COMMON BACTERIAL ISOLATES FROM INFECTED EYES

BY

UBANI, UDO AHANNA

DEPARTMENT OF OPTOMETRY, FACULTY OF HEALTH SCIENCES,
ABIA STATE UNIVERSITY, UTURU,
ABIA STATE, NIGERIA.

ABSTRACT

The common bacterial isolates and their antibiotics susceptibility were studied in 298 bacterial eye infected cases, consisting of 35 blepharitis, 208 conjunctivitis and 55 keratitis. The results yielded 333 bacterial isolates with the implicated bacteria in decreasing order of frequency as Staphylococcus aureus 80(23.70%), Staphylococcus albus 65(19.20%), Pseudomonas aeruginosa 34(10.10%), Streptococcus pneumoniae 29(8.60%), Haemophilus influenzae 26(7.70%), Streptococcus pyogene 20(6.20%), Klebsiella pneumoniae 18(6.20%), Escherichia coli 15(4.40%), Neisseria gonorrhoeae 13(3.90%), Streptococcus viridans11(3.50%), Moraxella catarrhalis 10(3.0%), Streptococcus faecalis 5(1.50%), Proteus mirabilis 5(1.50%) and Neisseria meningitides 1(0.30%). Bacteria were isolated most on the eye infections of the conjunctiva 222(66.70%), then the cornea 65(20.10%), and least on the eyelids 44(13.20%). Bacterial isolates varied in the clinical features; p<0.01. The age distribution showed an isolation of 77(23.20%) and 79(23.70%) in the age groups of 0-2+ and 3-11+ respectively, which was comparable to 66(19.80%) for the 12-17+; 18-39+ age groups 61(18.30%) and 50(15.0%) for the 40s and above. Bacterial isolates had no predilection for age of patients (p<0.95). Klebsiella pneumoniae was the most resistant to all the anti bacterial preparations. The bacterial isolates were more susceptible to the 2nd generation quinolones than the 1st generations. The study recommends them to be available as ophthalmic preparations, to be dispensed by qualified practitioners to avoid development of resistance from indiscriminate use.

KEYWORDS: *Blepharitis, conjunctivitis, keratitis, bacterial isolates and antibiotics susceptibility.*

INTRODUCTION

Pathogenic microorganisms cause diseases to the eyes due to their virulence and host's reduced resistance from many factors such as personal hygiene, living conditions, socio-economic status, nutrition, genetics, physiology, fever and age[1]. The areas in the eye that are frequently infected are the conjunctiva, lid and cornea[2].

In infections of the lids, the anterior lid margins show hyperamia, telangiectasis, and scaling. The scales are hard and brittle and tend to be centered on the bases of the lashes. When removed they may leave behind a tiny bleeding ulcer. In severe cases the lashes may become matted down by yellow crust. Spread of the infection to the glands of Zeis and Moll may give rise to an acute external hordeolum (stye) and spread to the meibomian glands may give rise to an internal hordeolum.

Conjunctivitis presents with an acute onset of redness, grittiness, burning and discharge. Photophobia may be present if there is associated severe punctate epitheliopathy or peripheral corneal infiltrates. On waking in the morning, the eyelids are frequently stuck together and difficult to open as a result of the accumulation of exudates during the night. Both eyes are usually involved; although one may become affected before the other[3]. Visual acuity is usually normal in the absence of severe punctuate epitheliopathy.

In keratitis, certain bacteria produce characteristic corneal responses. *Staphylococcus aureus (S.aureus)* and *Streptococcus pneumoniae* (*S.pneumoniae*) tend to produce oval, yellow-white, densely opaque stromal suppuration surrounded by relatively clear cornea. *Pseudomonas* spp. typically cause irregularly shaped ulceration, thick mucopurulent exudates, diffuse liquifactive necrosis and semi-opaque "ground-glass" appearance of adjacent stroma. The infection may progress rapidly and result in corneal perforation within 48hours.[3] *Enterobacteriaceae* usually cause a shallow ulceration, grey-white pleomorphic suppuration and diffuse stromal opalescence. The endotoxins present in gram-negative bacteria may induce ring-shaped corneal infiltrates.

