in nonpregnant women?	Q2	a) Bactrim DS twice daily for 7 days. b) Ciprofloxacin 500mg twice daily for 7 days. c) Augmentin twice daily for 10 days. d) Cefdinir 300mg twice daily for 10 days. e) All of the above. f) B and C.	1=1 2=3 3=0 4=0 5=0 6=1
What are the symptoms of a complicated UTI in a woman?	Q3	a) Fever of 100F or higher. b) Flank pain c) Costovertebral angle tenderness. d) Chills, fatigue, systemic changes. e) B & C. f) All of the above.	1=0 2=0 3=0 4=1 5=0 6=4
What is the highest rate of ciprofloxacin resistance in certain parts of the United States for UTI?	Q4	a) 10% b) 20% c) 30%. d) 40%	1=1 2=1 3=2 4=1
What special populations may have unique management considerations in the management of	Q5	a) Pregnant women b) Renal transplant recipients c) Patients with poorly controlled diabetes d) Patients who have	1=0 2=0 3=0

uncomplicated UTI?		underlying urologic abnormalities e) Patients who are immunocompromised such as HIV patients. f) All of the above g) A and B only	4=0 5=0 6=5 7=0
What makes ciprofloxacin a black box warning drug?	Q6	a) Tendon rupture b) Peripheral neuropathy c) Myasthenia gravis exacerbation d) CNS effects e) All of the above f) A & B	1=2 2=0 3=0 4=0 5=0 6=3
When should nitrofurantoin (Macrobid) be avoided?	Q7	a) In patients with renal insufficiency with creatinine clearance of <30ml/min. b) In patients with pyelonephritis c) In pregnant patients at 38 weeks or more gestation. d) A & B e) All of the above	1=1 2=0 3=0 4=2 5=2
A urine dip stick evaluation for predicting UTI in patients with symptoms may show which results?	Q8	a) Pyuria b) Hematuria c) Nitrite d) All of the above e) A and C only	1=0 2=0 3=1 4=4 5=0

When is it necessary to send out a urine culture after the prediction of a UTI?	Q9	a) A urine culture should be sent out for all UTI. b) Recent antibiotic use within the last 3 months. c) Recent inpatient stays at a health care facility. d) Traveling to parts of the world with high rates of multidrug resistance such as Mexico. e) B and C only f) B, C, and D	1=3 2=0 3=0 4=0 5=1 6=1
When would you see a positive nitrite in a urine dipstick test?	Q10	a) When gram-negative bacteria are present, such as Enterobacteriaceae. b) In the presence of both gram-negative and gram-positive bacteria. c) When the patient has ingested chemical dye or food that turns the urine red. d) A & C e) All of the above.	1=2 2=1 3=0 4=1 5=1
What is the current recommended first-line therapy for the treatment of uncomplicated UTIs in nonpregnant women?	Q1	a) Bactrim DS twice a day for 5 days. b) Ciprofloxacin 250mg twice a day for 5 days. c) Nitrofurantoin 100mg twice a day for 5 days. d) Augmentin 875mg twice a day for 3 days. e) C and D. f) All of the above.	1= 0 2=0 3=1 4=0 5=4 6=0

What is the recommended antibiotic therapy for complicated UTI in nonpregnant women?	Q2	a) Bactrim DS twice daily for 7 days. b) Ciprofloxacin 500mg twice daily for 7 days. c) Augmentin twice daily for 10 days. d) Cefdinir 300mg twice daily for 10 days. e) All of the above. f) B and C.	1=1 2=0 3=0 4=0 5=3 6=1
What are the symptoms of a complicated UTI in a woman?	Q3	a) Fever of 100F or higher. b) Flank pain c) Costovertebral angle tenderness. d) Chills, fatigue, systemic changes. e) B & C. f) All of the above. g)	1=0 2=0 3=0 4=0 5=5 6=0
What is the highest rate of ciprofloxacin resistance in certain parts of the United States for UTI?	Q4	a) 10% b) 20% c) 30%. d) 40%	1=0 2=0 3=4 4=1
What special populations may have unique management considerations in the management of uncomplicated UTI?	Q5	a) Pregnant women b) Renal transplant recipients c) Patients with poorly controlled diabetes d) Patients who have underlying urologic abnormalities e) Patients who are immunocompromised such as HIV patients. f) All of the above g) A and B only	1=0 2=0 3=0 4=0 5=0 6=2 7=3

