

**DESCRIPTION AND ANTIBIOTIC RESISTANCE OF BACTERIA ISOLATED
FROM SPUTUM SPECIMENS
AT CAN THO UNIVERSITY OF MEDICINE AND PHARMACY HOSPITAL
FROM JULY 2021 TO DECEMBER 2021**

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ABSTRACT

Background: Bacteria causing respiratory infections tend to rapidly increase antibiotic resistance, prolong treatment time, increase treatment costs and increase mortality. **Objectives:** 1). To determine the proportion of bacterial strains isolated from sputum specimens; 2). To describe the antibiotic resistance of bacterial strains isolated from sputum specimens. **Materials and methods:** A cross-sectional descriptive study was carried out on 96 patients with positive sputum cultures using convenient sampling method. **Results:** *Streptococcus pneumoniae* (44.8%) was found to be the predominant pathogen isolated followed by *Klebsiella pneumoniae* (20.8%), *Acinetobacter baumannii* (13.5%) and *Staphylococcus aureus* (8.3%). The highest resistance was observed with piperacillin, ampicillin, erythromycin, cefaclor, azithromycin. *Streptococcus pneumoniae* isolated were mostly resistant to azithromycin, cefaclor, and erythromycin (85.7%), while 0% resistance was observed for vancomycin, ampicillin and gentamycin. *Klebsiella pneumoniae* were highly resistant to ampicillin (95%), trimeth/sulfa (85%), and piperacillin (85%). *Acinetobacter baumannii* had a resistant rate of over 50% to most antibiotics, especially gentamycin and meropenem (84.6%). *Staphylococcus aureus* were completely resistant to ampicillin, clindamycin, penicillin, while vancomycin resistance was observed among 12.5% of the isolated bacteria. **Conclusions:** The most common pathogen was *Streptococcus pneumoniae*, *Klebsiella pneumoniae*, *Acinetobacter baumannii* and *Staphylococcus aureus*. The highest resistance was observed with piperacillin, ampicillin, erythromycin, cefaclor, and azithromycin. *Streptococcus pneumoniae* was highly resistant to macrolides. *Klebsiella pneumoniae* was highly resistant to most antibiotics of the 2nd, 3rd generation cephalosporins and beta lactams (penicillin and monobactam). *Acinetobacter baumannii* showed a noticeable resistance to fluoroquinolones, aminoglycosides, and 4th generation cephalosporins. *Staphylococcus aureus* was highly resistant to penicillin, lincosamides, fluoroquinolone, while 12.5% vancomycin resistance was observed.

Keywords: sputum specimen, bacteria, antibiotic, antibiotic resistance.

I. INTRODUCTION

Respiratory tract infections are one of the most common infections in hospitals. Every year, the number of patients with respiratory tract infections with sputum specimens sent to the microbiological testing departments of the hospitals usually accounts for a large proportion [4], [10]. Study of pathogens, mainly bacteria in sputum specimens is essential. A study on community-acquired pneumonia in 2017 showed that *Streptococcus pneumoniae*

is the most common bacterial pathogen with the rate of 50,6%, followed by *Pseudomonas aeruginosa* (16%), *Acinetobacter baumannii* (14.8%), *Enterobacteriaceae* (11.1%) and *Staphylococcus aureus* (7.4%) [7]. Agents of respiratory infections tend to increase antibiotic resistance, prolong the duration of treatment, increase treatment costs and mortality. Hence, knowing the types of pathogenic bacteria present in the sputum specimens as well as researching on their antibiotic resistances is essential to choose an appropriate, effective antibiotic and provides appropriate preventive measures in controlling bacterial infections. The aim of this study: 1).To determine the proportion of bacteria isolated from sputum specimens; 2) To describe their antibiotic resistance at Can Tho University of Medicine and Pharmacy Hospital from July 2021 to December 2021.

II. MATERIALS AND METHODS

2.1. Materials

Patients with positive sputum culture at Can Tho University of Medicine and Pharmacy Hospital from July 2021 to December 2021.

Selection criteria: Patients with positive bacterial sputum culture and agreed to participate in the study.

Exclusion criteria: Patients with contaminated specimens and patients whose results had not returned by the time of discharging.

2.2. Methods

Research design: This was a descriptive cross-sectional study.

