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Changing Pattern of Antimicrobial Susceptibility of Organisms Causing Community Acquired Urinary Tract Infections

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Abstract

Objective: To assess common organisms causing Urinary Tract Infection (UTI) in this community and to see antimicrobial susceptibility pattern of these isolates.

Design: Prospective study on urine samples.

Setting: Tertiary care hospital in Karachi.

Methods: Over a period of 8 years (1990-97) 9,892 Urine samples grew significant bacteriuria for various organisms. All Gram negative rods and enterococci were identified by using API 20E and API 32 strips respectively. Staphylococci were identified by catalase coagulase and DNase tests.

Antimicrobial sensitivity testing of all isolates was performed on Diagnostic Sensitivity Test plates by Kirby Bauer method. The discs used were ampicillin, trimethoprim-sulfamethoxazole, cefotaxime, ceftriaxone, aztreonam, ofloxacin, carbenicillin amikacin, gentamicin, penicillin, clindamycin, methicillin, vancomycin, ceftazidime, cefuroxime, Nalidixic acid, piperacillin and Nitrofurantoin,

Results: Our results indicate that *E. coli* and *Klebsiella aerogenes* are the most common organisms causing UTI in this community. Other organisms involved are *Pseudomonas aeruginosa*, *Enterobacter* species, *Enterococcus*, *Proteus mirabilis*, *Staphylococcus aureus* and *Staphylococcus saprophyticus*. Organisms resistant to various antimicrobial agents such as gentamicin, Amikacin, Ofloxacin, Cefotaxime and Ceftazidime are increasing.

Conclusion: In conclusion, *E. coli* and *Klebsiella aerogenes* are the most common organisms causing UTI in this community. Pattern of antibiotic susceptibility to first line antibiotics is changing. Antimicrobial susceptibility testing of all isolates is crucial for the treatment of UTI (JPMA 50:369, 2000).

Introduction

Community acquired Urinary Tract Infection (UTI) is a major public health problem. It is a commonly observed condition in clinical practice¹. Studies show prevalence rate of 1-2% in neonates mostly boys and up to 2.0% in school girls, which is 50 times more than those of boys of similar age. Figures available for pre-school children suggest that it tends to become commoner in girls during infancy². There is a trend of increasing antibiotic resistance in pathogens causing Urinary Tract Infection. The effective management needs the knowledge of various organisms and their antibiotic sensitivity pattern. The aim of this study was to assess common organisms causing UTI in this Community and antimicrobial susceptibility pattern of these isolates.

Material and Methods

Nine thousand eight hundred and ninety two samples of urine were collected over a period of 8 years (1990-97) randomly. Each sample was collected in a sterile screw capped container. Mid-stream urine was collected from in-patients who were more than three years of age. These samples were sent to the Microbiology Laboratory within an hour of collection^{3,4}. The samples, which could not be delivered within an hour, were refrigerated at 4°C for up to 24 hours⁵. Each urine sample was mixed well and

cultured on to Cysteine Lactose Electrolyte Deficient (CLED) agar medium by using a 5mm diameter calibrated loop⁶ Plates were incubated at 37°C for 24 hours. Colony forming units were counted for the presence of bacteria.

All gram negative rods (both lactose and non-lactose fermenters) and enterococci were identified biochemically by using API 201* and API 32* strips respectively (API=Analytical Prolix Index API System S.A. LA Balmeles rolles-38390 monta lieu). Colonies suspected to be Staphylococcus aureus were identified by catalase, coagulase and DNase tests. Antimicrobial sensitivity testing of all isolates was performed on Diagnostic Sensitivity test (DST) plates by Kirby Bauer method⁷. The discs used were ampicillin (30mg/l), trimethoprim-sulfamethoxazole (1.25/23.75mg/l) cefotaxime (30mg/L), ceftriaxone (30mg/l) aztreonam (30mg/l) ofloxacin (5mg/l) carbencillin (100mg/l) amikacin (30mg/l), gentamicin (10mg/l), penicillin (10 IU) clindamycin (2mg/l), methicillin (5mg/l), vancomycin (30mg/l), ceftazidime (30mg/l), cefuroxime (30mg/l) Nalidixic acid (30mg/l) piperacillin (20mg/l) and Nitrofurantoin (300mg/l). Control strains of E.coli ATCC 25922 Staphylococcus aureus ATCC 25923 and Pseudomonas aeruginosa ATCC 27853 were treated in the same way as test strains.

Results

E.COLI

Table. Common Community Acquired Urinary Pathogens (n= 40,194).

Pathogens	No.	%
Escherichia coli	20974	52
Klebsiella aerogenes	3825	9
Pseudomonas aeruginosa	3825	9
Enterobacter species	1465	4
Enterococcus	881	2
Beta Haemolytic Streptococci gp. B	774	1.9
Proteus Mirabilis	662	1.6
Pseudomonas species	596	1.5
Staphylococcal aureus	565	1.4
Candida albicans	415	1
Staphylococcus saprophyticus	356	0.8

Klebsiella aerogenes

Table II shows common organism causing community acquired UTI. E.Coli is the most common organism causing UTI in this community