What makes ciprofloxacin a black box warning drug?	Q6	a) Tendon rupture b) Peripheral neuropathy c) Myasthenia gravis exacerbation d) CNS effects e) All of the above f) A & B	1=1 2=0 3=0 4=0 5=4 6=0
When should nitrofurantoin (Macrobid) be avoided?	Q7	a) In patients with renal insufficiency with creatinine clearance of <30ml/min. b) In patients with pyelonephritis c) In pregnant patients at 38 weeks or more gestation. d) A & B e) All of the above	1=0 2=0 3=1 4=2 5=2
A urine dip stick evaluation for predicting UTI in patients with symptoms may show which results?	Q8	a) Pyuria b) Hematuria c) Nitrite d) All of the above e) A and C only	1=0 2=0 3=0 4=5 5=0
When is it necessary to send out a urine culture after the prediction of a UTI?	Q9	a) A urine culture should be sent out for all UTI. b) Recent antibiotic use within the last 3 months. c) Recent inpatient stays at a health care facility. d) Traveling to parts of the world with high	1=0 2=0 3=0 4=0 5=1

		rates of multidrug resistance such as Mexico. e) B and C only f) B, C, and D	6=4
When would you see a positive nitrite in a urine dipstick test?	Q10	a) When gram-negative bacteria are present, such as Enterobacteriaceae. b) In the presence of both gram-negative and gram-positive bacteria. c) When the patient has ingested chemical dye or food that turns the urine red. d) A & C e) All of the above.	1=1 2=2 3=0 4=2 5=0

Total=5 providers

Scale Interpretation:

Pre-test data collection
Pre-Tool Information
Post-tool Information

Appendix G

Chi-Square Tests for Protocol Compliance Comparison

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.117[a]	1	.733		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.117	1	.733		
Fisher's Exact Test				1.000	.500
Linear-by-Linear Association	.114	1	.735		
N of Valid Cases	50				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.50.
b. Computed only for a 2x2 table

Figure 1. There was a non-significant difference in protocol adherence, p = 0.73.

Row * Column Crosstabulation for fluoroquinolone Comparison

			Column		Total
			Flouro	No Fluoro	
Row	Pretest	Count	4	21	25
		% within Row	16.0%	84.0%	100.0%
	Posttest	Count	0	25	25
		% within Row	0.0%	100.0%	100.0%
Total		Count	4	46	50
		% within Row	8.0%	92.0%	100.0%

Chi-Square Tests for Fluoroquinolone Prescribing

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.348[a]	1	.037		
Continuity Correction[b]	2.446	1	.118		
Likelihood Ratio	5.893	1	.015		
Fisher's Exact Test				.110	.055

Linear-by-Linear Association	4.261	1	.039		
N of Valid Cases	50				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.00.

b. Computed only for a 2x2 table

Figure 2. There was a non-significant difference in Fluoroquinolone prescription, p = 0.11, using Fisher's Exact Test.

Descriptive Statistics for Knowledge Comparison

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
PreTotal	5	3.20	1.304	.541	.913	-1.488	2.000
PostTotal	5	7.60	1.517	1.118	.913	1.456	2.000
Valid N (listwise)	5						

Figure 3. The pre and post total knowledge means and standard deviations. Also, we checked the assumption of normality for both distributions using skewness and kurtosis statistics. Because both values are below an absolute value of 2.0, then normality assumption is met.

Paired Samples Statistics for Knowledge Assessment Comparison

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PreTotal	3.20	5	1.304	.583
	PostTotal	7.60	5	1.517	.678

Figure 4. Here are the means and standard deviations for each observation (pre and post).

Paired Samples Test for Provider Knowledge Comparison

		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	PreTotal - PostTotal	-4.400	2.074	.927	-6.975	-1.825	-4.745	4	.009

Figure 5. There was a statistically significant increase in knowledge scores across time, t(4) = -4.75, p = 0.009.