Urinary Bacterial Pathogens and their Antimicrobial Susceptibility Profile for the years 2005–2007 in St Kitts

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ABSTRACT

Objective: *The purpose of this study is to review bacterial isolates from cases of urinary tract infection (UTI) and their antimicrobial susceptibility pattern for the years 2005–2007 in St Kitts. It is hoped that the study will be of use in the treatment of cases of UTI in St Kitts.*

Methods: *The laboratory records at St Francis Hospital, Basseterre, St Kitts, for bacterial isolates from cases of urinary tract infection and their susceptibility profiles for three years, 2005–2007, were retrospectively reviewed and compared.*

Results: *A total of 595 isolates of 13 species of pathogenic bacteria were recovered from cases of UTI.* Escherichia coli *was the predominant species recovered each year. Among the other species frequently recovered were Citrobacter* spp, *Enterobacter* spp, Klebsiella pneumoniae *and* Pseudomonas aeruginosa.

Conclusion: *This study, the first of its kind from St Kitts serves to emphasize that treatment of UTI should be instituted generally on the basis of antimicrobial susceptibility tests.*

Patógenos Bacterianos Urinarios y Su perfil de Susceptibilidad Antimicrobiana Durante los Años 2003-2007 en Saint Kitts

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RESUMEN

Objetivo: *El propósito de este estudio es examinar los aislados bacterianos de casos de infección del tracto urinario (ITU) y su modelo de susceptibilidad antimicrobiana durante los años 2005–2007 en Saint Kitts. Se espera que el estudio sea de utilidad en el tratamiento de casos de ITU en Saint Kitts.*

Métodos: *Los archivos de laboratorio del Hospital Saint Francis, Basseterre, Saint Kitts, sobre los aislados bacterianos de los casos de infección del tracto urinario y sus perfiles de susceptibilidad durante tres años, 2005–2007, fueron examinados y comparados retrospectivamente.*

Resultados: *Un total de 595 aislados de 13 especies de bacterias patógenas fueron recuperadas de casos de ITU.* Escherichia coli *fue la especie predominante recuperada cada año. Entre las otras especies frecuentemente recuperadas se hallan: Citrobacter* spp, *Enterobacter* spp, Klebsiella pneumoniae *y* Pseudomonas aeruginosa.

Conclusión*: Este estudio – el primero de su tipo en Saint Kitts – sirve para enfatizar que el tratamiento de la ITU generalmente debe establecerse sobre la base de pruebas de susceptibilidad antimicrobiana.*

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INTRODUCTION

Urinary tract infection (UTI) is one of the commonest infections worldwide. It is responsible for significant morbidity in both hospitalized and community patients. Despite the widespread availability of antibiotics, it remains the most common bacterial infection in humans. The pattern of aetiological agents and antimicrobial susceptibility varies from region to region. It has been advocated that there should be surveillance of the bacterial spectrum of aetiological agents of UTI, and theirantimicrobial resistance pattern on both a global and local level (1–3). Antibiotics are usually given empirically before the laboratory results of urine

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culture are available. To ensure appropriate therapy, current knowledge of the organisms that cause UTI and their antibiotic susceptibility is mandatory (2). The aim of the present study is to review bacterial isolates from cases of urinary tract infection and their antimicrobial susceptibility profiles for the years 2005–2007. It is hoped that the information gained would help in instituting proper antibiotic therapy for cases of UTI in St Kitts.

SUBJECTS AND METHODS

A mid-stream ("clean catch") urine specimen was collected from each patient. Quantitative bacteriological cultures were performed according to standard laboratory procedures (4). A standard calibrated loop delivering 0.001 ml of urine was used to inoculate plates of cysteine lactose electrolyte deficient (CLED) agar and MacConkey agar. The inoculated plates were incubated aerobically at 37ºC for 18–24 hours and colony counts were expressed in colony–forming units (CFU) per millilitre (ml) of urine. A count of 10^5 or more CFU per ml was considered as significant bacteriuria. Species identification of bacteria was based on colony morphology and biochemical characterization. Isolates of *Citrobacter*, *Enterobacter* and *Acinetobacter* were not identified to species level due to limitations of time and lack of some reagents. Isolates were tested for antimicrobial susceptibilities on Mueller-Hinton agar by the Kirby-Bauer disk diffusion technique (5) using the following discs and concentrations (mentioned in parenthesis): amikacin (10 µg), ampicillin (10 µg), augmentin [amoxicillin and clavulanic acid] (30 µg), cefozolin (30 µg), cephalothin (30 µg), ciprofloxacin (5 µg), sulfamethoxazole) (25 µg), and norfloxacin (10 µg). The isolates of *Morganella morgani* were not tested for antimicrobial susceptibility due to shortage of antibiotic disks.

