Title: Antibiotic Stewardship for Uncomplicated Urinary Tract Infection in an Urgent Care

Setting: A Quality Improvement Project

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Abstract

Urinary tract infections (UTI) are common health care visits at roughly 7 million office visits yearly. Literature review demonstrated 63% of patients received non-adherent UTI treatment and the most commonly used antibiotic was fluoroquinolone in 98% of cases.

Aim: A UTI protocol quality improvement project was developed at an urgent care setting.

Results: The goal of decreasing quinolone prescribing was met as it decreased to 0% post-implementation. There was a statistically significant increase in provider knowledge scores across time, $t(4) = -4.75$, $p = 0.009$.

Implication: A UTI protocol may decrease unnecessary fluoroquinolone prescribing and increase provider knowledge about UTI.

Highlights

- The goal was of decreasing quinolone prescribing by 75% was met as fluoroquinolone prescribing decreased from 16% pre-implementation to 0% post-implementation.
- 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 pilot project should have a longer implementation phase for the goal of 100% protocol compliance to be met.

Keywords

Cover letter

My Name is My Phuong Nguyen FNP-C, a recently graduated DNP from Touro University of Nevada. My DNP project promoted antibiotic stewardship for an urgent care setting by implementing an uncomplicated urinary tract infection protocol to decrease the rate of unnecessary fluoroquinolone prescribing as it is now a black box warning drug. The secondary purpose of the UTI protocol was to increase provider knowledge on UTI symptoms and management. The goal of decreasing fluoroquinolone prescribing was met and there was a statistical significant increase in provider knowledge of UTI based on a 10-point CVI questionnaire. The UTI protocol project fits the Journal of Nurse Practitioners mission of thought-provoking articles that demonstrates to role of how policy plays in shaping practice and delivering outcomes. The Journal of Nurse Practitioners promotes original research based on evidence-based practice and continuing education. The manuscript has not been and will not be submitted elsewhere for publication.

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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.

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.

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).

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.

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Ethics and Human Subjects Protection

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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.

Project Proposal: Analysis

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. 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, $\chi 2(1) =$

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%.

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, $t(4) = -4.75$, $p =$ 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

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. 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 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.

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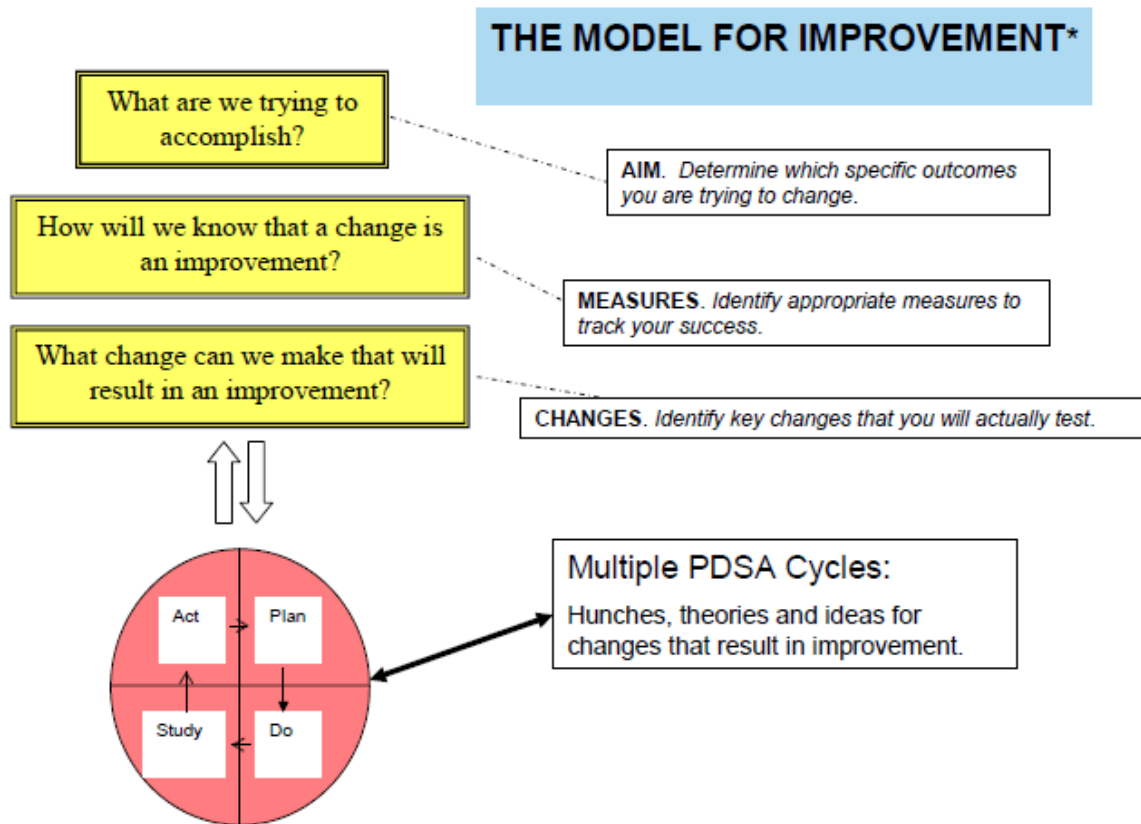
Appendix A

