

Prevalence and antibiotic resistance of *streptococcus pneumoniae* among different hospitals in Saudi Arabia

ABSTRACT

Objective: Current Study was directed to examine the pervasiveness and antibiotics resistance and susceptibility array in *S. pneumoniae* gram positive and gram negative isolated strains as it causes a greater number of instances of group procured pneumonia than other pathogen.

Methodology: In current study, 6549 suspected samples were proceeded to confirm pneumonia positive cases obtained from various hospitals. Pneumonia positive cases were tested to distinguish microbial isolates. These gram positive and negative isolates were further tested for their resistance and susceptibility against different antibiotics.

Results: 6549 samples were clinically suspected and 3716 (56.7%) pneumonia cases were observed to endorse. More than half of the confirmed cases fall in the age of 20-65 years and male proportion was 64%. Interestingly, 98.2% of the cases were healing facility procured. *P. aeruginosa* most widely recognized isolate both hospices and community acquired etiological agent was found to 18.4% and 32.2% respectively.

Conclusion: Clinicians ought to know that average observational pneumonia treatment administrations may not function admirably because of the wide assortment of segregated life forms. This requires sputum examining before beginning treatment for recognizable proof and affectability testing subsequent to a solitary measurement of anti-toxin treatment preceding pneumonia finding might impede the discovery of the causative specialists.

Keywords: *Streptococcus, pneumoniae, prevalence, antibiotic, resistance*

1. INTRODUCTION

Streptococcus pneumoniae is an essential respiratory pathogen that has been embroiled in a few respiratory illnesses including otitis media, pneumonia and sinusitis [1]. The predominance of pneumococcal nasal pharyngeal asymptomatic colonization in the sound grown-up populace has been assessed to be at 20-half [2]. The biological corner for *S. pneumoniae* is the human nasopharynx. Carriage of pneumococci in the nasopharynx is more basic in youthful youngsters. The span of carriage is impacted by host-related elements, for example, age, and by pathogen-related components, for example, serotype. Despite the fact that carriage is generally asymptomatic, it likewise serves as the boss hotspot for obtrusive pneumococcal contaminations and for individual to-individual transmission. The expanding frequency of anti-microbial safe *S. pneumoniae* strains overall postured another danger to the treatment of disease [3]. Amid the most recent decade, antimicrobial resistance has expanded around the world [4]. Specifically, imperviousness to penicillin and the macrolides has spread quickly among disengages of *S. pneumoniae* [5].

There has additionally been a stamped movement to abnormal state imperviousness to penicillin and cephalosporins among segregates of *S. pneumoniae*. Besides, a few distributed studies and case reports have proposed a connection between pneumococcal macrolide resistance and treatment disappointment in patients with group procured RTIs [6]. The development of multidrug-safe *S. pneumoniae* (MDRSP) has been seen in different nations over the previous decades. The developing resistance of *S. pneumoniae* to usually utilized anti-infection agents underlines the critical requirement for immunizations to be utilized to control pneumococcal malady.

The points of the present study incorporate to distinguish the normal etiological agents bringing on pneumonia in various hospitals of Saudi Arabia with an extraordinary focus on *S. pneumoniae* as it causes a greater number of instances of group gained pneumonia than whatever other pathogen, to decide the circulation of pneumonia cases among various hospitals, to plaid predominance of pneumonia cases in Al-Hajj and Al-Umrah seasons, to determine any conceivable measurable relationship between the commonness of pneumonia cases and different patients demographic information including; age, sex, wellspring of contamination (i.e., community acquired pneumonia (CAP's) or Hospital acquired pneumonia (HAP's)), to oversee the resistance rate among both Gram-positive and Gram-negative clinical disengages from pneumonia cases including *S. pneumoniae*.

2. MATERIALS AND METHODS

2.1 Samples collection

Current prospective study among patients clinically suspected with pneumonia with sputum samples submitted to the microbiology laboratory of various hospitals of Makkah from the 1st of Jumada al-Thani to the 30th of Jumada al-Awwal of the Islamic year 1429-1430 AH (6 Jun 2008 - 25 May 2009).

