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Bacteriological Pattern and Its Resistance on Antibiotics in Patient with Bacteriological Culture Test in ICU RSUP Sanglah Denpasar

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Abstract: **There have been recorded that more 23,000 deaths occur each year due to bacterial resistance to antibiotics. Antibiotic resistance can be prevented by rational and appropriate use of antibiotics. The bacteriological profile and its resistance on antibiotics can provide a reference in giving antibiotics rationally and appropriately. This research was conducted at ICU Sanglah Hospital Denpasar in the span of 1st January 2020 to 31st March 2020. This study uses the results of bacteriological culture tests and antibiotic susceptibility tests on all patients who carried out bacterial culture at the study site. The bacteriological profile found dominant in samples was *Acinetobacter baumannii* (28.75%), *Klebsiella pneumoniae ssp. pneumoniae* (17.5%), and *Pseudomonas aeruginosa* (16.25%). The susceptibility of *Acinetobacter baumannii* to antibiotics is 81.8% sensitive to Amikacin and 100% resistant to Cefazolin, Cefixime, Cefuroxime, and Cefoperazone. Susceptibility of *Klebsiella pneumoniae ssp. pneumoniae* to antibiotics are 100% sensitive to Meropenem and 100% resistant to Ampicillin. The susceptibility of *Pseudomonas aeruginosa* to antibiotics is 90% sensitive to Amikacin, 84.6% sensitive to Gentamicin, and 83.3% resistant to Levofloxacin.**

Keywords: **Bacteriological pattern, antibiotic resistance, ICU.**

1. INTRODUCTION

Antibiotics were first discovered by Alexander Flemming in 1928. First introduced as term "antibiotics" by Selman Waksman in 1942. The use of antibiotics has become a treatment of infections used throughout the world. [1] Problem that arises in the use of antibiotics is the incidence of antibiotic resistance. There are 23,000 deaths due to antibiotic resistance in the United States each year. While there are 700,000 deaths due to antibiotic resistance worldwide. [2,3] Antibiotic resistance occurs when microbes are able to adapt in the concentration of antibiotics that previously killed them. Prevention of antibiotic resistance can be done through the implementation of policies and guidelines on the use of appropriate antibiotics. [4] The bacteriological and antibiotic resistance pattern can provide a reference in the selection of antibiotics for patients. Bacteriological and antibiotic sensitivity patterns are found to be different in each place and time. Therefore, an understanding of bacteriological and antibiotic resistance patterns is needed. [5] This research helps in providing data on bacteriological and antibiotic sensitivity pattern in ICU Sanglah Hospital Denpasar. This study will summarize bacteriological data and antibiotic sensitivity pattern in ICU Sanglah Hospital during January to March 2020 and compare them in the discussion with bacteriological and antibiotic sensitivity pattern data in ICU Sanglah Hospital during 2017 to 2018.

2. METHODOLOGY

This research is a descriptive study with the data taken prospectively. Data collection was carried out for three months from 1 January 2020 to 31 March 2020. Consecutive sampling is a sampling method used in this study which means that all samples that meet the requirements will be taken into account. Data collected in this study were secondary data from patients in the form of bacterial culture test and antibiotic sensitivity test. Data taken from each sample consisted of found germs and a list of antibiotic results. The list of antibiotic results in the sample data consists of antibiotics that show

sensitivity, resistance, and intermediates. The population in this study were all patients in ICU RSUP Sanglah Hospital which were done bacterial culture and antibiotic sensitivity test and the results of the test were published in the period of 1 January 2020 to 31 March 2020. This study excluded uncomplete data or inaccessible data. This study also excluded data with negative culture results or it was found that germs did not cause the infection. Data on the results of germ patterns are presented with a percentage of the amount of each germ compared to the total findings of germs. Data on the results of antibiotic sensitivity patterns are presented with the percentage of the number of germ samples sensitive to antibiotics compared to the total antibiotics tested on these germs. Data on the results of antibiotic resistance patterns are presented with the percentage of the number of germ samples resistant to antibiotics compared to the total antibiotics tested on these germs.

