Antimicrobial Resistance of Uncomplicated Urinary Tract Infections in Northern Utah

MICHAEL MCQUILKIN, ALEXANDER LUND, WYATT PALMER

OBJECTIVE: To evaluate antimicrobial resistance in uropathogenic bacteria in northern Utah.

DESIGN: One hundred twenty bacterial isolates from community-acquired UTI in the northern Utah area (Davis and Weber Counties) were tested. Samples were taken from otherwise healthy women, ages 18 to 50. Antimicrobial susceptibility testing for sulfamethoxazole/trimethoprim (SXT/TMP), ciprofloxacin, and nitrofurantoin comprised the process.

SETTING: The Clinical Laboratory Science Department at Weber State University, with samples coming from clinics in the northern Utah area (Davis and Weber Counties).

PARTICIPANTS: Urine samples were taken from otherwise healthy women, ages 18 to 50, who suffered from uncomplicated urinary tract infections.

MAIN OUTCOME MEASURE: Antimicrobial resistance was measured using antimicrobial susceptibility testing and shown with other national resistance rates.

RESULTS: Of bacterial isolates, 21.3% were resistant to SXT/TMP, 14.4% were resistant to ciprofloxacin, and 13.9% were resistant to nitrofurantoin. The resistance rates for ciprofloxacin and nitrofurantoin were acceptable for empirical UTI treatment (< 20% resistance), but local bacterial populations were found to demonstrate an increase in resistance to these two drugs as compared to previously observed national data. SXT/TMP resistance was above the recommended resistance threshold of 20% for effective empirical treatment, as advised by the IDSA.

CONCLUSION: Results suggest that uncomplicated community-acquired UTI be treated with nitrofurantoin. Other recommendations include continued monitoring of local uropathogenic antimicrobial resistance.

ABBREVIATIONS: ATCC = American Type Culture Collection; IDSA = Infectious Disease Society of America; NCCLS = National Committee for Clinical Laboratory Standards; SXT/TMP = sulfamethoxazole/trimethoprim; UTI = urinary tract infections.

INDEX TERMS: infection; pathogen; resistance; urology; Utah.

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Urinary tract infections (UTI) cause millions of clinical visits every year in the US, with over half of all women reporting at least one UTI in their lifetime.[1] The organisms that cause these infections typically react well to a wide range of antibiotics, thus culture and antimicrobial sensitivity testing are rarely performed for patients with UTI.[2] The preference for empirical antimicrobial therapy is due, primarily, to the predictability of the etiological agents that cause infection; namely *Escherichia coli* which accounts for 75%-90% of bacterial isolates.[3,4] Recently, there has been an alarming increase in the occurrence of resistance to the drugs commonly prescribed, namely sulfamethoxazole/trimethoprim (SXT/TMP), ciprofloxacin, and nitrofurantoin. This resistance can cause

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a number of healthcare related issues ranging from problems with antibiotic dosage to patient hospitalization. While national trends of antimicrobial UTI resistance have been tracked, actual patterns of resistance vary by locale.[1,5,6]

The antimicrobial susceptibility of bacterial organisms isolated from patients with known UTI in northern Utah (primarily Davis and Weber Counties) was the primary focus of this study. The isolated bacteria were subjected to each of the three aforementioned antibiotics. These antimicrobials were chosen due to their high prescription and efficacy rates.[5] Measurement of resistance and susceptibility was accomplished by Kirby-Bauer disc diffusion antimicrobial susceptibility testing.

MATERIALS AND METHODS

This study included 108 bacterial isolates from the urine of 120 patients ages 18 to 50 with diagnosed uncomplicated community-acquired UTI from northern Utah during November 2006 to January 2007 (12 samples resulted in no growth). Specimens were received from 17 area clinics and hospitals, and all 120 patient records were reviewed by the primary care giver in order to verify that the UTI were community-acquired and uncomplicated, with uncomplicated defined as only structurally and neurologically normal female urinary tracts without pregnancy or urinary catheter involvement. Urine samples were collected in BD Vacutainer Culture and Sensitivity urine transfer kits with preservative and kept in a monitored refrigerator at four degrees Celsius for no more than 24 hours. Bacterial identification was performed on 62 samples using the Dade Microscan Walkaway instrument (Dade International Inc., West Sacramento CA).

Resistance of the bacterial isolates to SXT/TMP, ciprofloxacin, and nitrofurantoin was determined by comparing the zones of inhibition around each antibiotic coated sensitivity disc, obtained by measuring the diameter of the area which lacked bacterial growth in millimeters two ways and averaged, as according to the National Committee for Clinical Laboratory Standards (NCCLS) and the Infectious Disease Society of America (IDSA) Kirby-Bauer disc diffusion standards.[5,7,8] The bacterial measurements were then classified as susceptible or resistant as stated by NCCLS cut-off points.[8] Kirby-Bauer growth media was inoculated using 0.5 MacFarland standards as measured by BD Crystal Spec Nephelometer™ (Becton Dickinson Diagnostic Systems, Franklin Lakes NJ) in Hardy Diagnostic 10 mL clear tubes, in conformance with the previously mentioned guidelines. Hardy Diagnostic Antimicrobial Sensitivity discs were aseptically placed on the Kirby Bauer growth media. Bacterial inhibition zones were measured after overnight incubation. Three America Type Culture Collection (ATCC) bacterial control strains were continuously grown and measured throughout the experimental phase of the study, with all controls giving acceptable results.