Infection of the eye is a problem, for a loss or impairment of visual function is a major disability, the structures of the eye are particularly delicate and degree of scarring or inflammation which will

be relatively minor in other parts of the body, may have quite a serious consequence in the eye. Hence bacterial eye infection is an ophthalmic emergency that needs immediate institution of treatment[4]. Medical management of bacterial eye infections may involve treatment with broad spectrum antibiotics. This is most at times before pathogen identification and antibiotic susceptibility tests are available. This together with indiscriminate use of antibiotics have led to the development of resistance to many commonly used anti microbial medications[5,6,7].

This research, therefore, aims amongst others at evaluating the antibiotic sensitivity of the bacterial organisms isolated from the eye infections amongst people living in Aba, studying the distribution of the common bacterial isolates in the clinical features- conjunctivitis, blepharitis and keratitis, the distribution of these bacterial isolates amongst age groups and the distribution of these bacterial isolates between males and females.

RESEARCH METHODOLOGY

The research was a prospective, clinical laboratory study on bacterial isolation from infected eyes and their in vitro antibiotics susceptibility. These were studied on patients who visited the eye clinics in Abia State University Teaching Hospital and Niger Optical Service Company, all in Aba, South Eastern Nigeria in the period of January 2005 December 2006.

Material for culture was collected soon after the onset of infection (24 to 48hrs) and inoculated into the culture media- nutrient, blood and chocolate agars. This was before the instillation of antimicrobial or steroidal eye drops for treatment.

A total of 298 samples were collected from the actual sites of infections - 35 from the lid margin, 208 from the conjunctiva and 55 from the cornea.

The isolation of bacteria was done by incubating the agar plates at temperature of 37^0C. Aerobic atmospheric condition was maintained for the blood agar, while 10% carbon dioxide (CO_2) atmosphere was for the chocolate agar. Mixed colonies observed were purified by repeated sub-culturing on media originally used for their isolation. Pure culture from the continuous sub-culturing was stored in nutrient agar slants for further tests.

Gram's cell wall, capsule and spore staining tests, followed by tests demonstrating motility; the presence of the enzymes-Catalase, Coagulase, Oxidase and Amylase. Isolates sugar fermentation properties, that is, with or without the production of acid and gas. Methyl red and Voges Proskaeur tests to detect the production of sufficient acid during the fermentation of sugar; ability to decompose the amino acid Tryptophan to Indole; ability to utilize citrate as sole source of carbon and energy; and ability to utilize ammonium salt as the sole source of nitrogen. As well as the production of hydrogen sulphate from sulphur- containing amino acids were the biochemical tests performed.[8,9,10,11,12].

In the a**ntibiotics susceptibility test** (Kirby-Bauer Disk Diffusion Method), the uniformly inoculated agar plate containing the paper disks impregnated with fixed concentrations of the antibiotics was incubated soon after placing the paper disks, since the test is standardized under conditions where diffusion of the antibiotic and bacterial growth commences at approximately the same time.[13] Following an overnight incubation, the diameter of the zone of growth inhibition around each disk was measured to the nearest whole millimeter. The strain's susceptibility to the antibiotics was determined using a standard table of antibiotic susceptibility[8]. The susceptibility of bacterial agents to the antibiotics was presented in percentage.

In calculating the test statistics the mean of squares were determined using the computational formulae[14]. The cumulative probabilities were found in the Fisher's *F*-distribution. The hypothesis that ocular clinical features have no predilection for sex was tested in the Student's *t*-values.

RESULTS

There were a total of 298 bacterial infections (of the lids, conjunctiva and cornea) from which swabs or scrapping as the case may be were collected and cultured. The result was an isolation of 333 bacteria comprising of the *S. aureus*, *Staphylococcus albus (S. albus), Streptococcus pyogenes (S. pyogenes), S. pneumoniae*, *Streptococcus faecalis (S. faecalis), Streptococcus viridans (S. viridans), Neisseria meningitides (N. meningitides), Neisseria gonorrhoeae (N. gonorrheae), Moraxella catarrhalis (M.catarrhalis)* and the *Enteric bacteria Klebsiella pneumoniae (K.pneumoniae), Proteus mirabilis (P. mirabilis), Eshcerichia coli (E. coli), Pseudomonas aeruginosa (P. aeruginosa)* and *Haemophilus influenzae (H.influenzae;* Table 1).

The *Staphylococcus* (on the culture media) were round smooth, raised, glistering and produced

pigments that varied from white to deep yellow. Microscopic examinations of smears show gram positive spherical cells arranged in grape-like irregular clusters. They were non-motile and did not form spores. They fermented carbohydrates producing lactic acid but not gas. Two species were identified; *S. aureus* were coagulase positive which differentiated it from *S. albus*. They were highly sensitive to chloramphenicol (80%), cephalexin (80%), and were not sensitive to penicillin.

