Pathogenic Bacterial Pattern and its Resistance in the Care Rooms of the Hospital in Bandar Lampung

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The hospital ward cannot be separated from the threat of resistant pathogenic bacteria. The bacteria can cause nosocomial infections for patients treated in hospital care. The research objective was to determine the resistance pattern of pathogenic bacteria in a hospital ward in London. This type of research is observational analytic cross-sectional design. The research variables are the resistance patterns of pathogenic bacteria in the treatment room. The population for the sample in this research is the treatment room in the hospital, a total of 11 treatment rooms. In each treatment room, we swabbed at five points to obtain microbiological samples to examine. Microbiological examination was performed in the microbiology laboratories of the Health Laboratory in Lampung Province, July-October 2018. The microbiology laboratory examination includes microscopic examination of bacteria, isolation of bacteria, bacterial identification, and antibiotic sensitivity test. The results showed 12 species of bacteria from 67 bacterial isolates, ie, the pattern of the following bacteria: *Klebsiella pneumonia* (20.90%), *Klebsiella oxytoca* (5.97%), *Alcaligenes faecalis* (13.43%), *Citrobacter sp.* (5.97%), *E. coli* (5.97%), *Proteus Vulgaris* (2.99%), *Proteus rettgeri* (2.99%), *Proteus morganii* (1.49%) and *Pseudomonas aeruginosa* (11.94 %), *Staphylococcus aureus* (8.96%), *Staphylococcus saprophyticus* (11.94%), and *Staphylococcus epidermidis* (7.46%). Patterns of bacterial resistance to antibiotics is *Proteus Vulgaris* (71.43%), *Pseudomonas aeruginosa* (57.74%), *Citrobacter sp.* (54.76%), *Klebsiella oxytoca* (52.38%), *Staphylococcus saprophyticus* (44.05%), *Proteus rettgeri* (38.10%), of *Alcaligenes faecalis* (38.10%), *Klebsiella pneumonia* (36.39%), *Proteus morganii* (33.33%), E. coli (29.76%), *Staphylococcus aureus* (27.78%), and *Staphylococcus epidermidis* (14.29%). The results of the sensitivity test using 19 kinds of antibiotics showed all to be antibiotic-resistant. Seven kinds of antibiotics have been resistant above 50%, namely *Clindamycin* (79.10%), *Cefixime* (77.61%), *Cephalotin* (76.12%), *Cefazoline* (71.64%), *Amphicillin sulbactam* (68.66%), *Trimetophrim* (62.69%), and *Cefuroxime* (56.72%). The conclusion of this study is obtained bacteria Gram-positive group (three species of bacteria) and Gram-negative (9 species of bacteria). All bacterial

isolates (67 isolates) were resistant to the antibiotic resistance level of 2.99% to 79.10%.

Keywords: *Resistance Pattern, Bacterial Pathogens, The Treatment Room.*

Introduction

The treatment room in the hospital is a place for patients to undergo treatment at the hospital. Treatment room cleanliness should be maintained properly, including the purity of the walls, floor, bedding, curtains, bathroom, and medical devices that are in the treatment room. To prevent colonisation or growth of bacteria on the floor, walls, and showers in the treatment room, the cleaning must use a disinfectant (Wenzel, 2002).

Implementation of control measures and prevention of infection in hospitals that are not following the SOP (Standard Operating Procedure) can lead to the proliferation of bacteria in patient-care areas. The discovery of pathogenic bacteria in the hospital treatment room backed research by Oktarini (2013) who measured the growth of germs on the wall at 4.33%, 15.18% on the floor and 80.48% airborne, with the pattern of *Acinetobacter baumannii bacteria, Staphylococcus sp and Bacillus sp, Moraxella Lacunata, Bacillus sp, Klebsiella pneumonia, Pseudomonas aerogenes* and *E. coli.*

The presence of pathogenic bacteria in the patient's care areas can contaminate the surrounding environment, such as the room of the existing equipment, medical personnel, and can even infect visitors or families visiting patients (Sian, Hasibuan, Lubis, Azlin, & Tjipta, 2016), Patients treated may be exposed to nosocomial infections if contact with the tools that have been contaminated with bacteria such as pathogens. The existence of cases of nosocomial infections are supported by the results of research by Allegranzi et al. (2011), who noted care-associated diseases in the ICU for adults is 47.9 to 1000 patients/day caused by gram-negative bacilli, and Staphylococcus aureus is recorded in 158 of 290 (54%). Friedman et al. (2002) get 175 patients (35%) who had nosocomial bloodstream infections. Nurlita (2017), notes the highest bacterial cause of ventilator-associated pneumonia (VAP) in the ICU are *Pseudomonas aeruginosa*, and *Staphylococcus aureus*; the most sensitive antibiotic is ciprofloxacin. The high burden of infection-related hospital care needs supervision and control practices for the prevention of infection (Allegranzi et al., 2011).