RESULTS

The 108 microbial isolates tested were from 120 women with uncomplicated community-acquired UTI. Of the 120 samples collected, 12 resulted in no growth and therefore could not be tested. Results of bacterial identification were obtained from the clinical facility for 62 samples, which included the following organisms: 41 *E. coli*, eight *K. pneumoniae*, three *E. faecalis*, two *E. cloacae*, two *C. koseri*, one *C. freundii*, one *P. mirabilis*, one *P. aeruginosa*, one *E. aerogenes,* one *K. oxytoca,* and one *R. ornothinolyt*. Only a portion of the bacterial isolates were identified because overall resistance determines empiric treatment efficacy and the scope of this study did not warrant the identification of all samples. Of the 108 isolates tested, 21.3 % were resistant to SXT/TMP, 14.4% were resistant to ciprofloxacin, and 13.9% were resistant to nitrofurantoin.

As a subgroup of UTI in general, *E. coli* infections were also analyzed in order to detect the resistance rate, as *E. coli* represents the primary uropathogen.[5] Analysis of patient data concerning only infections in which *E. coli* was the known causative agent showed that SXT/TMP had exceeded the IDSA's advised resistance rate of 20%. Of *E. coli* strains, 21.95% were resistant to SXT/TMP, thus exceeding the IDSA acceptable level of resistance.[7]

DISCUSSION

Antimicrobial resistance is a nationwide problem, which requires constant surveillance in order to prevent a systemic breakdown in viable treatment due to widespread resistance. Other national studies have shown increasing uropathogenic resistance rates, but local studies are recommended so physicians and other primary care givers can be apprised of the resistance patterns in their regions and treat patients accordingly. As no data tracking resistant uropathogenic bacteria in northern Utah is available, comparisons have been drawn between local and national data. Data collected on the national level from 1995 to 2001 showed a small increase in the rate of resistance in three prominent drugs used to treat uncomplicated UTI as plotted with this current data (Figure 1). Although we cannot make a valid conclusion as to whether Utah is following a national trend due to the lack of published information, the results of this study showed that

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the uropathogenic bacteria in northern Utah have become sufficiently resistant to treatment with SXT/TMP as to render its use contraindicated. A ten-year resistance comparison is shown in Figure 2.

In order to prevent the propagation of SXT/TMP resistance traits, it is no longer advisable to use SXT/TMP for the treatment of uncomplicated UTI. An alternative to SXT/TMP, ciprofloxacin is an inadvisable option. Ciprofloxacin has been associated with tendinopathies, including spontaneous Achilles tendon detachment.[9,10,11] Nitrofurantoin, relatively free of major side effects and with the lowest demonstrated incidence of resistance, presents the most viable option for treatment. One hundred mg twice daily for 7 to 10 days is the appropriate UTI management course.[5]

The clear increase in antimicrobial resistance warrants continuing study of not only the local bacterial population in Utah but elsewhere. It is therefore recommended that further surveillance be undertaken in order to monitor local resistance rates. The importance of accurate local resistance information behooves institutions to monitor future changes and make the data public in order to prevent further resistance and possible antimicrobial impotence.

Figure 1. Years 1995-2001 represent national data, while 2007 details current northern Utah data

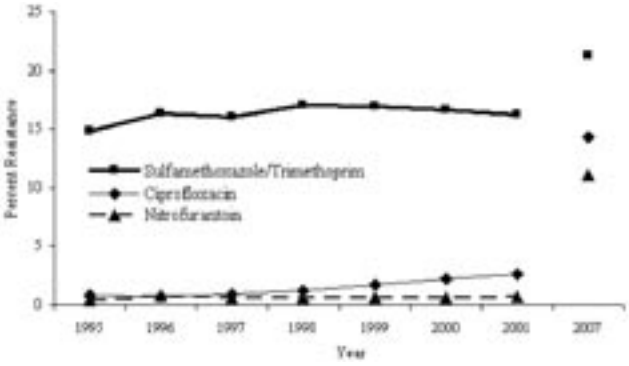
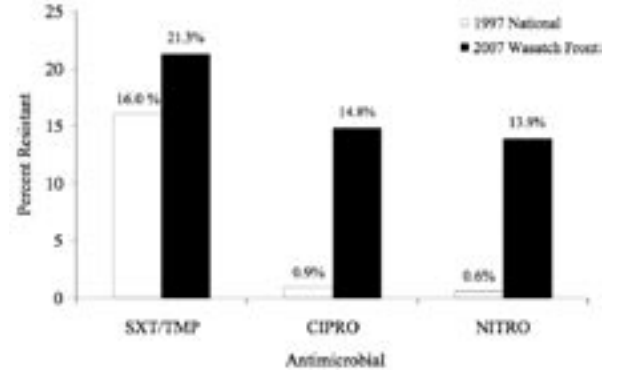


Figure 2. National antimicrobial resistance rates from 1997 contrasted with the experimentally determined resistance rates from northern Utah in 2007



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