

# The bacterial profile and antibiotic resistance in acute uncomplicated urinary tract infection of females

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## Curriculum Vitae

Dr Giuseppe di Bartolo was born on the 18th December 1957 in Sicily, Italy. He matriculated at Christian Brothers College in 1975 and in 1979 obtained his Diploma in Pharmacy (Dip Pharm) from the Cape Technikon. After qualifying MB ChB from UCT in 1985 and working in Grootte Schuur Hospital as intern and senior house officer from 1986 to 1988, he was in his own family practice in Vredeboek, Cape Town, from 1st February 1989 to 30th June 1993. He obtained the M Fam Med from the University of Stellenbosch in 1993. Since July 1993 he has been training in anaesthetics at Grootte Schuur Hospital and is at present an anaesthetic registrar at Grootte Schuur.

## Summary

*Objective: To determine the bacterial profile and antibiotic resistance in acute uncomplicated urinary tract infection (UTI) of females presenting in a family practice. Setting: A solo family practice near the Cape Town city center.*

*Design: Prospective descriptive study.*

*Methods: Urine samples from all consecutive female cases of clinically suspected UTI with microscopic bacteriuria were examined with bacterial cultures and antibiotic sensitivity testing to amoxycillin, cotrimoxazole, nitrofurantoin, nalidixic acid, amoxycillin/clavulanic acid, norfloxacin and cefaclor.*

*Results: Of the 49 positive cultures (growths > 100 000 per ml), 37 (76%, 95% CI 64% to 88%) were due to Escherichia (E.) coli and 10 (20%, 95% CI 9% to 31%) Staphylococcus (S.) saprophyticus. Twenty one (56.8%, 95% CI 39.5% to 72.8%) E.coli cultures were resistant to amoxycillin, while 18 (48.6%, 95% CI 31.9% to 65.6%) were resistant to cotrimoxazole. A 100% (95% CI 69% to 100%) of S.saprophyticus cultures were resistant to nalidixic acid.*

*Conclusions: E.coli is the most prevalent organism cultured in acute uncomplicated UTI of females in this family practice setting. Amoxycillin, cotrimoxazole and nalidixic acid is not appropriate first line therapy due to antibiotic resistance.*

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## KEYWORDS

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# Urinary Tract Infection

## Introduction

Acute uncomplicated UTI is a major health problem amongst females presenting in family practice, accounting for considerable morbidity and health care costs. It affects an estimated 10% to 20% of women at some point during their lifetime.<sup>1</sup> In the United States of America (USA) it accounts for an estimated 5.2 million medical consultations to family physicians' offices annually.<sup>1</sup> The management of an episode of acute uncomplicated UTI costs an estimated \$140 in the USA and the yearly national health care costs due to acute uncomplicated UTI in ambulatory patients alone approaches one billion dollars.<sup>1</sup> Silbert in his morbidity survey of Cape Town family practice reported that 2,8% of all family practice interactions involved urological problems,<sup>2</sup> including UTI. The spiralling health costs of health care in South Africa dictates that a clear and concise diagnostic and therapeutic protocol for acute uncomplicated UTI be determined.

*E. coli* was the most common pathogen in all the studies reviewed,<sup>1,3</sup> and the first line treatment varied from amoxicillin or cotrimoxazole<sup>1,3</sup> to the quinolones.<sup>4</sup> International studies may well not apply to South African family practice when considering infections and local antibiotic sensitivities and/or resistance.

Davie reported on 583 uncomplicated urinary tract infections over 9 years in a South African family practice. *E. coli* (86%), *Proteus* species (5,5%) and *Staphylococcus* species (5%), accounted for most of the cultures.<sup>5</sup> The antibiotic sensitivities expressed for these non-differentiated cultures were tetracycline (51%), ampicillin

(53%), cephalosporins (71%), nalidixic acid (74%), piperimidic acid (75%), nitrofurantoin (88%) and norfloxacin (89%).

The use of cultures for the diagnosis of acute uncomplicated UTI in primary care is as controversial as the appropriate choice of antibiotic. Pappas suggests that quantitative urine cultures remain the most accurate measure of bacteriuria<sup>6</sup> Powers is of the opinion that urine cultures are unnecessary in acute uncomplicated UTI and that they add substantially to the cost of therapy.<sup>3</sup> Johnson<sup>7</sup> and Brooks<sup>8</sup> argue that because most infections are caused by *E. coli*, pre-treatment cultures are unnecessary.