Nosocomial infections are infections acquired in a hospital or healthcare facility after the patients were treated for 3 x 24 hours (Soeparman, et al, 2001). The exogenous disease can infect patients who are hospitalised, hospital personnel who interact with patients, families who take care of patients, and visitors of patients. This infection can be carried over to the home of their families (Zulkarnain, 2009). These infections can also occur due to conditions in the hospitals with an infectious disease control system that was not good (Darmadi, 2008).

System control and prevention of infection in hospitals that did not run well can cause high nosocomial infection rates. This is evidenced by Trisakti (2014) who showed that the average incidence of nosocomial infections of hospitalised patients in the treatment room is 6 people. The average number of bacteria in the air treatment space is 208.06 CFU/m3, and there is a linear relationship between the amount of air germ numbers in the treatment room with the amount of the incidence of nosocomial infections of hospitalised patients in the treatment room (p-value = 0.057). This is in line with research by Sinaga (2014), who sees nosocomial bacterial infection on medical devices in the Jayapura Abepura Hospital emergency room, and as many as five types of bacteria in the air isolates found 13 species of bacteria. The Afia study (2018) found a total of 27 isolates.

The results of research by Maliku (2010) in the surgical hospital inpatient section at Abdul Moeloek, get aerobic bacterial isolates in surgical wounds are *Pseudomonas sp*. (32.1%), *Staphylococcus epidermidis* (28.3%), *Klebsiella sp*. (24.5%), *Staphylococcus saprophyticus* (7.5%), *Proteus Vulgaris* (5.7%), and *Escherichia coli* (1.9%). While the research results from Andini (2010) in the hospital inpatient obstetrics at Abdul Moeloek get aerobic bacterial isolates from surgical wounds are *Pseudomonas sp.* (26.5%), *Escherichia coli* (14.7%), *Klebsiella sp*. (11.7%), *Proteus sp.* (5.9%), *Staphylococcus aureus* (5.9%), and *Staphylococcus epidermidis* (2.9%).

Patterns of bacterial resistance to antibiotics in hospitals vary widely; Al Laham (2012) in the Gaza Strip find Gram-negative isolates that were resistant to ampicillin (93.9%) and amoxicillin (93.9%), cefazolin (81.8%), ciprofloxacin (27.3%) and gentamicin (15.2%). In contrast, Gram-positive isolates (all staphylococci) are resistant to penicillin and ampicillin (93.1%). Development of bacteria or microorganisms resistant to antibiotics has become a significant problem in healthcare in hospitals – bacterial resistance to antibiotics is increasing. The use of antibiotics to therapeutic and prophylactic use is not adequate and can be an essential factor of resistance (Setianingsih, Fadraersada, Ibrahim, and Ramadan, 2016).

Cases of antibiotic resistance in the United States showed 70% of bacteria causing the infection are resistant to one or more drugs that were previously used to handle it. Cases of antibiotic resistance in the world increased by 10% to 58%. Accordingly, the WHO *Antimicrobial Resistance*: Global Report on Surveillance stated that Southeast Asia has the highest number of cases in the world of antibiotic resistance, particularly infections caused by *Staphylococcus aureus* resistant to methicillin, resulting in decreased function of the antibiotic. The results of research *Antimicrobial Resistance in Indonesia* (AMRIN) of 2,494 individuals in the community, show 43% of *Escherichia coli* resistant to ampicillin (34%), cotrimoxazole (29%) and chloramphenicol (25%). (Kemenkes RI, 2011).