3. RESULTS AND DISCUSSION

This study obtained 80 samples of culture results and antibiotic sensitivity. The sample collected in this study consisted of 52 samples (65%) of sputum specimens, 12 samples (15%) of blood specimens, 7 samples (8.75%) of urine specimens, 4 samples (5%) of wound-based specimens , 2 samples (2.5%) from pus specimens, 2 samples (2.5%) from bone marrow fluid specimens, and 1 sample (1.75%) from pleural fluid specimens. This study collected data from 56 patients consisting of 37 men (66%) and 19 women (34%). Patients aged under 41 years were 16 people (28.5%), aged 41 to 60 years as many as 19 people (34%), and patients aged over 60 years were 21 years (37.5%). Patient placement consists of the ICU Barat, ICU Timur, and ICU IGD. The highest amount of research data was obtained from the Eastern ICU with 41 samples (51.25%), then from the West ICU as many as 22 samples (27.5%), and ICU ICU as many as 17 samples (21.25%).

3.1 Bacteriological Pattern in Patient with Bacteriological Culture Test in ICU RSUP Sanglah Denpasar

In this study found 80 germs data consisting of 20 species of bacteria and 3 species of fungi. The most bacterial species found was *Acinetobacter baumannii* with 23 findings (28.75%). The highest number of bacterial finding was followed by *Klebsiella pneumoniae* with 14 findings (17.5%) and followed by *Pseudomonas aeruginosa* with 13 findings (16.25%). The most common fungal species were *Candida albicans* and *Candida tropicalis* with 2 findings each (2.5%). The pattern of germs in Sanglah ICU in the January - March 2020 period is fully described in Table 1.

TABLE 1: Bacteriological pattern in ICU RSUP Sanglah during January-March 2020

Species	n	%
Acinetobacter baumannii	23	28,75
Acinetobacter denitrificans	1	1,25
Burkholderia cepacia	1	1,25
Candida albicans	2	2,5
Candida krusei	1	1,25
Candida tropicalis	2	2,5
Enterobacter aerogenes	1	1,25
Enterobacter cloacae ssp. cloacae	1	1,25
Escherichia coli	4	5
Klebsiella pneumoniae	14	17,5
Ochrobactum anthropic	1	1,25
Pluralibacter georgoviae	1	1,25
Proteus mirabilis	2	2,5
Pseudomonas aeruginosa	13	16,25
Pseudomonas putida	1	1,25
Raoutella ornithinolytica	1	1,25
Staphylococcus aureus	3	3,75
Staphylococcus epidermidis	1	1,25
Staphylococcus hominis ssp. hominis	1	1,25
Stenotrophomonas maltophilia	2	2,5
Streptococcus anginosus	1	1,25
Streptococcus mitis/Streptococcus oralis	1	1,25
Streptococcus suis II	2	2,5
Total	80	100

The bacteriological pattern on each ICU in Sanglah Hospital was found to be different. The results found in the ICU Timur with the findings of 14 bacterial species and 1 fungal species, ICU Barat with 9 bacterial species and 2 fungal species findings, and ICU IGD with 9 bacterial species and 1 fungal species finding. Germs that found to be dominant in ICU Timur are *Acinetobacter baumannii* and *Klebsiella pneumoniae*, ICU Barat with *Acinetobacter baumannii* and *Klebsiella pneumoniae*, and ICU IGD with *Acinetobacter baumannii* and *Pseudomonas aeruginosa*.