2.2 Sampling criteria

The criteria for the enrollment was all those patients with clinical diagnosis of pneumonia including; coughing with sputum, chills with shaking, fever, chest pain, shortness of breath and rapid breathing, with sputum samples submitted to the microbiology laboratory. Four hundred and forty two sputum cultures of both Gram-negative and Gram-positive bacteria and their sensitivity patterns were obtained from the various hospitals.

2.3 Sub culture and storage of specimens

The organisms were sub-cultured on blood and MacConkey agar. After overnight incubation at 37°C, they were isolated in trypticase soya broth, containing 15% Glycerol (850 µl bacterial broth and 150 µl glycerol), further stored at -80 °C.

2.4 Data Analysis

Data entry and statistical analysis were performed using the Statistical Package for Social Sciences (SPSS program Ver 17.0). Descriptive statistics, cross tabulations, Fisher's exact and Chi-square tests were performed. Statistical significance was set at <0.05 to check the significance among factors.

3. RESULTS

Data expressed 56%, 18%, 15% and 11% samples were collected from Al-Noor hospital (ANH), King Faisal hospital (KFH), King Abdul Aziz hospital (KAH) and Hera hospital respectively. Current data revealed that the out of 6549 samples, 3716 samples were positive representing a total frequency of 56.7% (data not shown). The difference between the total samples tested and positive samples was noted to be statistically significant (P. value <0.05).

During one year data collected, significant number of pneumonia cases (519, 14% of total positive) was recounted in the Dull Hijjah followed by Shawwal month (389, 10.5%) (data not shown). The gap between the total samples tested and number of positive samples was distinguished statistically significant (P-value <0.05). Gender and age groups results demonstrated that the infection affects all age groups, but significant number of both suspected and positive cases were reported in the age groups (20-65 years), followed by elderly (>65 years) people representing a percentage of 50.6% and 36% respectively. Significantly higher ratio of pneumonia cases was reported in male gender as compared to female ones.

Total one thousand seven hundred thirty three (98.2%) indoor while 31 (1.8%) outdoor patients were pretentious to pneumonia. Results displayed that most indoor-patients infected with pneumonia were related to ICU (49.6%) ward, followed by medical wards (MW) (31.7%) and surgical wards (SW) (10.6%), while out-patients were from out-patient department (OPD) (64.5%) and emergency room (ER) (35.5%) (Figure 3.1). The study disclosed that the majority of pneumonia cases were HAP (98.2%), typically caused by *P. aeruginosa* (18.4%), *A. baumannii* (14.4%) and *S. aureus* (12.5%) followed by *K. pneumoniae* (11.5%). Among the identified pathogenic agents causing CAP (total of 1.8%), the maximum isolated organism was *P. aeruginosa* (32.2%) followed by *K. pneumoniae* (29%) and *S. aureus* (12.9%) (Figure 3.2). During the study time frame, there were 323 positive TB cases. The most significant

causative agents, were found to be *P. aeruginosa* and *K. pneumoniae* followed by *S. aureus* and *A. baumannii*; organisms isolated from patients in most of hospital departments (Figure 3.2). Concerning the sensitivity patterns for more than 20 isolated organisms, both Gram-positive and Gram-negative were determined. Among most commonly isolated Gram-positive organisms, the study disclosed that the resistance rates among *S. aureus* isolates for penicillin-G and oxacillin were 94.7% and 65.2%, respectively (Table 3.1); the resistance rates of *S. pneumoniae* were 10.5% for ampicillin and erythromycin; and 73.7% for trimethoprim/sulfamethoxazole as obvious in figure 3.3. Regarding major Gram-negative isolates; the resistance of *P. aeruginosa* for ceftriaxone and ceftazidime was 68% and 49.2% respectively, 47% for aminoglycoside (gentamicin), and 36.7% for piperacillin/ tazobactam (Table 3.2); the resistance of *K. pneumoniae* for gentamicin and ceftazidime was 50.5% and 58.3% respectively; the resistance of *A. baumannii* for amikacin, gentamicin, ceftazidime and imipenem was 85.2%, 80.9%, 91.6% and 70.5% respectively (Figure 3.3).