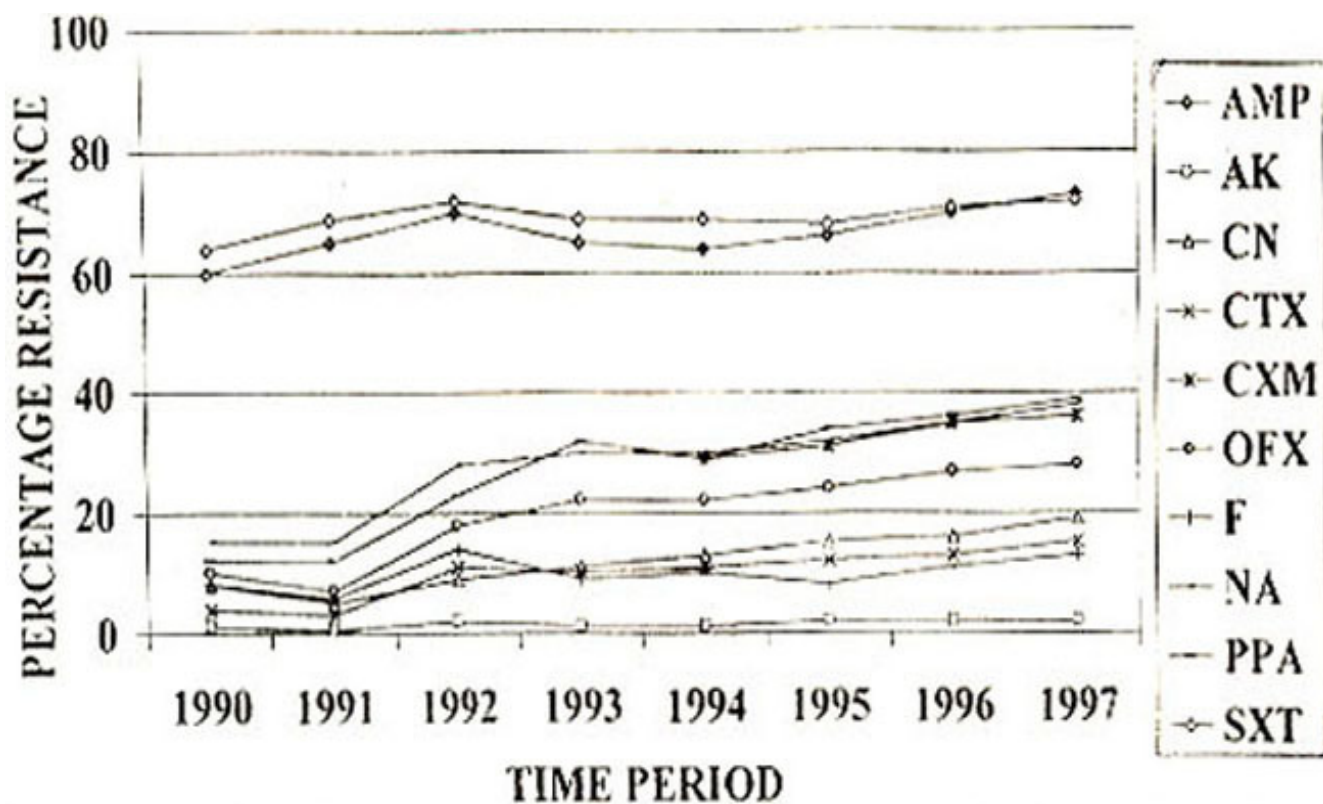


Figure 1. Pattern of antibiotic resistance of *E. coli*.

Figure 1 shows antimicrobial resistance has been negligible. Resistance to ofloxacin has gone up from 5% to 25%. Resistance to cefixime, nalidixic acid and piperimedic acid has gone up from 15 to 35%.

