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Bacterial Profiling And Antibiotic Susceptibility Isolated From Infection Cases In Dr. Soebandi Regional Hospital, Indonesia

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ABSTRACT

Hospital-Acquired Infection (HAI) is one of the highest causes of morbidity and mortality in patients treated in hospitals from bacteria in hospital environments, such as air, water, surfaces, or even medical equipment. The provision of broad-spectrum antibiotics and their combination can cause the bacteria to resist antibiotics. Microbial and antibiotic sensitivity profiling can reduce the resistance rate of bacteria. This research is expected to improve the health status of Indonesian citizens, especially in the area of dr. Soebandi Regional Hospital of Jember. This research used a descriptive research method with a prospective approach using primary data taken from patient's laboratory examinations on aspiration/pus/blood/urine/ sputum/vaginal secretions/CSF/infectious wound/ulcer patients of dr. Soebandi Regional Hospital from January 1st until December 31st, 2019. The patient's specimen results culture showed positive results in 219 patients. The most common type of infection was sputum infection (43%) and pus infection (42%). The majority type of bacteria is gram-negative (78.5%) and dominated by *K. pneumoniae*, *Escherichia coli*, and *Pseudomonas aeruginosa*. Gram-positive bacteria are found in 47 patients (21.4%), with the most common species are *Kocuria varians*, *Streptococcus sp.*, and *Staphylococcus aureus*. The antibiotics with the highest sensitivity were doxycycline for gram-positive and antibiotic for gram-negative are amikacin and piperacillin-tazobactam.

1. Introduction

Bacterial infection is a proliferation of a harmful strain of bacteria on or inside the human body. There are two types of bacterial infection, community-acquired infection and hospital-acquired infection (HAI). HAI or nosocomial infection is one of the highest causes of morbidity and mortality in patients treated in hospitals, with an incidence rate of 8.7% [1]. HAI is obtained from bacteria in hospital environments, such as air, water, surfaces, or even medical equipment. It is necessary for every hospital must make a strategy to

minimize the risk of nosocomial infection [2].

The wise usage of antibiotics in treating infectious diseases in hospitals is antibiotics with a narrow spectrum, on strict indications with adequate doses, and appropriate intervals and length of administration [3]. The provision of broad-spectrum antibiotics and their combination is one of the factors supporting changes in the pattern of bacteria and hence, causing it to resist antibiotics. The high rate of antibiotics resistance will also increase patients' morbidity and mortality rates [4].

Hospitals can do a strategy to reduce the resistance rate by providing information regarding the bacteria and its sensitivity toward antibiotics through microbial profiling. A microbial profile is a report about microbes' patterns based on laboratory findings of patients' specimens. It is then tested for its sensitivity towards antibiotics and reported in an antibiogram. The existence of hospital antibiograms might help the clinicians provide initial therapy [5].

Antibiogram is needed in every hospital for nosocomial infection treatment, including dr. Soebandi Regional Hospital of Jember. Based on the background, the authors felt the need to research "Environmental Microbes Profiling and Antibiogram at dr. Soebandi Regional Hospital, Jember". This research is expected to be used to improve the health status of Indonesian citizens, especially those who live in the area of dr. Soebandi Regional Hospital of Jember.

Survey Point

This research used a descriptive research method with a prospective approach. The data consisted of primary data taken from the laboratory examinations on aspiration/pus/blood/urine/sputum/vaginal secretions/CSF/infectious wound/ulcer patients of dr. Soebandi Hospital. Specimen samples were examined for bacterial culture and antibiotic sensitivity tests. This research was conducted at dr. Soebandi Regional Hospital from January 1st until December 31st, 2019. The data is processed using a computer program, presented in tables, diagrams, and narratives. An ethical permit was issued by the Health Research Ethics Commission of the Faculty of Medicine, University of Jember with the number 1.299/H.25.1.11/KE/2019.

2. Findings And Discussion

Form January 1st to December 31st, 2019, as many as 219 patient samples showed bacterial growth in culture. The most common type of sample was sputum infection (43%) and pus infection (42%), as shown in Table 1.