The traditional criterion for significant bacteriuria, greater than or equal to 100 000 uropathogens per milliliter of voided urine, has also been challenged with a count as low as 20 000.<sup>9</sup>

This study was initiated as a result of the perceived uncertainty about the most appropriate choice of antibiotic for acute uncomplicated UTI in family practice, as well as the personal experience of the researchers of high resistance to both cotrimoxazole and amoxicillin in urinary cultures from their Cape Town family practices.

The objectives of this limited study were to determine the bacterial profile and antibiotic resistance profile in acute uncomplicated UTI in a family practice, in order to determine an appropriate treatment of this condition in this and similar practice settings.

## Methods

The study was conducted in a solo

*E. coli* by far the most prevalent organism.



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family practice situated in a residential area near the Cape Town city center. The patients of this practice were predominantly belonging to the middle to high income groups, were employed and belonged to a medical aid scheme.

The design was a prospective descriptive study which lasted 18 months. All female patients presenting with one or more of symptoms of lower UTI (dysuria, urinary frequency, nocturia, urgency, voiding of small volumes, incontinence and suprapubic pain)<sup>1</sup> during the study period, were suspected of having an acute uncomplicated UTI. Their urines were examined microscopically for the presence of organisms. No exclusion criteria were used. During the study period no women presented with symptoms and signs of upper urinary tract infections.

Midstream urines were collected from all patients after the midstream urine collection procedures were explained to them. The instructions were to open the labia with the index and middle fingers, wipe once between the labia with a clean and water soaked piece of toilet paper, and urinate while keeping the labia open. The first part of the stream was to be

discarded, while the middle part of the stream was to be collected in a sterile plastic container.

Five milliliters (ml) of each sample were placed in a 5ml, test-tube and spun with hand-held centrifuge for two minutes. The supernatant was poured off and the precipitate was resuspended by gentle shaking of the test-tube. One drop was then placed on a glass slide and covered with a coverslip. A non-electrical microscope was used with a 40 times power lens.

The presence of any organisms on the slide was taken as proof of an acute uncomplicated UTI.<sup>10</sup> The presence of leucocytes were not used as criterion in order to exclude contamination from any vaginal discharge.

The samples were then immediately sent to a local private pathology laboratory, where the specimens were cultured on Blood agar/McConkey half plates. Using the standard semi-quantitative counting method, only counts greater than 100 000 were taken as proof of UTI.<sup>10</sup>

For direct sensitivity the Stokes method was used, with E.coli (ATCC 25922) as control. The following antibiotic discs were used: amoxy-

More than 5 million GP consultations per year in the USA because of UTI.

**Table 1**

**Age Distribution of Female Subjects With UTI**

Age Group	N	%	95% CI
15 - 18	3	6.1	0 - 12.9
19 - 45	31	63.3	49.5 - 76.5
46 - 85	15	30.5	17.6 - 43.4
Total	49	100	

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**Table II**

**Antibiotic Resistance of Organisms Cultured in Females with UTI**

	<b>E.coli</b>	<b>%</b>	<b>S.sapro</b>	<b>%</b>	<b>P.mirabilis</b>	<b>S.liqui</b>
Total cultures	37		10		1	1
Amoxycillin	21	56.8	2	20		1
Cotrimoxazole	18	48.6	1	10		1
Nitrofuradantoin	1	2.7			1	
Nalidixic acid			10	100		
Amox/Clav				1		
Norfloxacin						
Cafaclor	1	2.7				

Amox/clav = amoxycillin/clavuianic acid

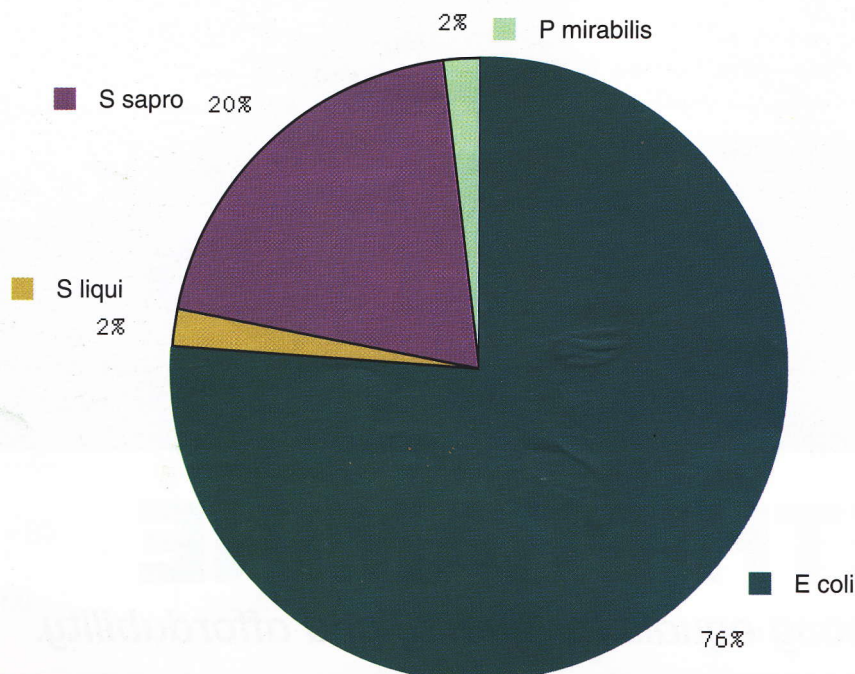
A very high level of resistance against many of the popular antibiotics.