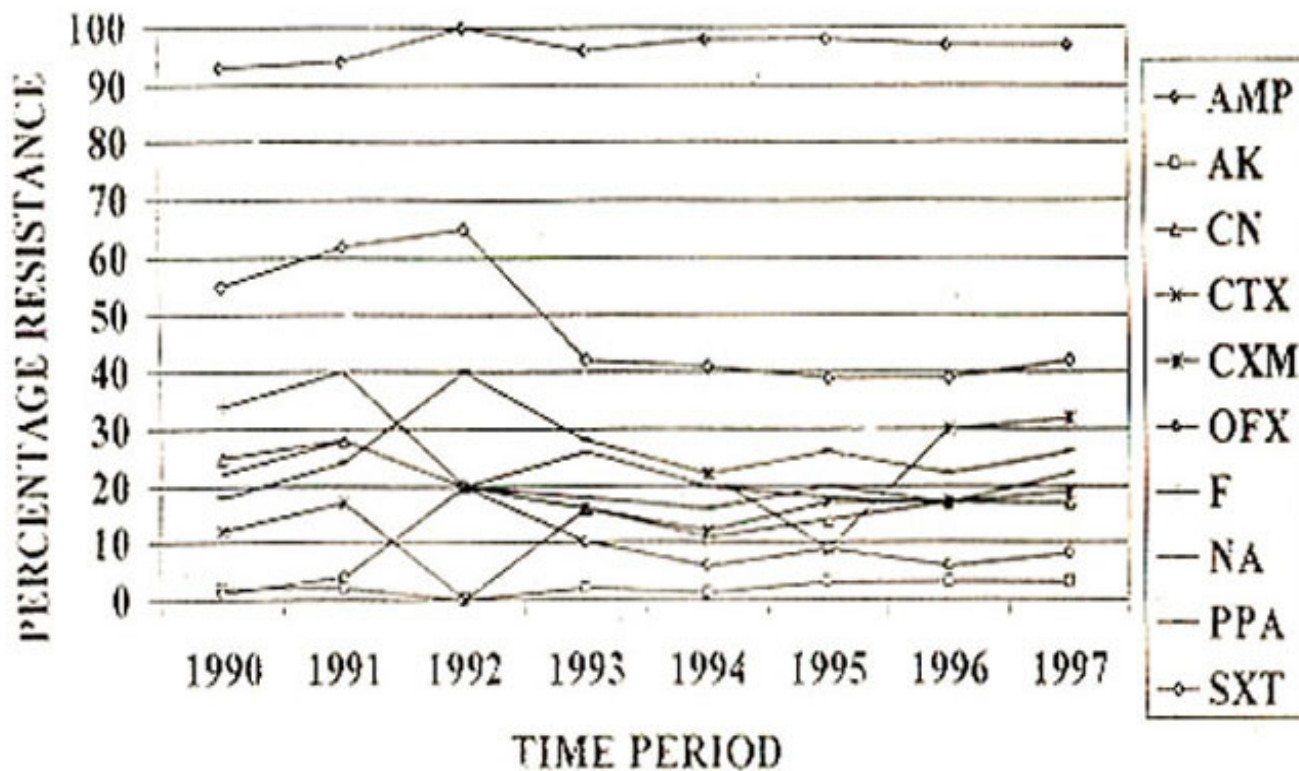


Figure 2. Pattern of antibiotics resistance of *Klebsiella aeruginosa*.

Figure 2 shows antimicrobial resistance pattern of *Klebsiella aerogenes*. There is little change except resistance to trimethoprim-sulfamethoxazole was 55% in 1990 and went up to 65% in 1992, but decreased to 40% in 1993, which persisted until 1997. As regards amikacin, cefotaxime and nitrofurantoin the resistance has been negligible. Resistance to ofloxacin has gone up from 5% to 25%. Resistance to cefixime, nalidixic acid and piperacillin has gone up 15% to 35%.

Pseudomonas aeruginosa

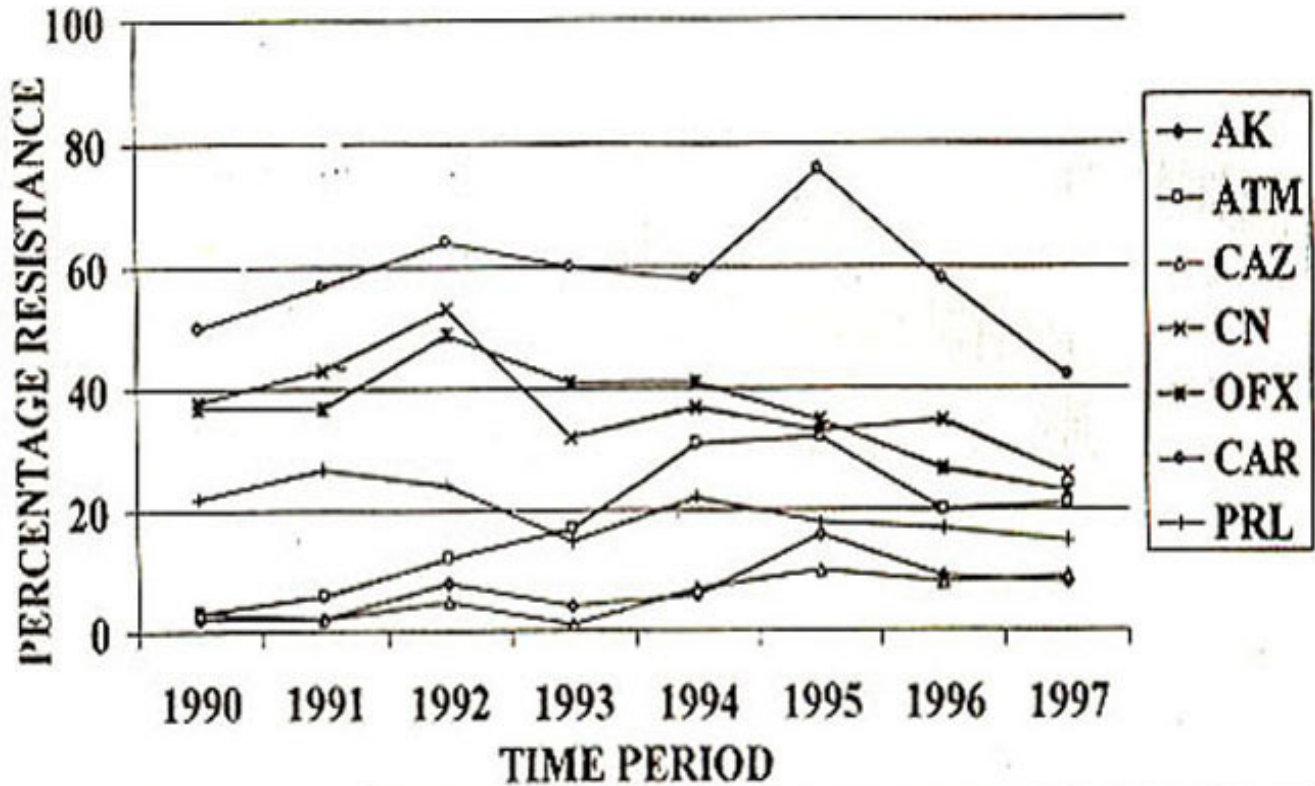


Figure 3. Pattern of antibiotic resistance of *Pseudomonas aeruginosa*.