4. DISCUSSION

Pneumonia is an irritation of the lungs, including the alveolar pipes and alveolar sacs, in relationship with new radiographic signs [7]. Pneumonia positions the sixth among the reasons for death on the planet today [8]. Clinically, there are various types of pneumonia; however a typical method for separating it is to arrange it as CAP and HAP. The blend of physical endeavors, stuffing and any prior wellbeing conditions upgrade the vulnerability of getting irresistible ailments amid Hajj venture [9]. Because of its simplicity of transmission by respiratory beads, meningitis and respiratory tract contaminations quicken the most widely recognized transmissible ailments amid Hajj and Umrah seasons [10]. Respiratory ailment was accounted for as the most widely recognized cause (57%) with pneumonia being the main purpose behind affirmation in 39.4% of all patients amid Dull Hijjah and Umrah season [11]. Contamination with pneumonia was the most widely recognized reasons for hospitalization amid Hajj, speaking to a rate of 19.7% [12]. Most astounding number of pneumonia cases in Dull Hijjah month reported followed by Umrah (Ramdan) surely in light of the fact that more number of explorers originating from everywhere throughout the world which improved by the impact of congestion, weariness and under sustenance among pioneers [9].

Among the four hospices incorporated into this study, results demonstrated that ANH had more than half of aggregate sputum tests submitted for testing. Present finding is most likely because of two components: the first is the higher number of beds in ANH in contrast with different hospices, and the second might be the physical closeness of ANH to Mena, Arafat and Muzdalifa. Positive samples (56.7%) with a momentous gap between the aggregate specimens tried were highlighted at cutoff P-value <0.05. This enormous hole could be because of a few variables including clinical misdiagnosis of cases, pre-anti-toxin use, lacking method of sputum accumulation and atypical pneumonia operators that are not routinely analyzed.

In the present study, the occurrence of pneumonia in guys was higher than in females (1.8:1) potentially on account of the distinctions in the societal position between the two genders. This finding is in concurrence with those reported by others, e.g. in Iraq, USA, Thailand and in Saudi Arabia [13-15]. A comparative finding was seen amid the month of Dull Hijjah, where the proportion of disease in the middle of male and female were 1.6:1. Our information with respect to the 98.2% indoor-patients and 1.8% were outside patients difference to discoveries what have been passed on in numerous past studies, both in neighborhood [12] and global levels [14-15]. One clarification to this finding could be the abusing of experimental treatment given to out-patients before taking a sputum test for microbiological refined, thus most situations where just recorded positive from hospitalized patients regardless of that there were numerous cases goes unnoticed from out-patients.

In current study greater part of HAP cases were generally brought about by *P. aeruginosa* (18.4%) and *A. baumannii* (14.4%) trailed by *S. aureus* (12.5%) and *K. pneumoniae* (11.5%). This finding is in concurrence with numerous national and universal studies that have shown that most HAP is brought about by pioneering Gram-negative microorganisms [16-17]. *P. aeruginosa* (32.2%), *K. pneumoniae* (29%) and *S. aureus* (12.9%) were observed to be most basic causative operators for pneumoniae in our study. Our outcomes complexity to past studies which reported that *S. pneumoniae* is the most continuous causative specialists for CAP [17-18]. This may be in all probability because of the abusing of observational treatment given to out-patients before taking sputum tests for microbiological refined.

S. aureus (17.1%), *A. baumannii* (15.5%), *K. pneumonia* (14.5%) and *P. aeruginosa* (12.8%) are most normal causative operators found in Dull-Hajj season, speaking to more than half of aggregate separates. The conclusion of pneumonia was affirmed in 72% patients; *M. tuberculosis* 28% and Gram-negative living beings 26% were among the most widely recognized causative creatures, representing over portion of the way of life affirmed cases. *S. pneumoniae* was distinguished in 10% patients, and atypical creatures were recognized in just 6% patients. Past report reasoned that the etiological operators of pneumonia in Hajj are varied from those of CAP (9). Most incessant pathogens creating *S. pneumoniae* was found because of *H. influenza*, *K. pneumoniae*, and *S. pneumoniae* [19].