The *Staphylococci* produced catalase, which differentiated them from the *Streptococci* which were also gram positive spherical bacteria that formed pairs of chains. Four species of *Streptococci* were identified- *pyogenes, viridans, faecalis and pneumoniae*. *S. pyogenes* were β-hemolytic highly sensitive to augumentin (90%) and penicillin (90%) and less (20%) to ofloxacin.

The *S. pneumoniae* were α-hemolytic and optochin sensitive. They fermented glucose with production of lactic acid. They were 90% sensitive to penicillin, chloramphenicol and augumentin. *S. pneumoniae* were resistant to nalidixic acid and gentamycin. The *S. viridans* were α-hemolytic or non-hemolytic. They were not inhibited by optochin. They were 95% sensitive to chloramphenicol, 80% to penicillin, nalidixic, augumentin and cephalexin. They were just 20% sensitive to ofloxacin. *S. faecalis* were non-hemolytic and occasionally α-hemolytic. They were only 20% sensitive to ofloxacin and cephalexin but highly sensitive to gentamycin and nalidixic acid.

The *Neisseriaceae* were *M. catarrhalis* and the *Neisseria* species of *gonorrhoeae* and *meningitidis*. They were non-motile gram-negative cocci that were kidney shaped occurring in pairs and with flat or concave sides adjacent. Gonococci and Meningiococci formed convex glistering elevated mucoid colonies about 1-5mm in diameter. They were transparent or opaque, non-pigmented and non-hemolytic gram-negative cocci that were kidney shaped occurring in pairs and with flat or concave sides adjacent. *M. catarrhalis* were also non-pigmented with pinkish-gray opaque colonies. They produced oxidase and fermented carbohydrate producing acid but not gas. *Gonococci* fermented only glucose. *M. catarrhalis* was differentiated by its lack of carbohydrate fermentation.

The *enterobacteriaceae* were characterized as gram-negative rods being either motile or non-motile. They fermented rather than oxidize glucose with gas production. They were catalase positive and oxidase negative. Five bacteria genera were isolated in the study-*P. aeruginosa*, *E. coli*, *K. pneumoniae, P. mirabilis* and *H. influenzae*. The *P. mirabilis* deaminated phenylalanine and were motile. They fermented xylose but lactose very slowly or not at all. They were not sensitive to penicillin. *K. pneumoniae* were non-motile and had large, very mucoid colonies. The organisms were positive to Voges Prauskaeur and citrate. They were not sensitive to penicillin but moderately sensitive to cephalexin and nalidixic acid (45%).

P. aeruginosa in culture media produced a sweet or grape-like odor. Some strains hemolyzed blood. They formed smooth round colonies, with fluorescent greenish colour and often a non-fluorescent bluish pigment, which diffused into the agar. They were oxidase positive and did not ferment carbohydrate, but oxidized glucose. They were not sensitive to penicillin. They were 10% sensitive to chloramphenicol; and highly sensitive to ciprofloxacin and gentamycin (90%). The *H. influenzae* were coccoid bacilli occurring in pairs and short chains. They were differentiated by their requirement of x- & v- factor which is maintained in the chocolate agar. They were not hemolytic and fermented carbohydrates poorly. Many were susceptible to chloramphenicol and the second generation quinolones.

The result in Table 2 shows 77 bacterial isolates in the age group 0-2^{+}, 25(32.5%) of this were *S. aureus* and 23(29.9%) were *S. albus*. *H. influenzae* were 6(7.8%) isolations. *S. pneumoniae* and *S. pyogenes* were 4(5.2%) isolates each. *N. gonorrhoeae* and the enteric bacteria-*E. coli*, *K. pneumoniae*, *and P. aeruginosa* had 3(3.9%) isolations each from this age group. *N. meningitidis*, *M. catarrhalis* and *P. mirabilis* were not isolated.