Figure shows antimicrobial resistance pattern of various species of *Pseudomonas aeruginosa* and their comparison from 1990-97. As regards amikacin and ceflazidime, the resistance has been negligible. About 50% of strains have been resistant to carbenicillin in 1990. Resistance went up to 70% in 1995 but decreased to 40% in 1997. As regard gentamicin the resistance was 38% in 1990, went up to 46% in 1992, then came down to 25% in 1997. As regards aztreonam resistance have gone up from 5% in 1990 to 30% in 1994 with a small decline to 20% in 1997. As regards ofloxacin the resistance was 38% in 1990, decreased to 22% in 1997. Resistance to piperacillin has been between 15 to 20%.

Enterobacter species

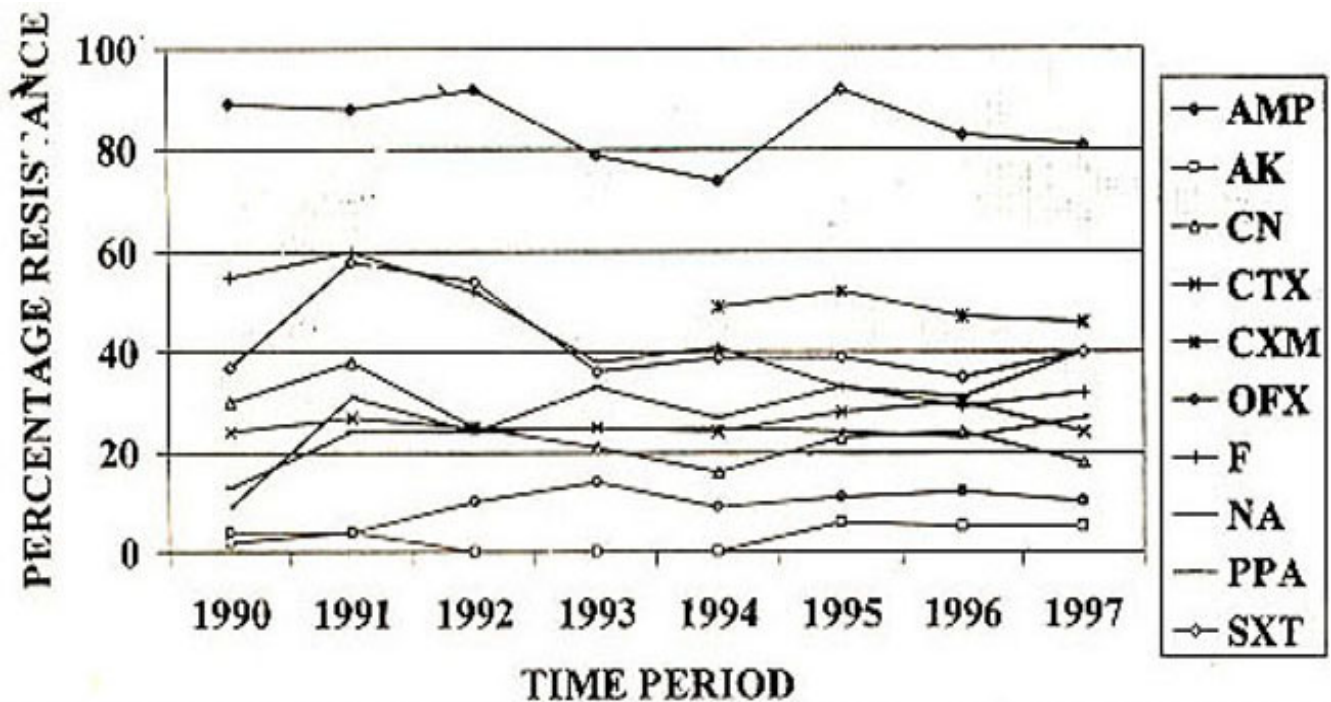


Figure 4. Pattern of antibiotic resistance of enterobacter.

Figure 4 shows antibiotic resistance pattern of various antibiotic for Enterobacter species and their comparison from 1990-97. About 90% of strains were resistant to ampicillin through out this period. Resistance to trimethoprim-sulfaniethoxazole was 38% in 1990, went up to 60% in 1991, then declined to 38% in 1993 and remained 38% until 1997, Gentamicin resistance was 25% in 1990 and remained the same through out these years. As regards amikacin, ofloxacin and cefotaxime the resistance has been negligible. Cefixime was tested since 1994. In 1994 50% strains were resistance to this antibiotic. There was negligible change in resistance between 1994 and 1997. Fifty five percent strains were resistant to nitrofurantoin in 1990. The resistant pattern has slightly decreased in the following years. Only 30% strains were resistant to nitrofurantoin in 1997. There has been negligible change in the resistance pattern of nalidixic acid and piperidic acid.