RESULTS

A total of 595 isolates belonging to 10 genera of pathogenic bacteria were recovered from cases of UTI with significant bacteriuria *ie* a count of 10^5 or greater than 10^5 CFU/ml of the suspected aetiological agent. The specifically identified isolates represented 10 distinct species; the isolates of *Citrobacter*, *Enterobacter* and *Acinetobacter* were not identified to species level. The patients with UTI had dysuria, polyuria, urgency to urinate, abdominal or flank pain, and, at times, fever. From the scanty clinical data provided by the referring physicians, no difference could be made between upper and lower UTI; such differentiation is also not considered relevant to this study. The number of isolates for the respective years was as follows: 2005–176 isolates, 2006–175 and 2007–244 isolates. The distribution of cases of UTI according to outpatients and inpatients, gender and amongst adults and children is given in Table 1. The percentage breakdown of outpatients and inpatients in the period of study was 78–91% and 9–22% respectively. As can be seen, females contributed to a much greater number of cases (63–71%) than males (29–37%). None of the inpatients had any functional or anatomic abnormalities of the urinary tract nor had any of them been on urinary catheters. *Escherichia coli* was by far the predominant species recovered each year (Table 2).

Table 1: Distribution (%) of 502 patients with UTI according to gender and amongst adults and children.

Year	No. of cases	% of cases in: out-pts	in-pts	M	F	% of cases in: Adults	children
2005	176	78	22	37	63	90	10
2006	175	87.5	12.5	34	66	88	12
2007	244	91	9	29	71	90	10

in-pts = inpatients, out-pts = outpatients

Table 2: Species distribution of bacterial causal agents of UTI in 2005–2007

Bacterial species	Total	2005 n (%)	2006 n (%)	2007 n (%)
Escherichia coli	291	81 (46)	98 (56)	112 (45.9)
Citrobacter spp	65	30 (17)	19 (10.9)	16 (6.6)
Enterobacter spp	56	18 (10.2)	14 (8.0)	24 (9.8)
Klebs pneumoniae	54	5 (2.8)	15 (8.6)	34 (13.9)
K oxytoca	10	3 (1.7)	1 (0.6)	6 (2.5)
Pseud aeruginosa	22	8 (4.5)	5 (2.86)	9 (3.7)
Hafnia alvei	18	8 (4.5)	3 (1.7)	7 (2.9)
Proteus vulgaris	9	5 (2.8)	2 (1.1)	2 (0.8)
P mirabilis	14	4 (2.3)	6 (3.4)	7 (2.9)
Morganella morgani	17	–	7 (4.0)	7 (2.9)
Acinetobacter sp	16	11 (6.3)	3 (1.7)	2 (0.8)
S saprophyticus	12	–	–	12 (4.9)
S aureus	11	3 (1.7)	2 (1.1)	6 (2.5)
Total	595	176	175	244

Kleb = Klebsiella, Pseud = Pseudomonas, S = Staphylococcus.

Among other bacterial agents recovered were *Citrobacter* spp, *Enterobacter* spp, *Klebsiella pneumoniae*, *Klebsiella oxyxtoca*, *Proteus mirabilis*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Acinetobacter*, *Hafnia alvei*¸ *Staphylococcus saprophyticus* and *Staphylococcus aureus*.