Sample size and sampling method: Applying the sample size formula to estimate a percentage of the population

$$n = Z_{1-\alpha/2}^2 \times \frac{p(1-p)}{d^2}$$

n: minimum sample size required

Z: Reliability coefficient. With a 95% confidence level, $Z_{(1-\alpha/2)} = 1.96$

d: allowable error. We chose $d = 0.08$ (<10%)

p: antibiotic resistance rate, based on the research of Dinh Chi Thien in 2021 [1], we chose $p = 0.80$. The actual samples obtained was 96 samples.

Sampling methods: The study used convenient sampling method.

Statistical analysis: The data were collected from test results from Microbiology laboratory and processed with SPSS 22.0.

III. RESULTS

From July 2021 to December 2021, there were 96 sputum specimens with positive bacteria culture results that met the sampling criteria. In the research sample, 80.2% of the patients were 60 years or older, followed by the age group of 40-59 years (15.6%) and the group under 40 years old (4.2%). 65.6% of the study sample were males, and 34.4% were females. Gram-positive bacteria dominated with 57.3%, Gram-negative bacteria accounted for a lower rate with 42.7%.

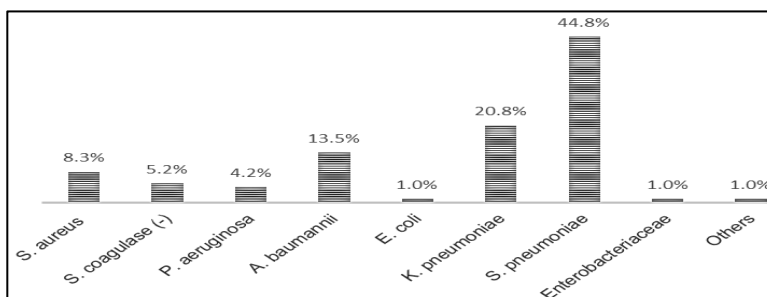


Figure 1. Percentages of isolated bacteria

The chart indicated that the most frequent pathogens were *S. pneumoniae* (44.8%), *K. pneumoniae* (20.8%), *A. baumannii* (13.5%) and *S. aureus* (8.3%).

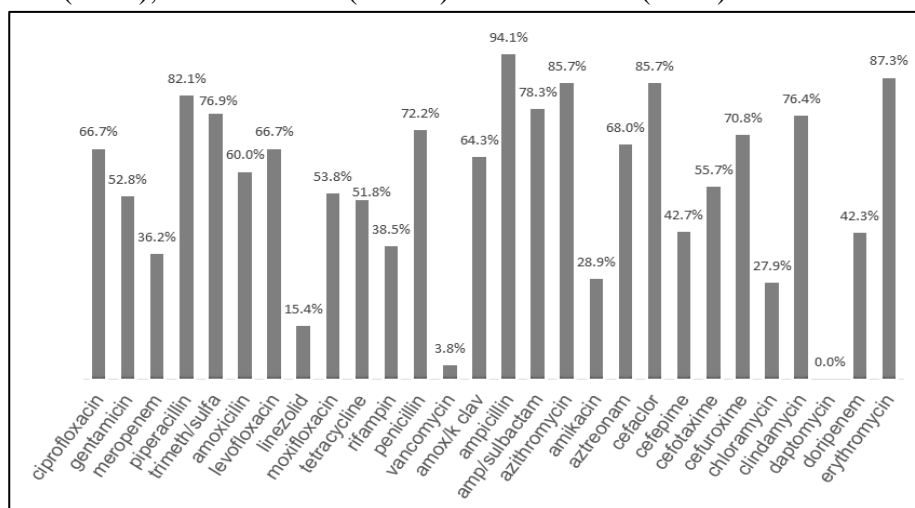


Figure 2. General antibiotic resistance rates

The chart showed that the highest resistance rates belonged to piperacillin, ampicillin, erythromycin, cefaclor, and azithromycin (>80%).

Table 1. Antibiotic resistance of Gram-positive and Gram-negative bacteria

Antibiotic	Resistance rate	
	Gram positive n (%)	Gram negative n (%)
ampicillin	11 (91.7%)	21 (95.5%)
ampicillin/sulbactam	9 (81.8%)	27 (77.1%)
cefepime	13 (31.0%)	22 (55.0%)
cefotaxime	26 (42.3%)	23 (65.7%)
ciprofloxacin	11 (84.6%)	23 (60.5%)
gentamicin	8 (57.1%)	20 (51.3%)
levofloxacin	42 (76.4%)	22 (53.7%)
meropenem	11 (27.5%)	18 (45.0%)
trimeth/sulfa	43 (81.1%)	27 (71.1%)

The table showed that Gram-negative bacteria exhibited higher resistance rates to cefepime, cefotaxime, and meropenem than Gram-positive bacteria.