CONCLUSION

This study provides information on the most common pneumonia causes, and the demographic distribution of the disease. Our study outcomes will aid health care planners, administrators, and officials in order to provide optimal health care services to locals in general and pilgrims during Hajj and Umrah seasons in particular. Clinicians should be aware that typical pneumonia treatment regimes may not work well due to the wide variety of isolated organisms. This necessitates taking a sputum sample before starting treatment for identification and sensitivity testing since a single dose of antibiotic treatment prior to pneumonia diagnosis may hinder the detection of the causative agent.

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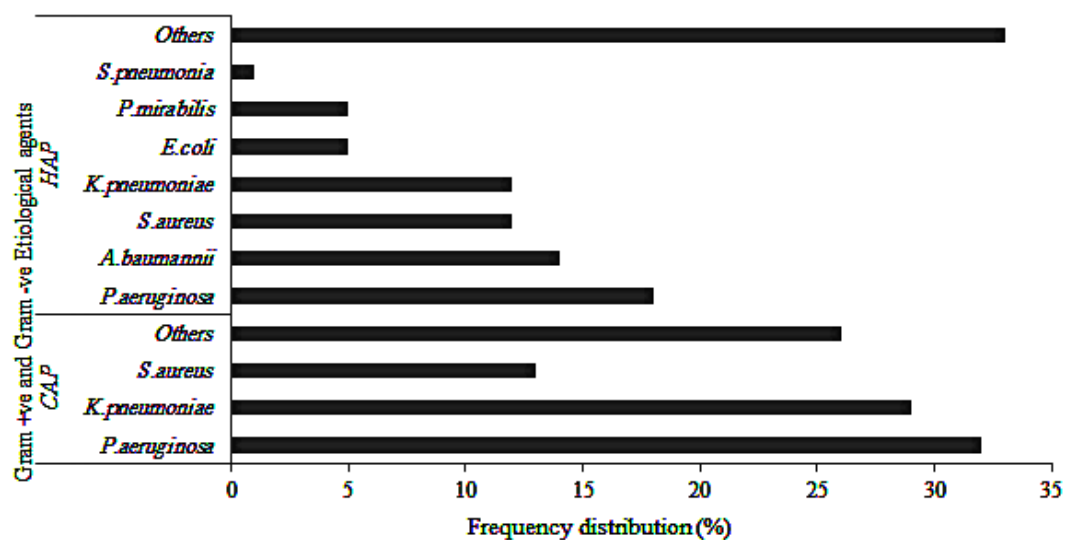


Fig 3.1 Frequency (%) of gram +ve and gram -ve etiological agents causing pneumoniae