Enterococcus

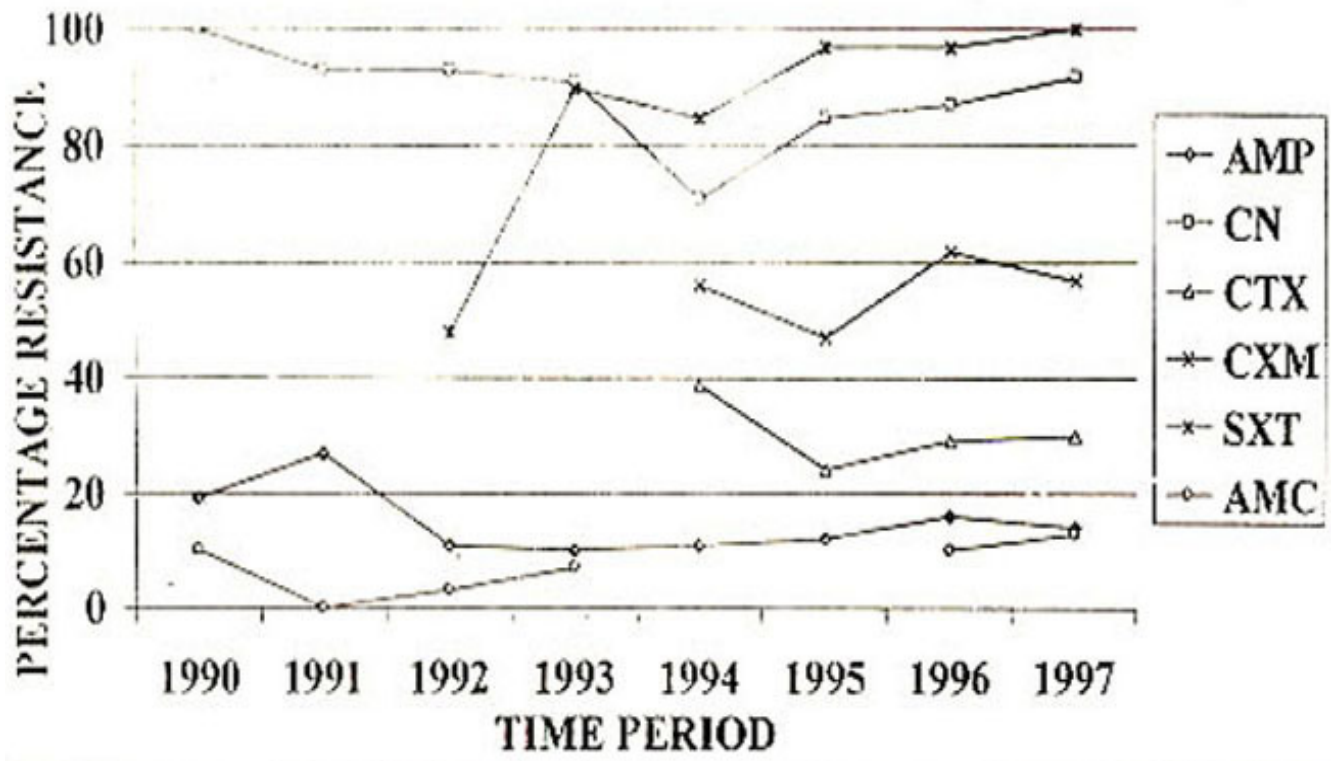


Figure 5. Pattern of antibiotics resistance of enterococcus.

Figure 5 shows antibiotic resistance pattern of various antibiotics for Enterococcus and their comparison from 1990-97. Resistance to trimethoprim-sulfamethoxazole has increased from 45% in 1992 to 100% in 1997. Resistance to Ampicillin remains negligible through out the period. Ampicillin resistant strains were tested for augmentine showed 60% of resistance in the year 1996-97.

Beta Haemolytic streptococci group B

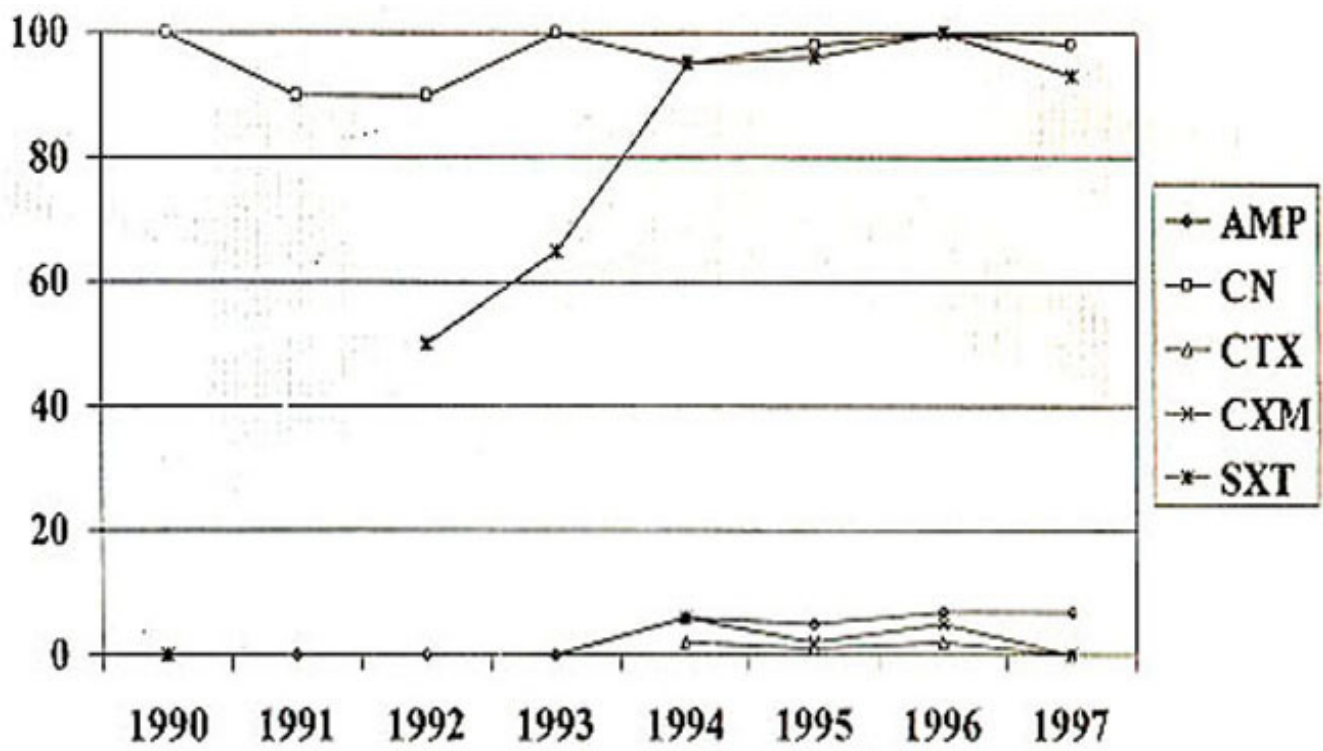


Figure 6. Pattern of antibiotic resistance of BHS GP B.