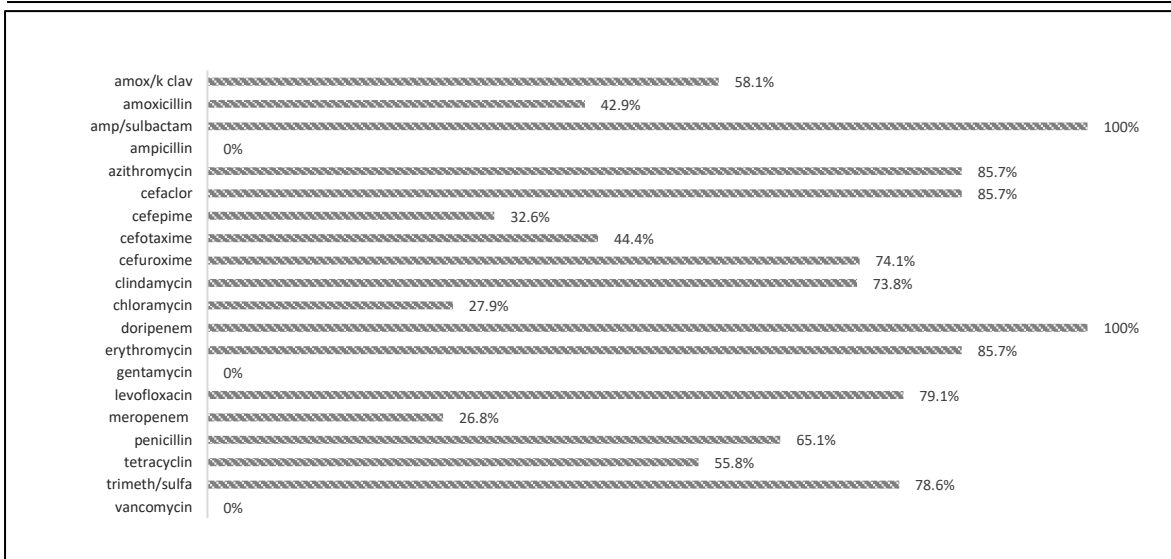


Figure 3. The antibiotics resistance rate of *S. pneumoniae*

The chart indicated that *S. pneumoniae* showed high resistance to azithromycin, cefaclor, and erythromycin (85.7%), while 0% resistance was observed for vancomycin, ampicillin and gentamycin.

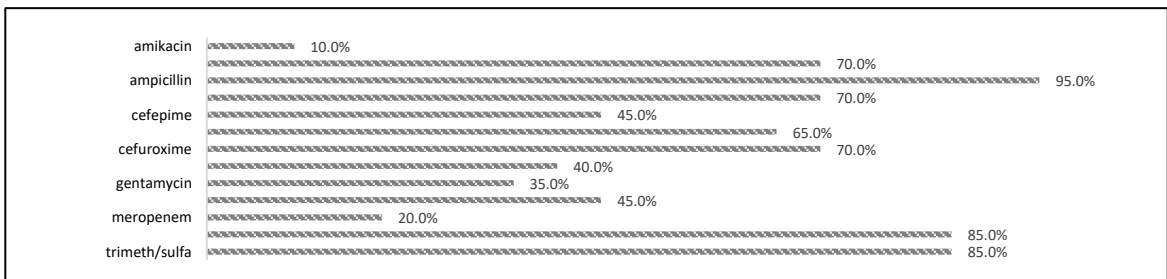


Figure 4. The antibiotics resistance rate of *K. pneumoniae*

K. pneumoniae showed high resistant to ampicillin (95%), trimeth/sulfa and piperacillin (85%), and low resistance to amikacin (10%), meropenem (20%).