Methods

This type of research is analytic observational with a cross-sectional design. The study was conducted at the largest hospital in the province of Lampung. Sampling was done in 12 rooms that consist of the accident treatment room (R1), a place for surgical treatment of men (R2), a room for surgical treatment of women (R3), space for treatment of diseases in women (R4), the treatment room of disease in man (R5), the treatment room for male infectious diseases (R6), the treatment room for infectious diseases of women (R7), cardiac care chamber (R8), the treatment room for ENT diseases (R9), ICU (R10), the treatment room for nerve disease (R11) and the operations space (R12). In every room was made swab on the walls, swab on the floor, swab the patient's bed and swabs in the bathroom, on the walls and floors and air sampling. Air sampling was conducted by avalanches, which put Nutrient media order at 5 points in the infirmary and left for 15 minutes to catch the micro-organisms in the air. Furthermore, nutrient media to incubate for 20-24 hours at 37ºC, to grow the microorganisms trapped in the media. Examination of the bacteria includes microscopic examination, isolation of bacteria, bacterial identification, and antibiotic susceptibility test. This examination was conducted in the Microbiology Laboratory Health Laboratory of Lampung Province, August - October 2018.

In this study, the microscopic examination is to see the shape of bacteria and Gram staining properties, with further isolation and identification of bacteria to obtain the genus or species. Having ascertained the species of bacteria, further testing sensitivity to antibiotics by using 19 kinds of discs of antibiotics to see whether patterns of resistance of bacterial pathogens were found.

Results and Discussion

The results showed 67 isolates of pathogens, which are grouped into 12 species of bacteria (Table 1). The bacterial strains were obtained after the isolation and identification of bacteria in the laboratory

Table 1. Results of the isolation and identification of bacteria from 12 hospital ward

No	Bacteria Species	Amount	Percentage (%)	The Room Sampling
1	*Klebsiella pneumonia*	14	20.90	L1, D2, D3, KM3, KM4, TT4, L5, TT5, L6, TT7, L10, KM10, L11, TT12
2	*Klebsiella oxytoca*	4	5.97	D1, L2, KM8, TT9
3	*Citrobacter sp.*	4	5.97	TT1, D6, L8, D11
4	*Escherichia coli*	4	5.97	KM6, D7, D8, L9
5	*Proteus Vulgaris*	2	2.99	KM5, TT10
6	*Proteus rettgeri*	2	2.99	TT11, KM12
7	*Proteus morganii*	1	1.49	D5
8	*Alcaligenes faecalis*	9	13.43	TT2, TT6, TT8, D9, D10, KM7, D12, L12, KM11
9	*Pseudomonas aeruginosa*	8	11.94	Km1, KM2, L3, TT3, D4, L4, L7, km9
10	*Staphylococcus aureus*	6	8.96	U1, U4, U5, U9, U10, U11
11	*Staphylococcus saprophyticus*	8	11.94	U2, U3, U4, U6, U7, L8, L9, U12
12	*Staphylococcus epidermidis*	5	7.46	U2, U3, U7, U8, KM8
	Total	67	100.00	

Description: D: wall, L: floor, KM: bathroom, TT: bed, U: air. Uppercase indicates the sampling point, and the numbers indicate the treatment room.

In Table 1, we can see 12 species of bacterium isolation and identification of the 12 wards. *Bacteria Klebsiella pneumonia* is found in all the treatment rooms, which is at 14 sampling points. In contrast, bacterium *Proteus morganii* were only found in one place for sampling, ie on the wall of the men's disease treatment room. Bacterial isolates were obtained from the air, all from the genus Staphylococcus. In addition to the air, Staphylococcus is also found in the sampling point on the floor and the bathroom. The results are consistent with the Genet (2011), Nurmala (2015), Amiril (2016), and Fatema (2016), finding the bacteria Klebsiella sp, Pseudomonas sp, Escherichia coli, and Staphylococcus aureus. The bacteria found in this study is mostly a group of Gram-negative bacteria, while the incoming group of Gram-positive bacteria found only 3 species; this can be seen in Table 2 below.