The age group 3-11^{+} had 79 isolations and *S. aureus* and *albus* combined made 50% (40 of the 79) of these bacterial isolations. The age group 12-17^{+} did not record any isolation from *N. meningitidis* and *P. mirabilis*. The highest isolation was still from *S. aureus* 15(22.7%) of the 66, *S. albus was 10(*15.2%). *H. influenza* and *P. aeruginosa* were 8(12.1%) each. The other enteric bacteria *K. pneumoniae* and *E. coli* were 5(7.6%) and 3(4.5%) respectively. *S. aureus* and *S. pneumoniae* each were 10(20%) of the 50 bacterial isolates of the 40s and above. *P. aeruginosa*, *S. pyogenes* and *S. albus* were next 6(12%), 6(12%) and 5(10%) respectively. The *Streptococci spp.* of *pyogenes, pneumoniae viridans* and *faecalis* were 76(22.8%) of the 333 total bacterial isolates.

Though more of these were from eye infections of the adults 15(19.7%) of the 76 in the 18-39$^+$ and 18(23.7%) in the 40s and above. Infants 0-2$^+$ and the 3-11$^+$ each had eleven (14.5%). While *N. gonorrhoeae was isolated 3(23%) each in the age groups 0-2$^+$, 12-17$^+$ and the 18-39$^+$.* ***Bacterial isolates did not vary with age of patients (p<0.95).***

In Table 3, the age group 12-17$^+$ had the highest figure of blepharitis 15(42.80%) of 35 cases. Blepharitis was evenly diagnosed in the other age groups with a mean of 5(14.0%). The age groups 0-2$^+$ and 3-11$^+$ recorded the highest cases of conjunctivitis 60(28.80%) and 53(25.50%) of 208 respectively. Conjunctivitis was least 30(14.40%) each in the 18-39$^+$ and in the 40s and above. In the 18-39$^+$ keratitis occurred highest 20(36.40%) of 55, and 15(27.30%) in the 40s and above. It was least in the 0-2$^+$ age group 4(7.20%) of 55. There was a relationship between ocular clinical features and age of patient (p< 0.99).

This study involved 139 males and 159 females. Conjunctivitis was 94(67.60%) of 139 of the eye infections in males; and 114(71.70%) in females. Blepharitis cases was 15(10.80%) in males and 20(71.70%) in females. Males recorded a higher case of keratitis 30(54.50%) of 55 than females 25(45.5%). There was no relationship between sex and clinical features (p<0.75).

DISCUSSION

The study showed that bacteria cause the most ocular infections on the conjunctiva 222(66.70%) then on the cornea 67(20.10%) and least on the lids 44 (13.20%). This agrees with Therese and Madhavan[15] as well as Levi[16]. Blepharitis occurred most in the 12-17$^+$ group 15(42.90%) of 35. This may not be unrelated to the general changes on the skin of the face that go with puberty. Corneal infections occurred most in the 18-39$^+$ and the 40s and above age groups (the working class). This may have come as occupational hazards in the abundant fabricating industries in the city of Aba. The age groups 0-2$^+$ had the highest number of bacterial ocular infections about 68(22.80%) of 298. These agree with the work of Madarres[17]. According to Prescott[1], susceptibility to infection increases for babies because they are at a greater risk after their maternal immunity has disappeared and before their own immunity system had matured. Three (23.0%) of 13 *N. gonorrhoeae* isolation was recorded in the 0-3$^+$ and the 18-39$^+$ a sexually active age group. Gonococci eye infections in neonates are due to exposure of the babies to an infected birth canal.

The implicated bacteria in order of decreasing frequency were *S. aureus* 80(23.70%), *S. albus 65*(19.20%), *P. aeruginosa* 34(10.10%), *S. pneumoniae* 29(8.60%), *H. influenzae* 26(7.70%), *S. pyogenes* 20(6.20%), *K. pneumoniae* 29(6.20%), *E. coli* 15(4.40%), *N. gonorrhoeae* 13(3.90%), *S. viridans 22*(3.50%), *M. catarrhalis* 10(3.0%), *S. faecalis 5*(1.50%), *P. mirabilis 5*(1.50%), and *N. meningitidis* (0.30%).

There was no case of *Diphtheriae, Pertusis and Tetanus* bacterial ocular infection (in children). This may be highly attributed to the national immunization programmes currently initiated by the Federal Ministry of Health in Nigeria which has reduced the generally reported cases of these aetiologic agents. This study also showed lower isolations of the enteric bacteria when compared to earlier works[17,18]. This low *enterobacteriaceae* cases may be due to reduction in hand-faecal contamination of the eye due to availability of potable water sources in most house-holds and neighborhoods.