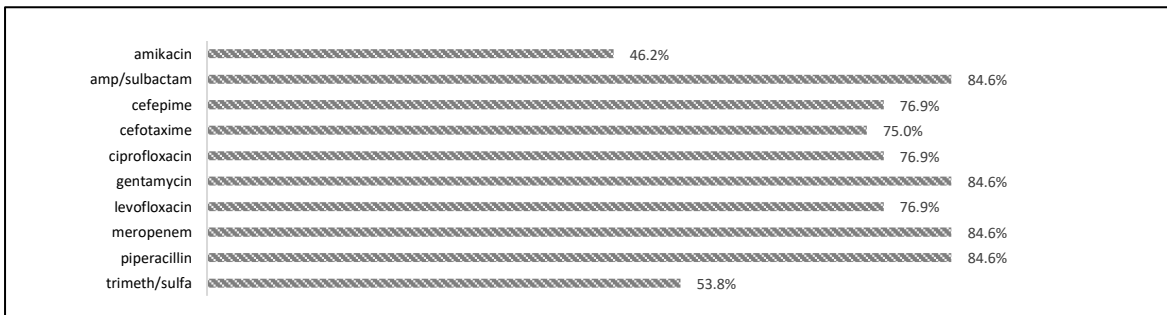


Figure 5. The antibiotics resistance rate of *A. baumannii*

A. baumannii had a resistant rate of more than 50% to most antibiotics, especially gentamycin and meropenem (84.6%). Bacteria also have a high resistance rate to ciprofloxacin and levofloxacin (76.9%).

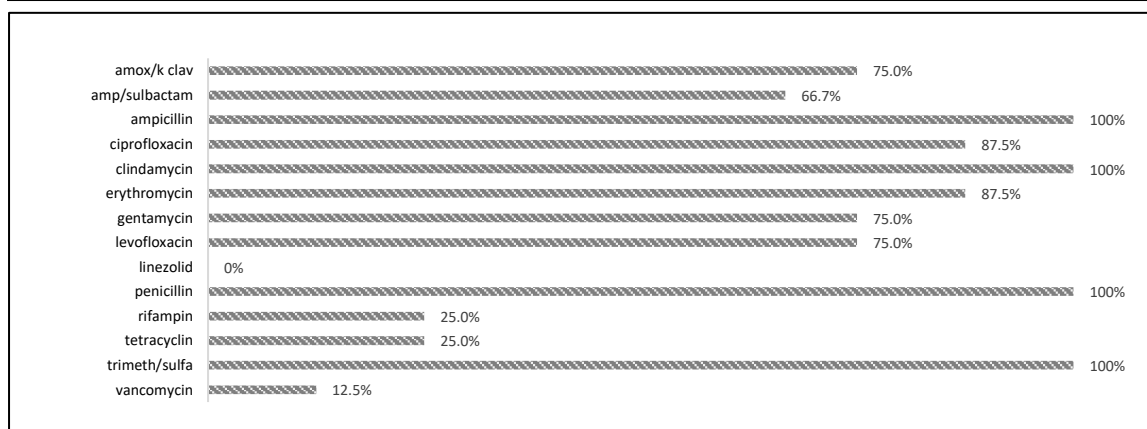


Figure 6. The antibiotics resistance rate of *S. aureus*

S. aureus showed a complete resistance to ampicillin, clindamycin, penicillin and a high resistance to gentamycin (75%), erythromycin and ciprofloxacin (87.5%). *S. aureus* had low resistance to linezolid (0%), vancomycin (12.5%), rifampin (25%), and tetracyclin (25%).

IV. DISCUSSION

From July 2021 to December 2021, there were 96 sputum specimens with positive bacterial culture results that met the sample selection criteria. In the research sample, 80.2% of the patients were 60 years or older. This result was similar to the studies of Son Thi Chanh Tria and Lam Nguyet Anh in which the proportion of elderly persons aged over 60 years are 82% and 81.8%, relatively [9], [5]. This showed that respiratory infections were associated with age. In our study, 57.3% of the isolated bacteria were Gram-positive and 42.7% were Gram-negative. Our result was consistent with Le Tien Dung's study in 2017 (Gram-positive: 58% and Gram-negative: 42%) [7]. The most frequent bacteria isolated were *Streptococcus pneumoniae* (44.8%), *Klebsiella pneumoniae* (20.8%), *Acinetobacter baumannii* (13.5%) and *Staphylococcus aureus* (8.3%). Our results were different from Lam Nguyet Anh which showed in descending order of *Klebsiella pneumoniae* (36.9%), *Acinetobacter baumannii* (29.5%), *Pseudomonas aeruginosa* (13.9%), and *Escherichia coli* (5.7%) [5], [2].