In-vitro susceptibility pattern of the bacterial species is given in Table 3. As is evident, the isolates of principal agents, *Escherichia coli*, *Citrobacter* spp, *Enterobacter* spp and *Klebsiella pneumoniae*, exhibited a low degree of resistance (8.7 to 17.8%) to co-trimoxazole, the antimicrobial most commonly employed in treatment of UTI in St Kitts. The rate of resistance of these bacteria was much higher for other antimicrobials used in the therapy of UTI, *viz*, norfloxacin (17.8–82.1%) and ciprofloxacin (15.4–100%). The rate of resistance of nitrofurantoin, another antimicrobial occasionally employed in the treatment of UTI in St Kitts was relatively low for *E* coli (25.1%) and *Citrobacter* spp (12.8%). The isolates of *Escherichia coli*, *Citrobacter* spp, *Enterobacter* spp and *Klebsiella pneumoniae* showed a high degree of resistance to augmentin (21.2–91.0%), cefazoline (14.8–50.0%) and cephalothin (36.7–85.7%).

Table 3: Susceptibility pattern of bacterial pathogens of UTI to antimicrobials in St Kitts

	Percentage of isolates resistant to									
	NOR	**FM**	**NA**	**AM**	**GM.**	**SXT**	**Aug**	**CIP**	**CZ**	**CF**
E coli	65.6	25.1	18.4	21.2	27.4	12.1	32.8	48.2	19.3	36.7
Citr spp	82.1	12.8	63.6	33.3	83.3	8.7	21.4	75.0	14.8	50.0
Enter spp	69.2	52.1	30.2	91.0	16.7	15.8	58.3	15.4	50.0	85.7
K pneum	17.8	NT	39.0	66.7	23.1	17.8	33.3	100	16.7	37.5
K oxyct	66.7	57.1	25.0	100.0	ND	22.2	33.3	0	75.0	NT
P aeru	25.0	62.5	33.3	75.0	55.0	81.5	100	33.3	100	100
P mirabilis	6.7	64.3	11.3	20.0	0	0	25.0	0	40.0	40.0
P vulgaris	14.3	ND	33.3	75	0	37.5	50	33.3	50.0	75.0
Hafneia alvei	56.2	81.2	53.8	100	25.0	50.0	80.0	40.0	40.0	85.7
Acinet spp	21.4	57.1	23.1	100	50	35.7	NT	NT	NT	NT
S saproph	0	20.0	50.0	75.0	50.0	75.0	50.0	0	40.0	40.0
S aureus	12.5	12.5	60.0	66.7	23.1	50.0	0	0	50.0	33.3

Nor = Norfloxacin, FM = Nitrofurantoin; NA = Nalidixic acid; AM = Ampicillin; GM = Gentamcin; AMC = Augmentin; SXT = Co-trimoxazole; CIP = Ciprofloxacin; CZ = Cefazoline; CF = Cephalothin; NT = not tested; *Citr = Citrobacter*; *Enter = Enterobacter*; *pneum = pneumonaie*; *oxyct = oxyctoca*; *aeru = aeruginosa*; *Acinet = Acinetobacter*; *saproph = saprophyticus*

DISCUSSION

A variety of enteropathogenic bacteria are known to cause UTI worldwide. *Escherichia coli* is the predominant aetiological agent in outpatients and inpatients. Other bacterial agents include species of *Klebsiella, Enterobacter, Serratia, Proteus, Pseudomonas, Providencia, Morganella*, *Staphylococcus, Streptococcus* and *Enterococcus faecalis* (1–3). The major risk factors include the neonates (particularly the premature), pre-pubertal girls, sexually active young women, elderly males and females (3). The greater number of cases of UTI in the females than in males is consistent with one and the same reasons may apply (3). Further, it may be mentioned that the outpatients investigated were patients who attended the hospital with symptoms of UTI. The inpatients covered in the study were those who were admitted for other ailments, and their urine samples were sent to the laboratory for detecting possible UTI. Thus decline in the relative percentage of hospitalized cases investigated for UTI in the years 2005–2006 could be purely incidental. To our knowledge, there is no previous report on the pattern of bacterial agents of UTI and their antibiotic susceptibility profile in the Federation of St Kitts and Nevis. As is evident from the results, this study demonstrated *E coli* to be the predominant aetiological agent (45.9–53.3%) of UTI, followed by *Citrobacter spp*, *Enterobacter* spp, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*. This is in close agreement with a previous study reported from Trinidad and Tobago and with the reports from several other countries (6–8). *Staphylococcus saprophyticus*, represented by 12 isolates in this study, is frequently recovered from young female outpatients presenting with uncomplicated urinary tract infections (3, 9, 10). *Hafnia alvei* and *Klebsiella oxyctoca* are rare agents of UTI (3). *Acinetobacter* spp are known to be important in nosocomial UTI (11). Recovery of 18 isolates of *Hafnia alvei*, 10 of *Klebsiella oxyctoca* and 16 of *Acinetobacter* from cases of UTI in the present study is noteworthy; 10 of the *Acinetobacter* isolates were from outpatients.