In Table 1, *S. aureus* and coagulase negative albus were the most frequently isolated bacteria from infected eyelid margins, conjunctiva and cornea. These can be compared to Modarres *et al*[17], where *staphylococci* were isolated 25.0% from blepharitis, 26.25% from conjunctivitis and 18.80% from Keratitis. *S. aureus* high pathogenicity is attributed to their being able to multiply and spread widely in tissues through their production of many extra cellular substances like coagulase which deposits Fibrin on the surface of the microorganism altering their ingestion by phagocytic cells; alpha toxin (hemolysin) which lyse erythrocyte and damage platelets[1,9]. The coagulase negative *S. albus* were next in frequency. Though they are normal flora of the eye[9], they caused infection in the immuno compromised patients; 10(15.40%) of 65 on the lids, 40(61.50%) on the conjunctiva and 15(23.0%) on the cornea. Of equal etiology in keratitis was *P. aeruginosa. Also* a normal flora of the cornea causes infection in mechanical trauma of the cornea when epithelium/stroma is disrupted by direct tissue damage. They produce exotoxin A which causes tissue necrosis-corneal ulcer[9].

There was only a single case of *N. meningitides in the study;* on a 3year-old girl who traveled down from the northern part of the country during the month of February in the year of study (the northern part of the country is an arid region of Sub-Saharan Africa which is associated with

outbreaks of *N. meningitidis* during the hot dry season of harmattan). This case was managed with a 3rd generation cephalosporin. The Cephalosporins are B-lactam compounds with a nucleus of 7 amino cephalosporanic acid. Their antimicrobial action is through inhibition of cell wall. They attach to receptors inhibiting peptidoglycan synthesis.[19] Resistance to them is determined by the organism production of beta-lactamases. Beta lactamases open the B-lactam ring and abolish their anti-microbial activity. Cephalexin a first generation cephalosporin used in the disk diffusion susceptibility test was very active against most gram positive cocci (between 70.0% and 80.0% susceptibility). It was moderately active against the gram negative rods- 50.0% for *E. coli*, and 45.0% for *K. pneumoniae* and *P. mirabilis.*

Another B-lactam- penicillin (nucleus of 6-aminopenicillanic acid) was most sensitive to *Streptococci* species and *N. meningitidis*. Amoxicillin which is a better absorbed penicillin given together with clavulanic acid was active against B-lactamase producing *H. influenzae.*[9] Thus augumentin in this study showed a 100% sensitivity to *H. Influenzae* (Table 4). Clavulanic acid is a B-lactamase inhibitor that has a high affinity for and irreversibly binds some B-lactomases. Clavulanic acid protects the simultaneously present hydrolysable penicillin (amoxicilin) from destruction.

As sensitivity to antibiotics is variable in bacterial isolates and recent studies have shown increasing resistance to most antibiotics[20,21], with past literatures reporting indiscriminate use of antibiotics as the reason for drug resistance in microbial population[20]. In the study, chloramphenicol eye drop a potent broad spectrum antibiotics which is highly sensitive to the gram positive cocci and most gram negative bacilli should be protected from indiscriminate use and should not be acquired over-the-counter. It is widely prescribed for external ocular infections and dubiously as placebo by practitioners. The 2nd generation quinolones (the fluorinated derivatives of ciprofloxacin and ofloxacin) were highly susceptible. They have a greater antibacterial activity and low toxicity[9,22]. Unfortunately ophthalmic preparations containing these antibiotics as active ingredients are not available in our local store for dispensing. This leaves a call to the pharmaceutical companies for better ophthalmic preparations with novel antibiotics.

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TABLE 1: DISTRIBUTION OF BACTERIAL ISOLATES IN CLINICAL FEATURES

	Blepharitis	Conjunctivitis	Keratitis
Organisms	**N (%)**	**N (%)**	**N (%)**
S. aureus	20(45.50)	45(20.30)	15(22.40)
S. albus	10(22.70)	40(18.0)	15(22.40)
S. pyogenes	6(13.60)	13(5.86)	1(1.50)
S. pneumoniae	4(9.0)	23(10.40)	2(3.0)
S. viridans	1(2.30)	10(4.50)	*
S. faecalis	*	5(2.25)	*
N. meningitidis	*	1(0.45)	*
N. gonorrhoeae	*	12(5.40)	1(1.5)
M. cotarrhalis	*	10(4.50)	*
E. coli	*	1(0.45)	15(22.40)
K. pneumoniae	3(6.80)	15(6.75)	*
P. mirabilis	*	5(2.25)	*
H. influenzae	*	23(10.40)	3(4.48)
P. aeruginosa	*	19(8.56)	15(22.40)
Total	**44(100)**	**222(100)**	**67(100)**