Figure 6 shows antibiotic resistance pattern of various antibiotics for Beta Haemolytic streptococci group B and their comparison from 1990-97. Resistance to trimethoprim-sulfamethoxazole has increased from 45% in 1992 to 95% in 1997. Resistance to ampicillin and cefixime remains negligible throughout the period.

Proteus mirabilis

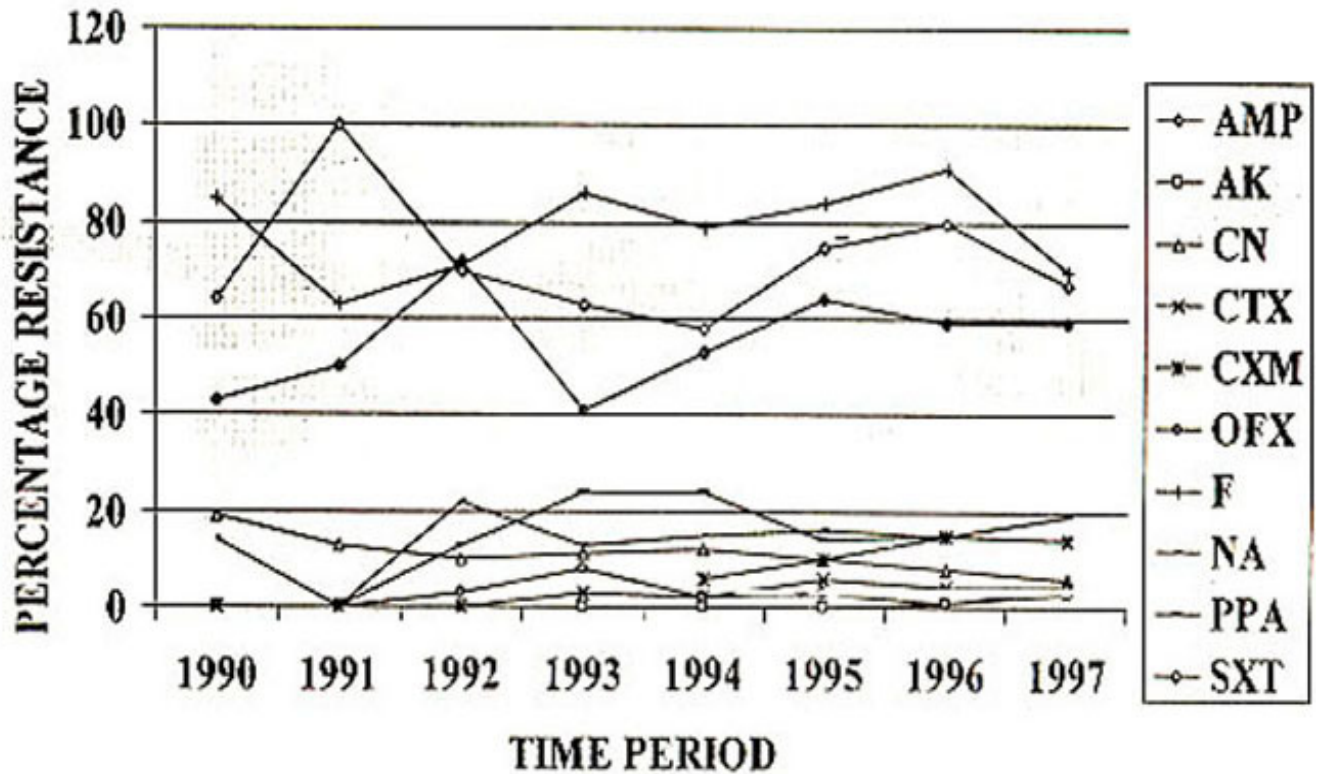


Figure 7. Pattern of antibiotic resistance of *Proteus Mirabilis*.

Figure 7 shows antibiotic resistance pattern of *proteus mirabilis* against various antibiotics. From 1990 to 1997 resistance to ampicillin and nitrofurantoin was 40-60%. Resistance to trimethoprim-sulfamethoxazole was fluctuating between 60 to 100% from 1990 to 1997. As regards gentamicin, amikacin, cefotaxime, cefixime, ofloxacin, nalidixic acid and pipemidic acid the resistance has been negligible and remains the same over a period of seven years.