The Model for Improvement

THE MODEL FOR IMPROVEMENT*

What are we trying to accomplish?

AIM. *Determine which specific outcomes you are trying to change.*

How will we know that a change is an improvement?

MEASURES. *Identify appropriate measures to track your success.*

What change can we make that will result in an improvement?

CHANGES. *Identify key changes that you will actually test.*

Act | Plan
Study | Do

Multiple PDSA Cycles:

Hunches, theories and ideas for changes that result in improvement.

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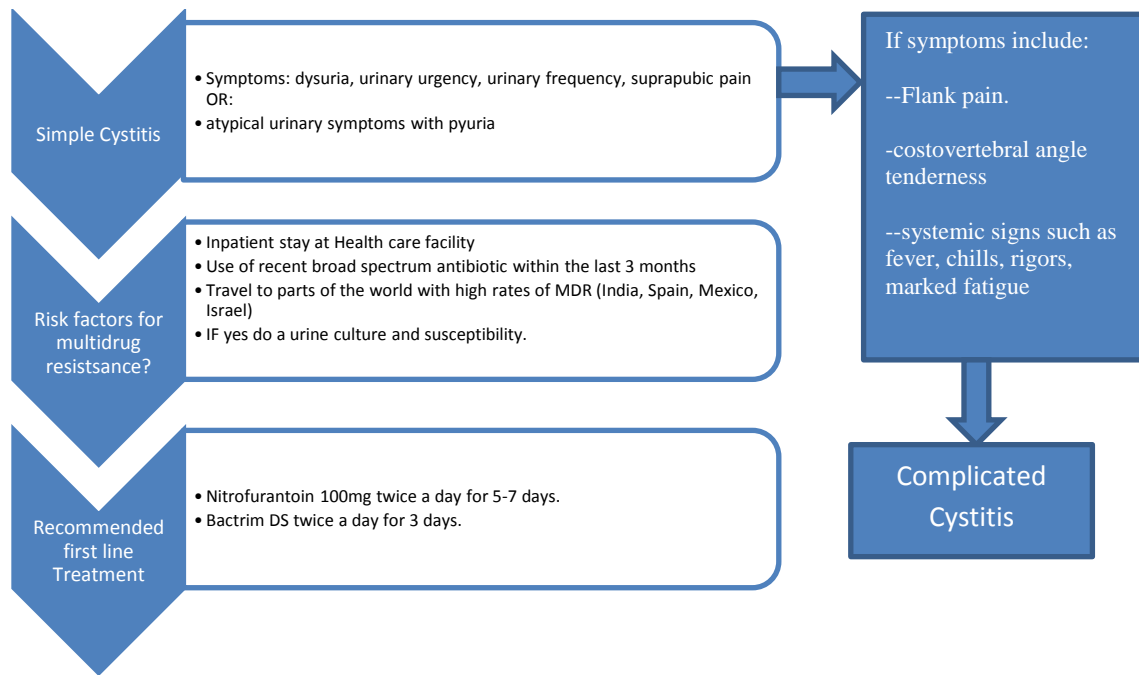
Appendix B

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

Test Construction

Learning Objectives

- 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.

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.

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.

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.

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%

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

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

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

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

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

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.