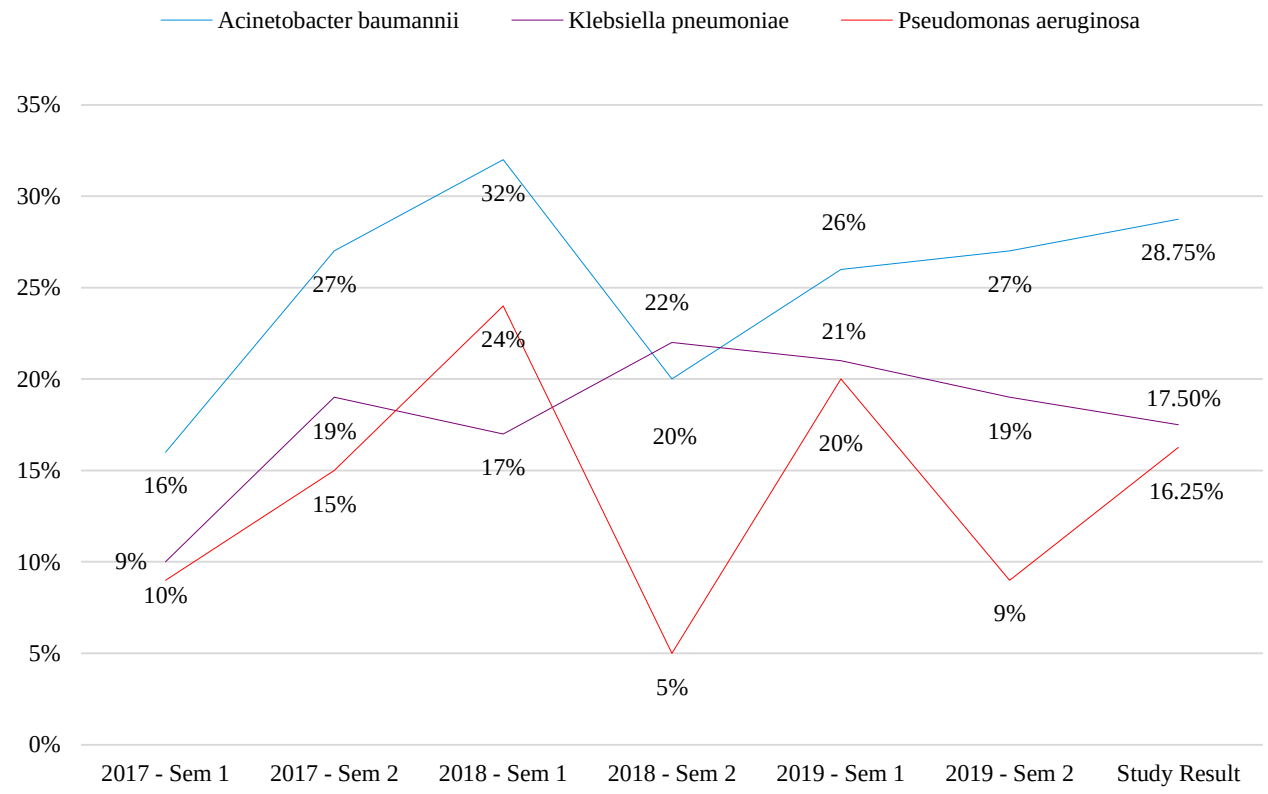
The bacteriological pattern found dominant in this study when compared with bacteriological pattern data which published by KSM Microbiology Sanglah Hospital Denpasar in 2017 to 2019 shows that *Acinetobacter baumannii* and *Klebsiella pneumoniae* are the most dominant germs each year. Whereas *Pseudomonas aeruginosa* was found dominant in 2017, January to June 2018, and in 2019 [6,7,8,9,10,11]. Figure 1 will explain the trend of dominant germ trends over the past three years.

The bacteriological pattern in male patients is dominated by *Acinetobacter baumannii* and *Klebsiella pneumoniae*, whereas in female patients' germs are dominated by *Acinetobacter baumannii* and *Pseudomonas aeruginosa*. Germs found in patients under 41 years are dominated by *Acinetobacter baumannii* and *Pseudomonas aeruginosa*. In 19 patients aged 41 to 60 years the bacteria were dominated by *Acinetobacter baumannii* and *Klebsiella pneumoniae*. In 21 patients over the age of 60 years the bacteria were dominated by *Acinetobacter baumannii* and *Klebsiella pneumoniae*.

This study collected additional data in the form of giving antibiotics to patients and the patient's diagnosis. These additional data are used to compare the diagnosis of patients with germ patterns and illustrate the accuracy of antibiotics given based on the sensitivity results found.

Patients with Acinetobacter baumannii findings were found in 8 out of 20 patients with pneumonia. Patients with Klebsiella pneumoniae findings found 9 out of 12 patients had pneumonia. Patients with Pseudomonas aeruginosa findings found in 5 of 11 patients experiencing pneumonia.