Antibiotic resistance may develop in uropathogenic bacteria due to frequent misuse of antibiotics. It is encouraging to observe that the rate of resistance of the principal aetiological agents of UTI *ie Escherichia coli* and *Citrobacter* spp was relatively low for co-trimoxazole, the most commonly used antimicrobial for UTI in St Kitts, is in contrast to a relatively higher rate of resistance to co-trimoxazole for Gram negative urinary bacterial pathogens observed in Trinidad and Tobago (6). It was also low for nitrofurantoin, an antimicrobial occasionally employed for treatment of UTI. However, resistance to nitrofurantoin and nalidixic acid was high for *Enterobacter* spp, *Citrobacter* spp and *Klebsiella pneumoniae* exhibited high resistance to nalidixic acid (Table 3). This is in close agreement with a low overall resistance rate for norfloxacin for *Escherichia coli* reported from Trinidad and Tobago (6). A relatively high rate of resistance to augmentin (amoxicillin-clavulanic acid) for the principal uropathogenic bacteria observed in the present study is in agreement with the said report from Trinidad and Tobago. The isolates of most of the species also exhibited a high rate of resistance to ampicillin, co-trimoxazole, cefozoline and cephalothin. The pattern of antimicrobial susceptibility of uropathogenic bacteria may vary greatly in different geographic locales. For instance, a report from India (7) mentioned that 70–80% of *Escherichia coli* isolates from outpatients with UTI showed resistance to co-trimoxazole and ampicillin. Another report from India (12) reported maximum resistance of common uropathogenic bacteria to ampicillin (79.6%), co-trimoxazole (82%) and nalidixic acid (73.8%). A study from Port-Harcourt, Nigeria

(13) recorded resistance to ampicillin (71.0%), co-trimoxazole (65.3%) and nalidixic acid (76.6%) in a majority of the urinary isolates. Another study from Sudan (14) reported high rates of resistance of urinary *Escherichia coli, Klebsiella pneumoniae* and *Proteus mirabilis* to ampicillin (75%, 90%, 85%, respectively), and of *Escherichia coli, Klebsiella pneumoniae*, *Proteus mirabilis* and *Enterobacter* to co-trimoxazole (67%, 68%, 81% and 56%, respectively).

Further isolates of *Klebsiella oxyctoca*, *Pseudomonas aeruginosa*, *Hafnia alvei*, *Acinetobacter,* and *Staphylococcus aureus* demonstrated resistance to several antibiotics *viz* norfloxacin, furadantoin, ampicillin and co-trimoxazole. Increasing resistance among *Enterobacteriaceae,* isolated from community patients with UTI, to ampicillin (77.3%), co-trimoxazole (55%) and amoxicillin-clavulanic acid (34.7%) has been reported from Senegal (15). In the present study, norfloxacin was the least effective anti-timicrobial from *in vitro* susceptibility tests, in contrast to a low rate of resistance observed in Trinidad and Tobago (6). These variations in antimicrobial susceptibility in different countries may depend on the antimicrobials used empirically in a particular area and the easy availability of antimicrobial drugs over the counter in some countries *eg* India and Nigiera. In view of these findings, except for co-trimoxazole, no other single antimicrobial agent can be suggested for empirical therapy of UTI, as also reported elsewhere (2, 8). The present study emphasizes the need for periodic reassessment of *in vitro* susceptibility pattern of urinary pathogens to serve as a guide for antibiotic therapy of UTIs in St Kitts since these organisms exhibit resistance to first-line drugs used for UTI infection. In order to prevent or decrease resistance to antibiotics, the use of antibiotics should be kept under supervision, should be given in appropriate doses for an appropriate period of time. Further treatment of UTI should be instituted generally on the basis of antimicrobial susceptibility tests.

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