Table 1. Sample specimen

	Amount (n)	(%)
Aspiration	5	2%
Blood	5	2%
Tissue	3	1%
CSF	2	1%
infectious wound	1	0%
Pus	91	42%
Vaginal secretion	2	1%
Sputum	94	43%
Ulcer	3	1%
Urine	12	5%

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Unknown	1	0%
Total	219	100%

Most colonies that were found are gram-negatives as many as 172 samples. Meanwhile, only 47 gram-positive samples were found. The most common species of gram-positive bacteria are species *Kocuria varians* (17%), *Streptococcus sp*. (17%), *Staphylococcus spp*. (15%) and *Staphylococcus aureus* (15%), as shown in Table 2. The three most gram-negative species identified in this study are *K. pneumoniae* (16%), *Escherichia coli* (13%), and *Pseudomonas aeruginosa* (11%), as shown in Table 3.

Table 2. Types of gram-positive bacteria

	Amount (n)	%
Kocuria varians	8	17%
Staphylococcus aureus	7	15%
Staphylococcus epidermidis	2	4%
Staphylococcus capitis	4	9%
Staphylococcus haemolyticus	5	11%
Staphylococcus lentus	2	4%
Staphylococcus lugdunensis	1	2%
Staphylococcus spp	7	15%
Staphylococcus warneri	1	2%
Staphylococcus xylosus	2	4%
Streptococcus sp	8	17%
Total	47	100%

Table 3. Types of gram-negative bacteria

	Amount (n)	%
Acinetobacter baumannii	10	6%
Aeromonas hydrophila	2	1%
Burkholderia cepacia	3	2%
Chryseobacterium meningosepticum	1	1%
Chryseomonas luteola	11	6%
Citrobacter freundii	2	1%
Citrobacter koseri	2	1%
Citrobacter youngae	1	1%
Enterobacter	1	1%
Enterobacter aerogenes	4	2%
Enterobacter cloacae	9	5%
Enterobacter intermedius	1	1%
Enterobacter sakazaki	1	1%
Escherichia coli	22	13%
Flavimonas oryzihabitans	1	1%
Klebsiella ornithinolytica	4	2%
Klebsiella oxytoca	4	2%
Klebsiella pneumoniae	28	16%
Klebsiella terrigena	1	1%

Pantoea spp	5	3%
Pasteurella pneumotropica	11	6%
Proteus mirabilis	6	3%
Providencia rettgeri	1	1%
Pseudomonas aeruginosa	19	11%
Pseudomonas fluorescens	2	1%
Pseudomonas luteola	3	2%
Pseudomonas oryzihabitans	1	1%
Pseudomonas spp	1	1%
Salmonella sp	1	1%
Salmonella orizonae	1	1%
Serratia odorifera	5	3%
Stenotrophomonas malthophillia	6	3%
Vibrio parahaemolyticus	1	1%
Yersinia pseudotuberculosis	1	1%
Total	172	100%

Samples with bacterial growth were analyzed for the antibiotic sensitivity test. The results showed gram-positive bacterial isolates were highest sensitive to doxycycline (Table 4.). Test results on isolates with gram-negative growth showed that 80% sensitive to amikacin and 64% of them are sensitive to piperacillin-tazobactam (Table 4).

Table 4. The pattern of sensitivity of gram-positive bacteria to antibiotics

Antibiotik	**Type of Bacteria (%)**											
	Kocuria varians	*Staphylococcus aureus*	*Staphylococcus capitis*	*Staphylococcus epidermidis*	*Staphylococcus haemolyticus*	*Staphylococcus lentus*	*Staphylococcus lugdunensis*	*Staphylococcus spp*	*Staphylococcus warneri*	*Staphylococcus xylosus*	*Streptococcus sp*	**Average**
AMC	-	-	25	50	-	-	-	57	100	-	38	25
AZM	38	71	50	50	60	50	-	14	100	-	38	43
AMP	-	-	-	-	-	-	-	43	100	-	38	16
AK	-	-	-	-	-	-	-	14	-	-	-	1
C	-	86	50	50	40	50	100	43	-	50	25	45
CFR	-	-	-	50	-	-	-	29	100	-	-	16
DA	-	14	25	50	-	-	-	-	100	-	-	17
CIP	25	29	25	-	20	100	-	29	100	-	50	34
CN	-	43	-	-	20	100	-	-	-	50	-	19
CFP	-	-	-	-	-	-	-	14	-	-	-	1
CRO	-	-	25	-	-	-	100	43	-	-	-	15
DO	38	43	50	100	40	100	-	57	100	100	50	62
E	-	-	-	-	-	-	-	-	-	-	13	1
FOX	-	14	50	-	-	-	-	14	100	-	-	16
GM	-	-	25	-	-	-	-	-	-	-	-	2
LEV	38	43	25	50	-	100	-	29	100	50	63	45