FIGURE 1: Trends in Bacteriological Patterns in ICU RSUP Sanglah Denpasar in January 2017 to March 2020



Note: Sem 1 = January to June. Sem 2 = July to December. In 2018 Semester 2, Staphylococcus aureus and Escherichia coli are 8% each.

3.2 Pattern of Bacteriological Sensitivity and Resistance to Antibiotics in ICU Sanglah Hospital

Samples with the findings of *Acinetobacter baumanni* were tested with 15 types of single antibiotics and 4 antibiotic combinations. Amikacin is an antibiotic with the highest sensitivity with 18 of 22 samples showing sensitive. Several types of antibiotics showed 100% resistance, namely Cefazolin with 14 samples, Cefixime with 18 samples, Cefuroxime with 13 samples, Cefoperazone with 20 samples, and Fosfomycin with 1 sample. The complete pattern of sensitivity and resistance of *Acinetobacter baumanni* to antibiotics is described in Table 5.

TABLE 5: Antibiotics Sensitivity and Resistance Pattern on *Acinetobacter baumannii* in ICU RSUP Sanglah Denpasar in January to March 2020

Antibiotics	S (%)	I (%)	R (%)
Amikacin	18 (81,8%)	0	4 (18,2%)
Ampicillin	1 (100%)	0	0
Cefazolin	0	0	14 (100%)
Cefepime	6 (27,3%)	0	16 (72,7%)
Cefixime	0	0	18 (100%)
Ceftriaxone	0	4 (18,2%)	18 (81,8%)
Ceftazidime	3 (20%)	0	12 (80%)
Cefuroxime	0	0	13 (100%)
Cefoperazone	0	0	20 (100%)
Ciprofloxacin	5 (23,8%)	0	16 (76,2%)
Fosfomycin	0	0	1 (100%)
Gentamicin	7 (31,8%)	1 (4,5%)	14 (63,6%)
Levofloxcin	7 (63,6%)	0	4 (36,3%)
Meropenem	7 (33,3%)	1 (4,8%)	13 (61,9%)
Tigecycline	9 (69,2%)	4 (30,8%)	0
Ampicillin/ Sulbactam	7 (35%)	0	13 (65%)
Cefoperazone/ Sulbactam	2 (33,3%)	0	4 (66,7%)
Piperacillin/ Tazobactam	6 (30%)	0	14 (70%)
Trimethoprim/ Sulfamethoxazole	12 (63,2%)	0	7 (36,8%)

Samples with the findings of *Klebsiella pneumoniae* were tested with 8 types of single antibiotics and 2 combinations of antibiotics. Antibiotics with 100% sensitivity are Meropenem with 7 samples and Ceftriaxone with 3 samples. Antibiotics with 100% resistance are Ampicillin with 9 samples, Amikacin with 1 sample, Amoxicillin with 1 sample, Gentamicin with 1 sample, and Ampicillin/Sulbactam with 1 sample. The complete pattern of sensitivity and resistance of *Klebsiella pneumoniae* to antibiotics is described in Table 6.

TABLE 6: Antibiotics Sensitivity and Resistance Pattern on *Klebsiella pneumonia* in ICU RSUP Sanglah Denpasar in January to March 2020

Antibiotics	S (%)	I (%)	R (%)
Amikacin	0	0	1 (100%)
Amoxicillin	0	0	1 (100%)
Ampicillin	0	0	9 (100%)
Cefepime	2 (66,7%)	1 (33,3%)	0
Ceftriaxone	3 (100%)	0	0
Gentamicin	0	0	1 (100%)
Meropenem	7 (100%)	0	0
Tigecycline	0	1 (100%)	0
Ampicillin/ Sulbactam	0	0	1 (100%)
Piperacillin/ Tazobactam	2 (50%)	2 (50%)	0

Samples with the findings of *Pseudomonas aeruginosa* were tested with 13 types of single antibiotics and 2 combinations of antibiotics. The antibiotic with the highest sensitivity is Amikacin with 9 out of 10 samples showing sensitive. Antibiotics with 100% resistance consist of Cefixime with 10 samples, Cefuroxime with 9 samples, Cefazolin with 8 samples, Tigecycline with 6 samples, Piperacillin, and Colistin each with 1 sample. The complete pattern of sensitivity and resistance of *Pseudomonas aeruginosa* to antibiotics is outlined in Table 7.