cillin, cotrimoxazole, cefaclor, nitrofurantoin, nalidixic acid, amoxycillin/clavulanic acid and norfloxacin.

The aim of the statistical analysis was to provide descriptive statistics, with estimates and confidence intervals that reflect the sampling variability associated with the sample size of 49.

Simultaneous 90% confidence intervals were only obtained for the multinomial distributions of the total sample of E.coli since the method uses large sample approximations.<sup>11</sup> An exact 95% confidence interval was obtainable for the percentage resistance of a specific antibiotic for E.coli and S.saprophyticus.

**Figure 1: Profile of organisms cultured in Females with UTI**





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## Results

Forty nine (49) women aged between 15-65 years were found to have both microscopic evidence of micro-organisms and subsequently yielded a positive urine culture. No tally was kept of those patients without organisms in the urine on the initial examination, or those without positive urine cultures.

The age distribution (table 1) shows that 63% (95% CI 49.5 to 76.5) of the subjects were in the reproductive age group (19 - 45 years).

Only 4 organisms were cultured (figure 1), the dominant organisms being *E.coli* (76%) (95% CI 64 to 88) and *S.saprophyticus* (20%) (95% CI 9 to 31).

The *E.coli* cultures resulted in 56.8% (95% CI, 39.5 to 72.8) resistance to amoxycillin, as well as 48.6% (95% CI, 31.9 to 65.6) resistance to cotrimoxazole. *S.saprophyticus* showed a 100% (95% CI, 69 to 100) resistance to nalidixic acid (table II).

With regard to the multiplicity of resistance of all cultures, 24.5% (90% SCI (simultaneous confidence interval), 11.4 to 37.6) were not resistant to any antibiotic, 38.8% (90% SCI, 23.9 to 53.5) were resistant to one antibiotic only and 36.7% (90% SCI, 22.1 to 51.4) were resistant to two or more antibiotics.

## Discussion

This study has shown *E.coli* to be the predominant pathogen to be cultured in acute uncomplicated UTI of females presenting in the study practice with microscopic bacteriuria, confirming the findings of most other studies in family practice.

The study did not include urine

samples showing only pus cells but no organisms on microscopy, and cultures of less than 100 000 organisms were also not reported on. These may have resulted in a smaller study sample<sup>6,8</sup> which could have biased the bacterial profile and consequently the antibiotic resistance profile. However no patients in these categories returned to the study practitioner subsequently for treatment.

The study has demonstrated a very high occurrence of resistance of the cultured organisms against very commonly used first line antibiotics like amoxycillin, cotrimoxazole and nalidixic acid. More appropriate first line antibiotics to use in the study practice would have been amoxycillin/clavulanic acid, norfloxacin, nitrofurantoin and cefaclor.

These findings do not necessarily apply to other family practices in different settings or primary care settings in the public sector, due to the differences in practice populations and the effect of the prescribing habits of physicians in the area.

In spite of these limitations of the study, the authors wish to make the following conclusions about acute uncomplicated UTI of females presenting in family practice:

1. *E.coli* is by far the most prevalent bacterial pathogen.
2. *E.coli* may in certain urban communities have reached too high a level of resistance to amoxycillin and cotrimoxazole to warrant their continued use as first line therapy.
3. Amoxycillin, cotrimoxazole and nalidixic acid should probably not be used as therapy in such

... depending on the practice population and prescribing habits of the doctor.

Urine microscopy is a simple but effective method to diagnose UTI - even in rural areas.

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communities without a urine culture showing sensitivity to these antibiotics.

4. Nitrofurantoin, amoxicillin/clavulanic acid, norfloxacin or cefaclor, depending on cost considerations, would be more appropriate first line therapy in similar settings.
5. Bacterial resistance profiles should be done in different ambulatory care settings in order to minimise treatment failures of this very common condition.

The study practitioner has used a non-electrical microscope with great ease and it should be emphasised that urine microscopy is a simple but effective method to diagnose UTI in family practice, which can even be used in remote areas of South Africa without electricity.

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