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LZD	-	29	75	50	20	-	100	29	100	100	38	49
MEM	38	-	25	50	-	-	-	14	100	-	88	29
SAM	-	-	25	-	-	-	-	43	-	-	-	6
SXT	88	43	25	-	-	100	-	29	100	50	75	46
TE	25	29	50	50	40	-	-	29	100	100	38	42
OX	-	-	25	50	-	-	-	14	100	-	-	17
OFX	-	43	-	-	20	100	-	-	-	-	-	15
VA	-	-	25	50	-	-	100	14	100	50	13	32

The examination results in the patients with infection showed positive results in 219 patients. The most common type of sample was sputum infection and pus infection. This result is similar to a study by [6], which carried out a mapping of germs in patients in the Intensive Care Unit of the Prof. Dr. RD Kanadou Hospital Manado for July 2017-July 2018 received 40% of the specimens used for examination came from sputum. Sputum is the most common type of specimen associated with almost all patients treated in the intensive care unit on a ventilator for a long time. Upper respiratory tract infections primarily Ventilator-Acquired Pneumonia (VAP) became the most frequent causes of HAIs [7]. VAP occurs in about 10% to 20% of patients who use a ventilator for more than 48 hours and is associated with a significant increase in the length of stay, mortality, and cost [8].

The microbial was obtained from examining microbial culture specimens in aspiration/pus/blood/urine/sputum/vaginal secretions/CSF/infectious wound/ulcer patients of dr. Soebandi Hospital. This study found 47 gram-positive bacteria (21.4%). The most common species of gram-positive bacteria are species *Kocuria varians*, *Streptococcus sp.*, *Staphylococcus spp.*, and *Staphylococcus aureus*. Kocuria infections are pretty rare in clinical practice. Recently a research study has highlighted the importance of Kocuria in causing HAIs. *Kocuria varians* as a potential pathogen in immunocompromised patients or patients who have undergone surgery [9]. *Kocuria rosea* was isolated in a 58-year-old woman with a case of descending necrotizing mediastinitis who was taking drugs for hypertension and gout [10]. In another recent report, A 10-year-old woman with a history of surgery to correct congenital heart disease has observed endocarditis caused by *Kocuria rosea*, even though the patient was healthy before suffering from the infection [11]. In addition, *Streptococcus sp.* and *S. aureus* is considered the most important pathogens that cause HAIs. *Streptococcus sp.* (5,1%) and *S. aureus* (13,4%) have been reported and are associated with hospital-acquired blood stream infection [12]. Another study also found that *S. aureus* (16.2 %) was most common in hospital acquired bacteremia patients and *Streptococcus sp.* was the most common pathogen in children and adolescents. Mainly group B *Streptococcus* was observed exclusively in the elderly group (≥ 60 years) and infants (≤ 1 year) [13].

The most common type of bacteria in this study is gram-negative (78.5%). The results of this study are consistent with the latest data from the U.S. National Healthcare Safety Network, which shows that gram-negative bacteria are found in more than 30% of HAIs [14]. The most gram-negative species identified in this study are *K. pneumoniae*, *Escherichia coli*, and *Pseudomonas aeruginosa*. Gram-negative organisms dominate cases of hospital acquired pneumonia, specifically *P. aeruginosa*, *A. baumannii*, and *Enterobacteriaceae*. Three to seven percent of nosocomial infections are caused by *K. pneumoniae*. *K. pneumoniae* is an opportunistic pathogen commonly is found in the digestive tract, pharynx, and skin that causes various infections, including pneumonia, urinary tract infections, bacteremia, neonatal septicemia, and liver abscesses [15].