TABLE 6: Antibiotics Sensitivity and Resistance Pattern on *Pseudomonas aeruginosa* in ICU RSUP Sanglah Denpasar in January to March 2020

Antibiotics	S (%)	I (%)	R (%)
Amikacin	9 (90%)	0	1 (10%)
Cefazolin	0	0	8 (100%)
Cefepime	7 (58,8%)	1 (7,7%)	4 (30,8%)
Cefixime	0	0	10 (100%)
Ceftazidime	7 (58,8%)	3 (23,1%)	3 (23,1%)
Cefuroxime	0	0	9 (100%)
Ciprofloxacin	7 (58,3%)	1 (8,3%)	4 (33,3%)
Colistin	0	0	1 (100%)
Gentamicin	11 (84,6%)	0	2 (15,4%)
Levofloxcin	1 (16,7%)	0	5 (83,3%)
Meropenem	7 (63,6%)	0	4 (36,4%)
Piperacillin	0	0	1 (100%)
Tigecycline	0	0	6 (100%)
Cefoperazone/ Sulbactam	2 (50%)	0	2 (50%)
Piperacillin/ Tazobactam	6 (54,5%)	1 (9,1%)	4 (36,4%)

The results of the sensitivity and resistance patterns of *Acinetobacter baumannii* to antibiotics in this study are similar to the data of antibiotic sensitivity and resistance patterns in the ICU published by KSM Microbiology Sanglah Hospital Denpasar in 2017 to 2019. Amikacin and Tigecycline are the antibiotics with the highest sensitivity in the data from January 2017 to March 2020[6,7,8,9,10,11]. The sensitivity pattern of *Acinetobacter baumannii* during January 2017 to March 2020 is explained in full in Figure 2. Patients with the findings of *Acinetobacter baumannii* found as much as 40% given Amikacin in these patients after the results of the antibiotic sensitivity test came out. This is in line with the antibiotic sensitivity test results mentioned above that Amikacin is an antibiotic with the highest sensitivity for *Acinetobacter baumanniii*.

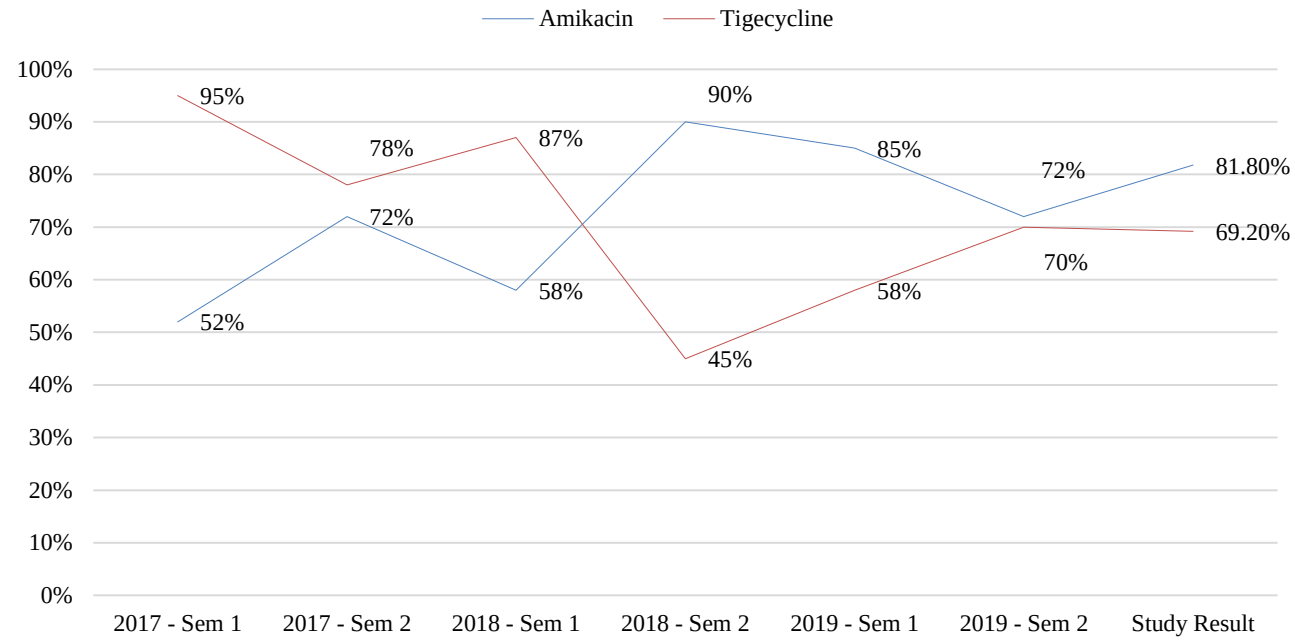
The results of the sensitivity and resistance patterns of *Klebsiella pneumoniae* to antibiotics in this study are similar to the data of antibiotic sensitivity and resistance patterns in the ICU published by KSM Microbiology Sanglah Hospital Denpasar in 2017 to 2019. Meropenem and Amikacin are the highest sensitivity antibiotics in the data from January 2017 to March 2020[6,7,8,9,10,11]. The sensitivity pattern of *Klebsiella pneumoniae* during January 2017 to March 2020 is explained in full in Figure 3. Patients with the finding of *Klebsiella pneumoniae* were found as much as 66.7% given Meropenem in these patients after the results of the antibiotic sensitivity test came out. This is in line with the antibiotic sensitivity test results mentioned above that Meropenem is the antibiotic with the highest sensitivity for germs *Klebsiella pneumoniae.*