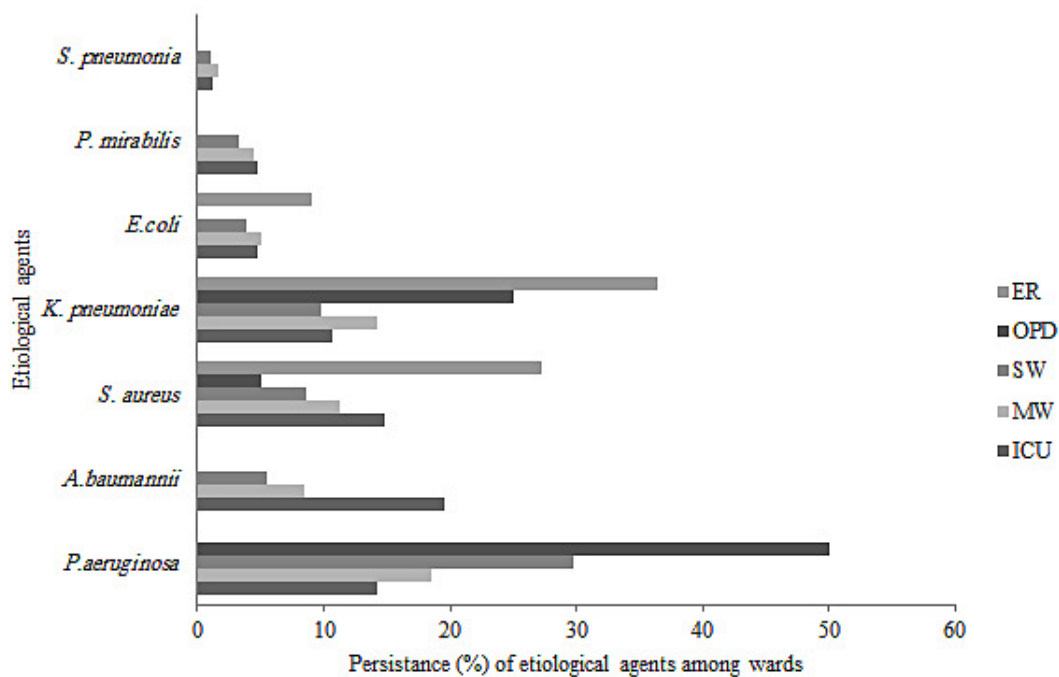


Fig 3.2 Distribution of isolated causative agents among different hospital wards

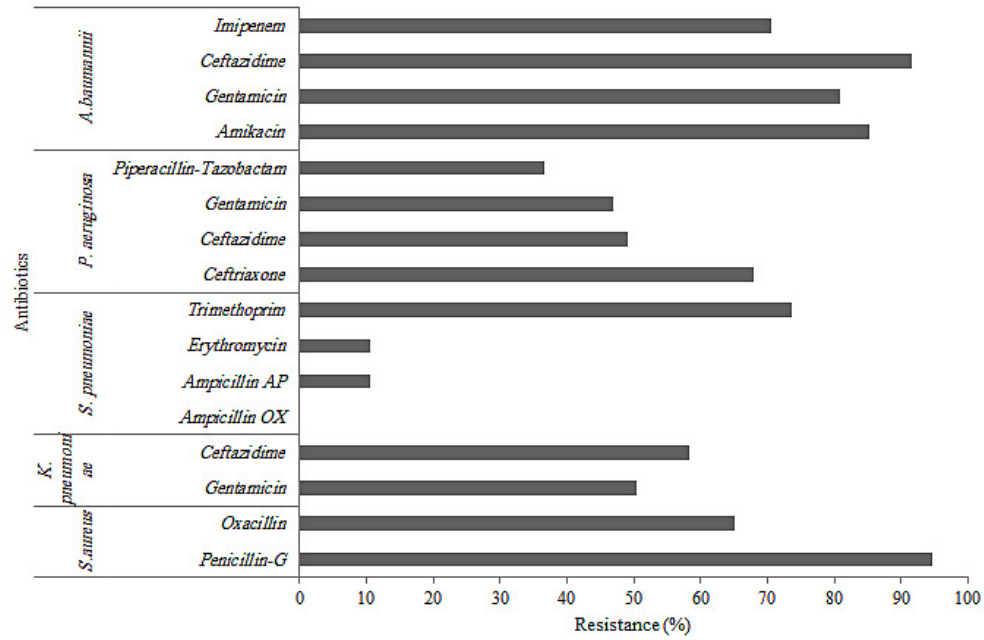


Fig 3.3 Antibiotics resistance (%) on different etiological agents causing pneumoniae

Table 3.1 Resistance rates among Gram-positive clinical isolates.

Organism	Isolated identified	Ampicillin	Amikacin	Augmentin	Ampicillin/sulbactam	Cefazolin	Cefotaxime	Ceftriaxone	Clindamycin	Ciprofloxacin	Erythromycin	Gentamicin	Imipenem	Levofloxacin	Linezolid	Norfloxacin	Oxacillin	Penicillin-G	Rifampin	Tetracycline	Trimethoprim/sulfa	Vancomycin
<i>Staphylococcus aureus</i>	241	94.7 % 189	67.3 % 101	73.5% 166	73.9 % 69	52.2% 23	58.6% 87	71.1% 149	57.7 % 215	57.1% 184	60.8% 217	54.1 % 196	61.4 % 57	43.3% 30	24.4% 78	75% 4	65.2 % 221	94.7% 171	30.1 % 83	55% 160	38.5% 226	0% 203
<i>Streptococcus pneumoniae</i>	23	10.5 % 19	80% 5	7.1% 14	0% 2	 	15.4% 13	10% 10	14.3 % 21	30% 10	10.5% 19	66.7 % 9	10.0 % 10	 	0% 7	 	0% 6	15% 20	33.3 % 3	70% 10	73.7% 19	0% 13
<i>Enterococcus faecalis</i>	9	0% 9	100% 1	50% 2	 	 	100% 2	100% 1	100% 3	62.5% 8	83.3% 6	100% 7	100% 1	 	20% 5	 	100% 1	50% 2	100% 1	71.4% 7	50% 2	0% 9