Staphylococcus aureus

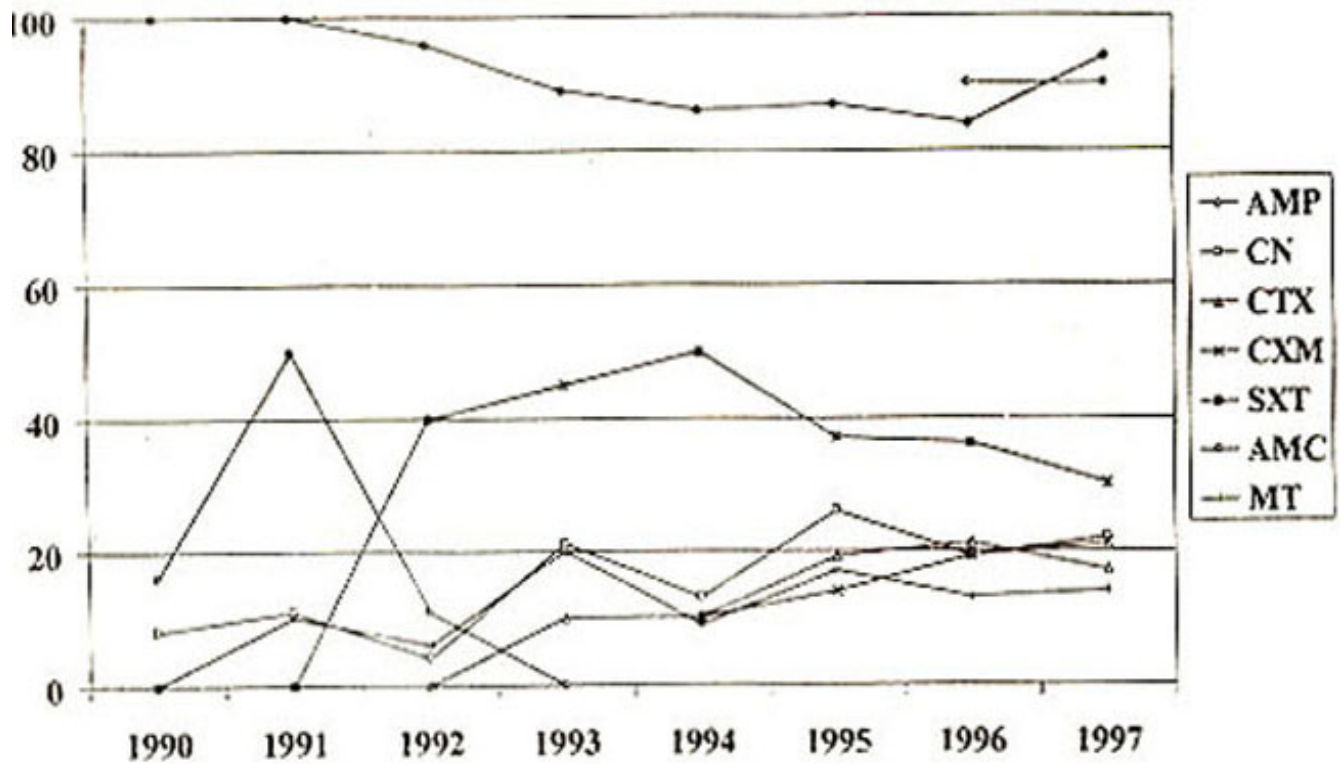


Figure 8. Pattern of antibiotic resistance of Staph. aureus

Figure 8 shows antibiotic resistance pattern of various antibiotics for Staphylococcus aureus and their comparison from 1990—97. All isolates were sensitive to trimethoprim—sulfamethoxazole in 1990. However, resistance has increased to 30% in 1997. Resistance to ampicillin and augmentin was almost 95% throughout this period. Resistant to methicillin, cefixime and gentamicin in showing gradual rise from 10% in 1990 in 20% in 1997.