The results of the sensitivity and resistance patterns of *Pseudomonas aeruginosa* to antibiotics in this study are similar to the sensitivity and antibiotic resistance data in the ICU published by KSM Microbiology Sanglah Hospital Denpasar in 2017 to 2019. Amikacin and Meropenem are the antibiotics with the highest sensitivity in the data from January 2017 to March 2020 [6,7,8,9,10,11]. There was a difference in 2018 from July to December in the Meropenem sensitivity pattern due to the presence of a small sample of only 5% of all germ patterns in that period[9]. The sensitivity pattern of *Pseudomonas aeruginosa* from January 2017 to March 2020 is explained in full in Figure 4. Patients with the finding of *Pseudomonas aeruginosa* found 45% were given Meropenem to these patients after the results of the antibiotic sensitivity test came out. This is in line with the antibiotic sensitivity test results mentioned above that Meropenem is an antibiotic with the highest sensitivity for *Pseudomonas aeruginosa*.

4. CONCLUSION

Based on the results of research that has been done, it can be concluded that the dominant germicidal pattern in ICU Sanglah Hospital Denpasar is *Acinetobacter baumannii*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*. Antibiotics with the highest sensitivity of Acinetobacter baumannii are Amikacin and Tigecycline. Cefazolin, Cefixime, Cefuroxime, Cefoperazone, and Fosfomycin are antibiotics that have been resistant to *Acinetobacter baumannii*. Antibiotics with the highest sensitivity of Klebsiella pneumoniae are Amikacin and Meropenem. Ampicillin is an antibiotic that is resistant to *Klebsiella pneumoniae*. The antibiotic with the highest sensitivity to Pseudomonas aeruginosa is Amikacin. Cefixime, Cefuroxime, Cefazolin, and Tigecycline are antibiotics that are resistant to *Pseudomonas aeruginosa*.

FIGURE 2:



Note: Sem 1 = January to June. Sem 2 = July to December. In 2018 Semester 2.

FIGURE 3:

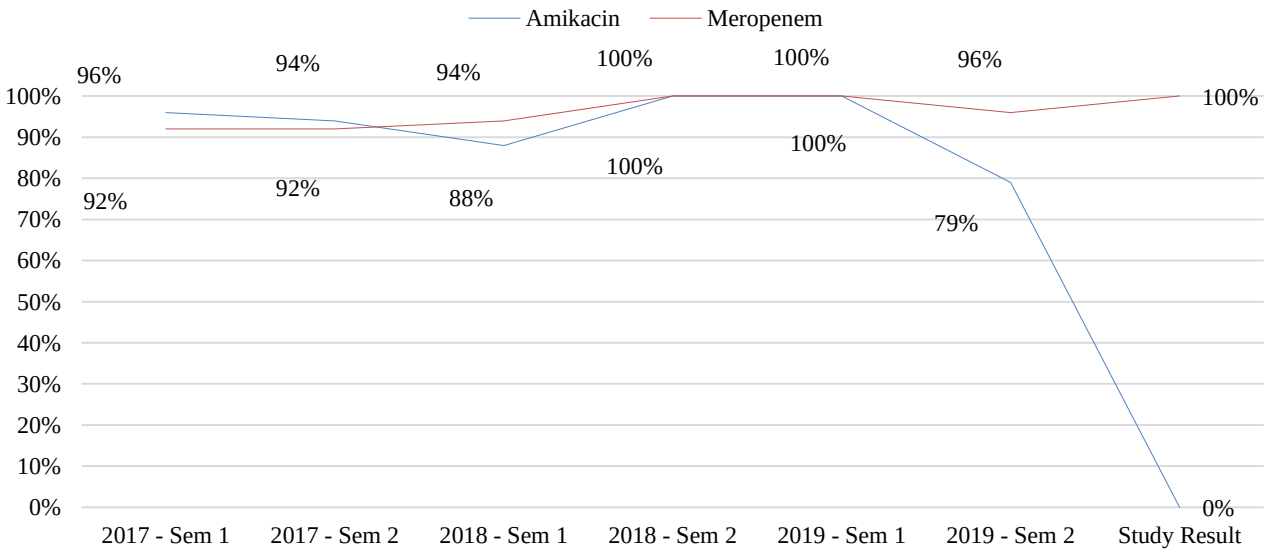


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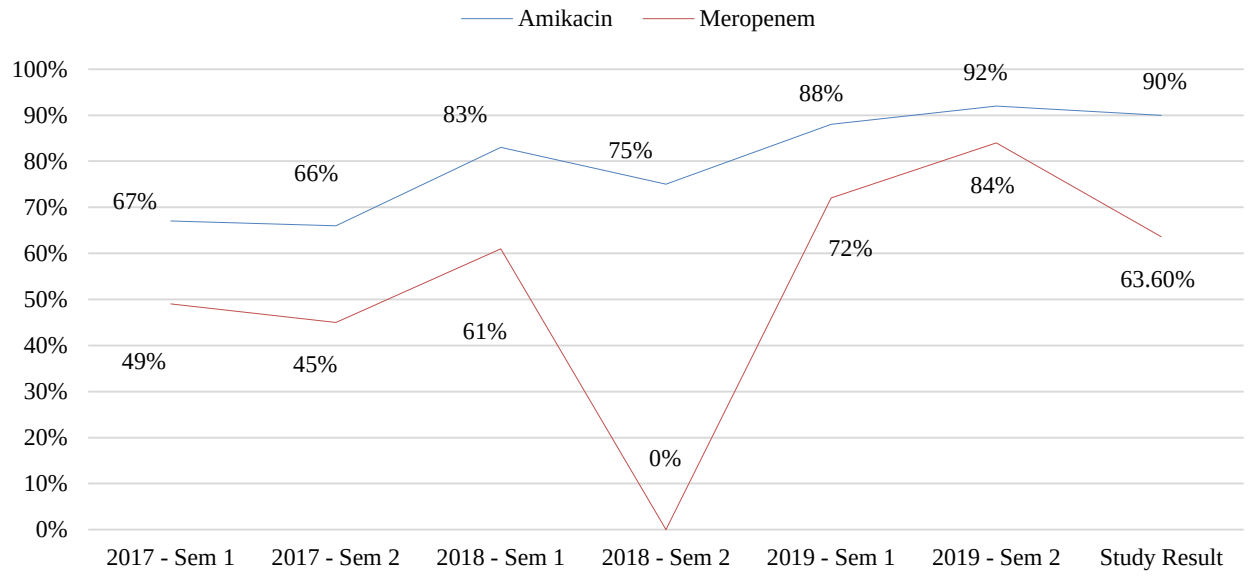
FIGURE 4:



Note: Sem 1 = January to June. Sem 2 = July to December. In 2018 Semester 2.

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