Bacteria showed highest resistant to piperacillin, ampicillin, erythromycin, cefaclor, azithromycin (>80%) and lowest resistant to vancomycin (3.8%). Gram-negative bacteria exhibited higher resistance rates to cefepime, cefotaxime, and meropenem than Gram-positive bacteria.

Streptococcus pneumoniae showed high resistant to azithromycin, cefaclor, and erythromycin (85.7%), but no resistance to vancomycin, ampicillin and gentamycin (0%). This result was in agreement with Nguyen Ngoc Kim Huyen 2016 which indicated a high rate of resistance to macrolides (85.5% to erythromycin, 100% to azithromycin), and cephalosporins (92.3%) [8], however the vancomycin resistance rate was higher (40.9%). In 2017, Le Tien Dung also found high resistance to azithromycin (82%), but identified a higher resistance to ampicillin (75%) than that in our research [7].

Klebsiella pneumoniae were highly resistant to ampicillin (95%), piperacillin (85%). This result were similar to Duong Thi Thanh Van in 2019 [3] and Le Hoang Phuc in 2019 [6]. However, our result showed higher resistance to trimeth/sulfa (Duong Thi Thanh Van: 68% and Le Hoang Phuc: 73.7%). In our study, *Klebsiella pneumoniae* had the lowest

resistance to amikacin 10%, similar to Le Hoang Phuc (22.8%) and Duong Thi Thanh Van (20%). Our results indicated a resistance of 20% to meropenem, which was lower than that of Duong Thi Thanh Van (75%) and Le Hoang Phuc (54.5%).

Acinetobacter baumannii had a resistant rate of over 50% to most antibiotics, especially gentamycin and meropenem (84.6%), which was equivalent to the study of Dinh Chi Thien [1] and Le Hoang Phuc [6]. The resistance rate to fluoroquinolones (76.9%) were slightly lower than that of Dinh Chi Thien (100%), Duong Thi Thanh Van (almost 95%) [3] and Le Hoang Phuc (91.8% of levofloxacin and 95.3% of ciprofloxacin).

Staphylococcus aureus exhibited a complete resistance to ampicillin, clindamycin, penicillin, which was in agreement with that of Nguyen Ngoc Kim Huyen in 2016 [8]. The resistance rate to gentamycin (75%), erythromycin and ciprofloxacin (87.5%) were higher to those reported in the study of Duong Thi Thanh Van 2019 (ciprofloxacin of 80%) [3], Le Hoang Phuc 2019 (gentamycin of 50%, erythromycin of 71.4%) [6], and Nguyen Ngoc Kim Huyen (ciprofloxacin of 50%) [8]. *Staphylococcus aureus* had a low resistance to linezolid (0%) and vancomycin (12.5%), which was consistent with that in the studies of Duong Thi Thanh Van [3] and Le Hoang Phuc [6]. However, they both reported a higher resistant rate to rifampin (Duong Thi Thanh Van: 40%, Le Hoang Phuc: 100%) than our study (25%). The decreasing resistance of rifampin may be due to the difference in the use of antibiotics in hospitals and limited isolates.

V. CONCLUSIONS

In 96 sputum specimens with positive bacterial culture results, 57.3% of the isolated bacteria were Gram-positive and 42.7% were Gram-negative. The most common pathogen was *Streptococcus pneumoniae* (44.8%), followed by *Klebsiella pneumoniae* (20.8%), *Acinetobacter baumannii* (15.3%), *Staphylococcus aureus* (8.3%), *Staphylococcus coagulase* (5.2%), *Pseudomonas aeruginosa* (4.2%), *E. coli* (1%), and other pathogens (1%).

The highest resistance was observed with piperacillin, ampicillin, erythromycin, cefaclor, and azithromycin. *Streptococcus pneumoniae* was highly resistant to macrolides and had no resistance to vancomycin, ampicillin and gentamycin. *Klebsiella pneumoniae* was highly resistant to most antibiotics of the 2nd, 3rd generation cephalosporins and beta lactams (penicillin and monobactam). *Acinetobacter baumannii* showed a noticeable resistance to fluoroquinolones, aminoglycosides, and 4th generation cephalosporins. *Staphylococcus aureus* was highly resistant to penicillin, lincosamides, fluoroquinolones while 12.5% vancomycin resistance was observed.

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