In the antibiotic therapy guidelines of dr. Soebandi Regional Hospital, the first-line therapy for cases of VAP and HAI with gram-positive bacteria with activity against MRSA is vancomycin. Gram-negative

bacteria can be treated with piperacillin-tazobactam. These antibiotic therapies are expected to be the first line that effectively eradicates bacterial growth. This is in line with the findings of sensitivity test results of this study on 172 isolates with gram-negative growth that have been tested, 64% of which have a reasonably high sensitivity to TZP. Unlike the 47 positive gram-positive growth isolates whose sensitivity to vancomycin was tested, there were 32% still sensitive to VA. Gram-positive in this study had a higher sensitivity level to doxycycline, which was 62%. This study is not in line with a previous study by [16] who conducted a bacterial sensitivity test on diabetic ulcers and found a gram-positive sensitivity of only 33% to doxycycline. The majority of gram-positives found in this study came from the staphylococcus group. Several studies have stated that the staphylococcus group still has a fairly high sensitivity, such as a study conducted by Salsabila, 2020 which stated that *Staphylococcus sp*. 82.35% are still sensitive to doxycycline and research by Rachmaniar, 2015 stated that 83.3% of *Staphylococcus aureus* isolates are also sensitive to doxycycline [17], [18].

Antibiotic sensitivity testing of patients determines the characteristics of bacterial resistance to various types of antibiotics. However, this examination requires a long time, so it the importance for hospitals to have guidelines in determining the kind of initial antibiotic given before the results of the bacterial sensitivity test appear. In someone who is treated with antibiotics that they have resisted, the bacteria will be more capable of resisting itself from the other antibiotics. This causes the prognosis of the patient's disease to worsen, more extended hospital treatment, and a higher incidence of multidrug resistance (MDR). MDR is when a bacterium becomes resistant to at least one type of antibiotic in at least three classes of antibiotics. This MDR event can arise due to various things, some of which are irrational antibiotic therapy [19].

The major antibiotics cause of complications in nosocomial infections can be caused by β-lactam. *K. pneumoniae* is a microbe with resistance to β-lactam antibiotics by producing β-lactamase enzymes [20]. A report of a study in Southeast Asia revealed that there was a significant pattern of resistance in *E. coli* and *K. pneumoniae* bacteria to third-generation cephalosporins [21]. The study results by Khan et al. are in accordance with this research which shows the low sensitivity of *Enterobacteriaceae* bacteria to the third-generation cephalosporin antibiotics such as cefixime, ceftriaxone, and cefotaxime. This resistance can be overcome by using first-generation cephalosporin antibiotics such as cephalexin which have good sensitivity to *Enterobacteriaceae* in this study, except in cases involving *Enterobacteriaceae* infections in meninges, such as meningitis, because they cannot penetrate the brain barrier [22].

Resistance to carbapenem class antibiotics has also been widely reported. Resistance to carbapenem has been reported in many gram-negative bacteria [21]. Carbapenem is an antibiotic used for bacteria with MDR. Gram-negative bacteria *Enterobacteriaceae* family and resistance to carbapenem or Carbapenem-Resistant *Enterobacteriaceae* (CRE) drastically increased in the last decade [23]. In this study, 28 isolates of *K. pneumoniae* were obtained its sensitivity to the carbapenem class of antibiotics, imipenem, shows at 14%. In contrast its sensitivity to meropenem shows better results than imipenem which is 46%. Another *Enterobacteriaceae*, *Proteus mirabilis*, was also sensitive to meropenem. This indicates that there are still opportunities for carbapenem (especially meropenem) as the chosen agents to fight bacteria from the family *Enterobacteriaceae*.

Other types of beta-lactamase enzymes and Multidrug-Resistant Gram-Negative Bacteria (MDR-GNB) resistant to higher generation cephalosporins (e.g., ceftriaxone and cefepim) are effectively eradicated by the carbapenem. Carbapenemase producing organisms that can hydrolyze almost all beta-lactams will present a serious management challenge due to resistance to carbapenem and other antibiotics such as

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aminoglycosides, fluoroquinolones, and a combination of beta-lactam and beta-lactamase inhibitors [24]. As a result, this condition will induce extensively drug resistant (XDR) or pan drug-resistant (PDR) antibiotics. Therefore, bacterial resistance to carbapenem antibiotics must be prevented to reduce the incidence of XDR and PDR in the future. For this reason, strategies are needed to avoid the development of HAI by early detection through targeted laboratory protocols and containment of spread through comprehensive infection control measures.

3. Conclusion

The bacteria identified in dr. Soebandi's hospital patients were dominated by gram-negative bacteria, especially the *Enterobacteriaceae* family. The antibiotics with the highest sensitivity were doxycycline for gram-positive and antibiotic for gram-negative are amikacin and piperacillin-tazobactam. Surveillance of bacteria and sensitivity patterns should be carried out routinely to establish policy on the use of antibiotics at dr. Soebandi Regional Hospital.

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