N = Number isolated
***** = Not isolated

TABLE 2: FREQUENCY OF BACTERIAL ISOLATES IN RELATION TO AGE OF PATIENTS

Organisms	Age				
	0-2+ N (%)	**3-11+ N (%)**	**12-17+ N (%)**	**18-39+ N (%)**	**40& above N (%)**
S. aureus	25(32.50)	20(25.30)	15(22.70)	10(16.40)	10(20.0)
S. albus	23(29.90)	20(25.30)	10(15.20)	7(11.50)	5(10.0)
S. pyogenes	4(5.20)	3(3.80)	3 (4.50)	5(8.20)	6(10.0)
S. pneumoniae	4(5.20)	5(6.30)	4(6.10)	6(9.80)	10(20.0)
S. viridans	2(2.60)	2(2.50)	2(3.0)	3(4.90)	2(4.0)
S. faecalis	1(1.30)	1(1.30)	1(1.50)	1(1.60)	1(2.0)
N. meningitidis	x	1(1.30)	x	x	x
N. gonorrhoeae	3(3.90)	2(2.50)	3(4.50)	3(4.90)	2(4.0)
M. catarrhali	x	2(2.50)	4(6.10)	3(4.90)	1(2.0)
E. coli	3(3.90)	2(2.50)	3(4.50)	3(4.90)	5(10.0)
K. pneumoniae	3(3.90)	4(5.10)	5(7.60)	6(9.80)	x
P mirabilis	x	1(1.30)	x	2(3.30)	2(4.0)
H. influenzae	6(7.80)	6(7.60)	8(12.0)	3(4.90)	3(6.0)
P. aeruginosa	3(3.90)	8(10.10)	8(12.0)	9(14.40)	6(12.0)
Total	77	79	66	61	50

N = Number isolated
***** = Not isolated

TABLE 3: OCULAR CLINICAL FEATURES IN RELATION TO AGE AND SEX OF SAMPLED PATIENTS

Clinical Features	**Sex**		**Age**				
	Male N (%)	Female N (%)	**0-2+** N (%)	**3-11+** N (%)	**12-17+** N (%)	**18-39+** N (%)	**40>** N (%)
Blepharitis	15(10.80)	20(12.60)	4(6.0)	5(7.80)	15(25.0)	6(10.70)	5(10.0)
Conjunctivitis	94(67.60)	114(71.70)	60(80)	53(82.80)	35(58.30)	30(53.60)	30(60.0)
Keratitis	30(21.60)	25(15.70)	4(6.0)	6(9.30)	10(16.70)	20(35.70)	5(30.0)
Total	139(46.60)	159(53.40)	68	64	60	56	50

N = number of isolates
% = percentage frequency

TABLE 4: PERCENTAGE SUSCEPTIBILITY OF ISOLATES

Organisms	No of **isolates**	**OFX**	**CPX**	**AUG**	**GENT**	**CEP**	**NA**	**SXT**	**PN**	**CHL**
S. aureus	80	20	80	70	70	80	10	30	-	80
S. albus	65	30	20	80	60	80	10	25	-	80
S. pyogenes	20	20	40	90	20	70	30	35	90	75
S. pneumoniae	29	80	10	90	-	80	-	25	90	90
S.viridans	22	20	40	80	30	80	80	60	80	95
S. faecalis	5	20	40	80	100	20	100	55	80	70
N. meningitidis	1	100	100	100	-	-	-	-	100	-
N. gonorrhoeae	13	90	80	50	50	60	65	-	95	50
M. catarrhalis	10	10	20	20	50	60	70	-	10	20
E. Coli	15	20	40	20	70	50	50	90	-	80
K. pneumoniae	20	70	80	20	75	45	45	90	-	80
P. mirabilis	5	70	80	20	70	45	45	90	-	75
H. influenzae	26	80	80	100	40	20	20	60	5	95
P. aeruginosa	34	80	90	50	90	20	40	30	-	10

OFX = Ofloxacin, CPX=Ciprofloxacin, AUG=Augumentin
GENT = Gentamycin, CEP=Cephalexin, NA=Naldixic acid,
SXT = Sulfonamides and trimethoprim CHL=Chloramphenicol.
\- Not susceptible