Each organism is presented in two rows. The top row represents its resistance in percent to that antibiotic. The 2nd row represents number of isolates tested for that specific antibiotic. Resistance equal to 100% is highlighted in (Aqua Color), and equal to 0% in Purple color. The empty shaded cells (red color) indicate that susceptibility testing for that specific organism is not recommended or complete testing data was not available.

261 Table 3.2 Resistance rates among Gram-negative clinical isolates.

Organism	Isolated identified	Ampicillin	Amikacin	Augmentin	Ampicillin/sulbactam	Aztreonam	Cefepime	Cefazolin	Cefuroxime	Cefotaxime	Cefoxitin	Ceftazidime	Ceftriaxone	Cephalothin	Ciprofloxacin	Gentamicin	Imipenem	Levofloxacin	Nitrofurantoin	Piperacillin	Piperacillin-tazobactam	Tetracycline	Ticarcillin/clavulanate	Tobramycin	Trimethoprim/sulfa
<i>Acinetobacter baumannii</i>	270	96.6 % 177	85.2 % 250	97.3 % 150	77.6 % 107	93.4 % 181	93.8 % 225	93.1 % 58	91.5 % 118	94.7 % 226	97.1 % 170	91.6 % 251	94.3 % 123	96.9 % 162	94.2 % 241	80.9 % 241	70.5 % 234	82.1 % 95	92% 50	94.7 % 247	92.4 % 158	79.7 % 212	91.7 % 84	64.6 % 113	88.1 % 236
<i>Pseudomonas aeruginosa</i>	371	67% 88	38.2 % 343	65.3 % 75	38.5 % 39	49.7 % 147	47.2 % 318	39.5 % 43	65.8 % 73	74.2 % 168	68.5 % 89	49.2 % 307	68% 128	68.1 % 91	43.3 % 312	47% 332	29.2 % 319	51.6 % 95	36.6 % 41	51.7 % 300	36.7 % 245	76.7 % 73	50% 102	40.5 % 131	68.6 % 105
<i>Klebsiella pneumoniae</i>	238	94.3 % 212	23.4 % 222	54.3 % 175	64.6 % 65	63.9 % 122	57.5 % 200	70% 60	64.5 % 169	59.2 % 174	45.6 % 160	58.3 % 192	59.8% 102	72.9 % 207	56.3 % 208	50.5 % 218	13.1 % 199	55.2 % 58	64.1 % 39	74.9 % 175	38.3 % 175	62.2 % 143	48.3 % 58	62.8 % 78	57.4% 209
<i>Klebsiella oxytoca</i>	11	77.8 % 9	0% 8	60% 5	50% 2	83.3 % 6	33.3 % 9	100% 2	42.9 % 7	37.5 % 8	66.7 % 6	44.4 % 9	56.7% 3	87.5 % 8	37.5 % 8	12.5 % 8	11.1 % 9	50% 2	50% 2	75% 8	11.1 % 9	42.9 % 7	50% 2	100% 2	50% 8
<i>Escherichia coli</i>	94	96.4 % 84	22.2 % 90	73.7 % 76	85.7 % 7	72.3 % 65	68.5 % 73	85.7 % 7	81.1 % 53	71.4 % 70	42.9 % 77	68.6 % 86	55.2% 23	91.7 % 84	70% 80	63.6 % 88	8% 87	100% 6	60% 10	88.2 % 76	39.3 % 61	80% 50	44.4 % 9	90.9 % 11	78.5% 79
<i>Proteus mirabilis</i>	93	96.1 % 77	77% 87	79.2 % 77	75% 12	48.5 % 68	59.1 % 88	83.3 % 12	87.5 % 56	76.6 % 77	75.7 % 74	72% 82	63% 27	89.2 % 83	84.6 % 78	91.7 % 84	20% 85	81.8 % 11	81.8 % 11	93.3 % 75	36.1 % 72	100% 53	15.4 % 22	73.3 % 15	93.1% 87
<i>Enterobacter cloacae</i>	18	93.3 % 15	23.5 % 17	91.7 % 12	80% 5	72.7 % 11	40% 15	100% 5	87.5 % 16	80% 15	100 % 11	76.5 % 17	75% 8	100% 17	17.6 % 17	41.2 % 17	11.8 % 17	40% 5	100% 1	86.7 % 15	60% 15	50% 12	80% 5	50% 6	43.8% 16
<i>Enterobacter aerogenes</i>	10	90% 10	60% 10	100 % 10	75% 10	50% 10	70% 10	100% 10	71.4 % 10	71.4 % 10	60% 10	77.8 % 10	83.3% 10	88.9 % 10	66.7 % 10	60.0 % 10	22.2 % 10	40% 10	100% 10	87.5 % 10	22.2 % 10	85.7 % 10	75% 10	83.3 % 10	80% 10