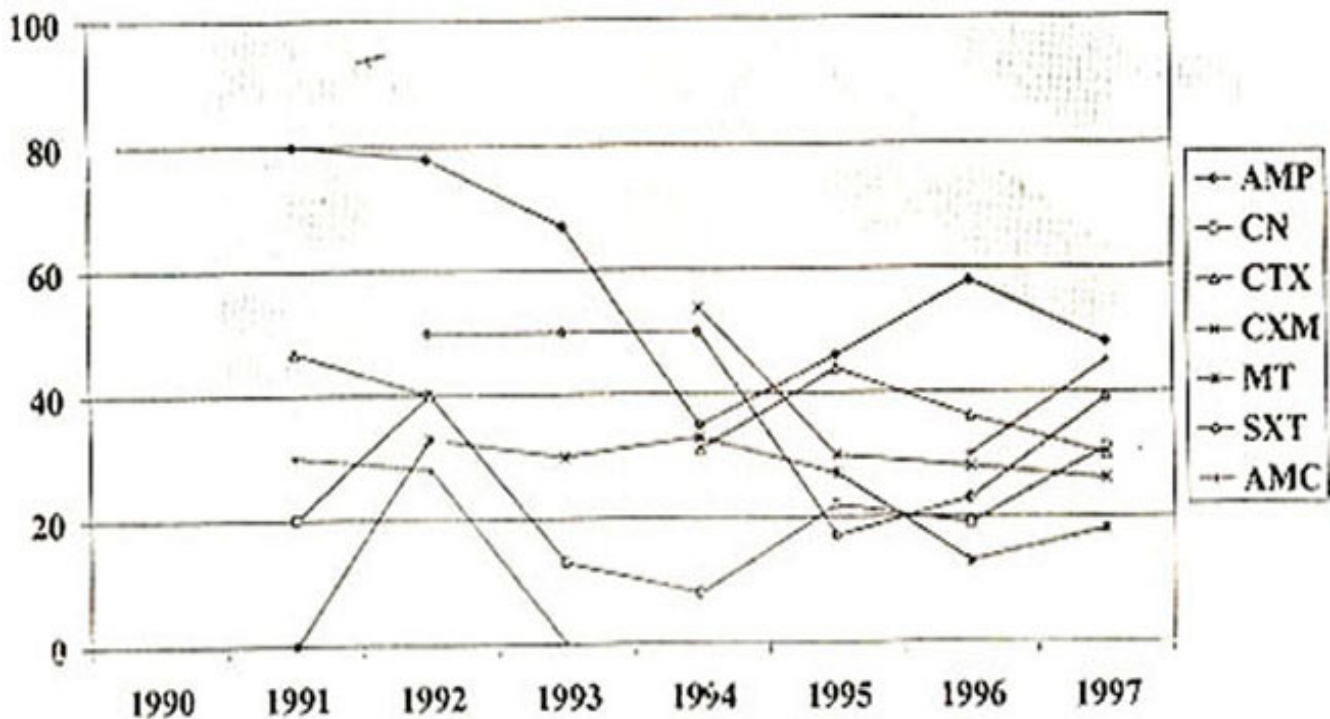


Figure 9. Pattern of antibiotic resistance of Staph. Saprophyticus.

Figure 9 shows antibiotic resistance pattern of various antibiotics for Staphylococcus saprophyticus and their comparison from 1990-97. All isolates were resistant to tromethoprim-sulfamethoxazole from 1992 to 1994, followed by a dec line to 20% in 1995. There is again a gradual increase to 40% in 1997. Resistance to ampicillin was 80% in 1991 declined to 35% in 1994 and then went up to 50% in 1997. All isolates were sensitive to methicillin in 1991 however, resistance has been fluctuating from 30% to 20% during 1992 to 1997. Testing of cefixime started in 1994 and 50% isolates were resistant to it however pattern decline and only 25% isolates were resistant to this antibiotic in 1997. Resistance Pattern of gentamicin has been fluctuating between 20% to 40% during the period 1991 to 1997.

Discussion

E.Coli was the commonest organism causing Urinary Tract Infection in this community. This is keeping with the studies carried out by other authors from Pakistan⁸⁻¹¹. E.Coli was isolated in 52% of our samples which is less than reported by other authors^{12,13}. This may be because our outside referrals also included samples from other hospitals (out patients as well as in-patients). Detail history of these patients was not available. Other organisms isolated were Klebsiella aerogenes (9%), Pseudomonas aeruginosa (7.7%), Enterobacter species (4%), Enterococcus (2%), Beta Haemolytic streptococci group B (2%), Proteus mirabilis (1.6%), Staphylococcus aureus (1.4%) and Staphylococcus saprophyticus (0.8%). Pseudomonas aeruginosa was isolated in 7.7% of our samples which is more than what is reported by other authors¹⁵. This may be because our outside referrals include samples from other hospitals (in-patients).

Klebsiella aerogenes in present study is isolated in 9% of cases. It is the second most leading cause of UTI in this community. Similar findings have been reported by other authors⁹. Enterobacter species has been isolated in 4% of cases. Similar findings have been reported by other authors⁹.

The findings of Pseudomonas aeruginosa, in present studies in 7.7%. Similar findings has been reported by other authors¹⁸. No decrease in incidence of Pseudomonas aeruginosa was noted with time,

which in contrast of the findings of other authors who reported a decrease in the isolates of *Pseudomonas aeruginosa* from 1970 to 1990¹⁷. *Proteus mirabilis* is isolated in 1.6% of our samples. Our study shows marked decrease of *Proteus mirabilis* which might be due to changing pattern of UTI pathogens in recent years. Similar findings have been reported by other authors from the West^{16,17}. *Enterococcus* was isolated in 2.0% of cases. *Staphylococcus aureus* has been isolated in 1.4% of cases and *Staphylococcus saprophyticus* in 0.8% of cases. This is in keeping with the study carried out by other author¹⁶. Beta Haemolytic streptococci group B was isolated in 2% of our samples. This is similar to what has been reported by other authors¹⁷.

As regards antimicrobial susceptibility pattern, overall 75% *E. coli* remains resistant to ampicillin and Trimethoprim-sulfamethoxazole throughout this period. Similar observation was reported in other authors from Pakistan⁸⁻¹¹. For gram negative rods other than *E. coli*, however, significantly high rates of resistance are also seen for ampicillin and trimethoprim-sulfamethoxazole. Similar have been reported by other authors^{13,14}. These organisms have shown low rate of resistance to cefotaxime, ceftriaxone, aztreonam, ofloxacin, amikacin, gentamicin, nalidixic acid, piperacillin and nitrofurantoin.

Although resistance to these above antimicrobials have gone up from 10% to 40% over a period of 7 years (1990-97). Other gram negative rods show a similar pattern to those reported earlier^{17,18}.

As regards *Pseudomonas aeruginosa* resistance to carbenicillin has gone down from 75% in 1995 to 40% in 1997. This may be because carbenicillin may not be used during this period.

Our study shows that the antimicrobial drug resistance pattern of above-mentioned organisms has changed significantly in the past 7 years. This is in keeping with the studies carried out by other authors^{15,17}. Our findings are similar to those reported by other author¹².

As regards Beta Haemolytic streptococci group B, it is sensitive to most agents. However, resistance to cefuroxime has gone up from 45% in 1992 to 100% in 1997. Our findings are similar to those reported by other authors¹³. Most strains of *Staphylococcus aureus* have been resistant to ampicillin. However these organisms have shown low rate of resistance to other antimicrobials tested. As regards *Staphylococcus saprophyticus* resistance to ampicillin has gone down from 80% in 1991 to 40% in 1997. This may be because ampicillin may not be used during this period. These organisms have shown low rate of resistance to other antimicrobials tested. As regards *Enterococci*, the organisms have shown low rate of resistance to antimicrobials tested.

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