		10	10	5	4	4	10	4	7	7	5	9	6	9	9	10	9	5	2	8	9	7	4	6	10
<i>Haemophilus influenzae</i>	12	36.4 %	14.3 %	10%		40%	25%	0%	0%	14.3 %	12.5 %	20%	0%	45.5 %	25%	16.7 %	16.7 %			75%	100%	66.7 %			90.9%
		11	7	10		5	4	1	5	7	8	5	1	11	8	6	6			4	1	3			11
<i>Serratia marcescens</i>	29	96.4 %	25%	100%	83.3 %	53.3 %	48.1 %	90.9 %	95.7 %	60%	77.8 %	50%	60%	96.2 %	42.3 %	42.9 %	19.2 %	58.3 %	75%	65.2 %	38.1 %	68.2 %	40%	61.5 %	44.8%
		28	28	19	12	15	27	11	23	25	18	28	15	26	26	28	26	12	4	23	21	22	10	13	29
<i>Providencia stuartii</i>	29	96.6 %	70.4 %	100%	85%	66.7 %	74.1 %	100%	88.5 %	76%	42.9 %	75%	76.2%	100%	85.7 %	92.9 %	14.8 %	68.4 %	100%	44.4 %	23.1 %	100%	15.8 %	95.2 %	32.6%
		29	27	7	20	6	27	20	26	25	7	28	21	27	28	28	27	19	2	27	26	26	19	21	23
<i>Citrobacter Species</i>	8	62.5 %	50%	100%	100%	66.6 %	50%	100%	100%	50%	100 %	50%	100%	83.3 %	100%	25%	25%	100%	100%	100%	50%	100%	0%	100%	33.3%
		5	2	2	1	3	2	1	2	2	2	4	1	6	4	2	4	1	1	4	2	2	1	1	6
<i>Morganella morganii</i>	12	100 %	58.3 %	100%	57.1 %	100 %	36.4 %	100%	75%	40%	50%	45.5 %	40%	100%	58.3 %	90%	12.5 %	57.1 %	100%	63.6 %	18.2 %	100%	28.6 %	88.9 %	31.7%
		12	12	6	7	1	11	7	8	10	2	11	10	11	12	10	8	7	1	11	11	10	7	9	12
<i>Stenotrophomonas maltophilia</i>	13	100 %	100%	100%	100%	100 %	100 %	100%	100%	100%	100 %	69.2 %	100%	100%	80%	100%	100%	60%	100%	80%	100%	85.7 %	66.7 %	100%	8.3%
		8	8	5	2	9	6	2	5	6	6	13	2	8	10	9	10	5	1	10	7	7	3	3	12

Each organism is presented in two rows. The top row represents its resistance in percent to that antibiotic. The 2nd row represents number of isolates tested for that specific antibiotic. Resistance equal to 100% is highlighted in (Aqua Color), and equal to 0% in Purple color. The empty shaded cells (red color) indicate that susceptibility testing for that specific organism is not recommended or complete testing data was not available.