Table 2. Categorisation Of Bacterial Isolates By Nature Gram

Painting Nature	Species Of Bacteria
gram Negative	*Klebsiella pneumoniae, Klebsiella oxytoca, Citrobacter sp., Escherichia coli, Proteus vulgari, Proteus rettgeri, Proteus morganii, Alcaligenes faecalis, Pseudomonas aeruginosa*
gram Positive	*Staphylococcus aureus, Staphylococcus saprophyticus, Staphylococcus epidermidis*

The test results in Table 2 of antibiotic sensitivity of 67 isolates of bacteria, found all strains of bacteria resistant to antibiotics. This sensitivity test used 19 kinds of antibiotics disk. Of the 12 species of bacteria isolated from hospital 12 treatment rooms, it showed varying patterns of bacterial resistance. Patterns of bacterial resistance to antibiotics can be seen in Figure 1.
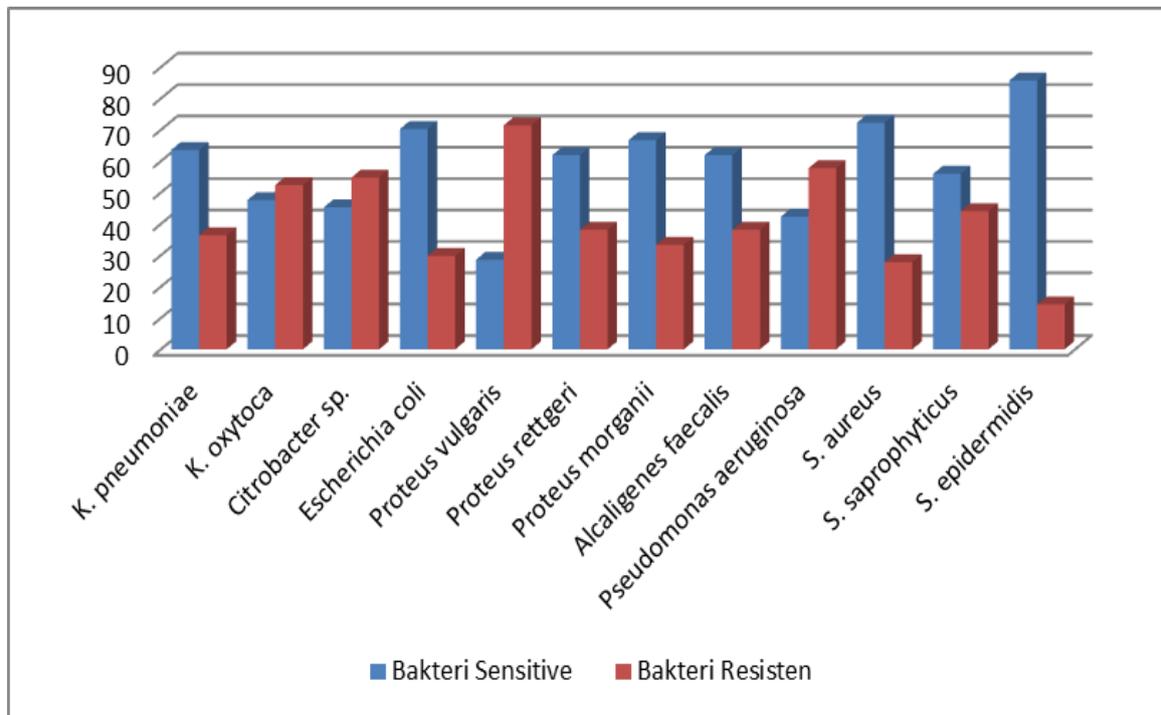

Figure 1. Patterns of bacterial resistance to antibiotics

In Figure 1 we can see that Gram-negative bacteria dominate the pattern of bacteria that are resistant to antibiotics, the *Proteus Vulgaris* (71.43%), *Pseudomonas aeruginosa* (57.74%), *Citrobacter sp.* (54.76%), *Klebsiella oxytoca* (52.38%), *Proteus rettgeri* (38.10%), *Alcaligenes faecalis* (38.10%), *Klebsiella pneumonia* (36.39%), *Proteus morganii* (33.33%), and *E. coli* (29.76%). Resistant Gram-positive bacteria, such as *Staphylococcus saprophyticus* (44.05%), *Staphylococcus aureus* (27.78%), and *Staphylococcus epidermidis* (14.29%).

The results of the sensitivity test using 19 kinds of antibiotics, showed all to be antibiotic-resistant. Seven kinds of antibiotics have been resistant above 50%, namely Clindamycin(79.10%), Cefixime (77.61%), Cephalotin (76.12%), Cefazoline (71.64%), Amphicillin sulbactam (68.66%), Trimetophrim (62.69%), and Cefuroxime (56.72%). Antibiotic sensitivity test results can be seen in Figure 2.
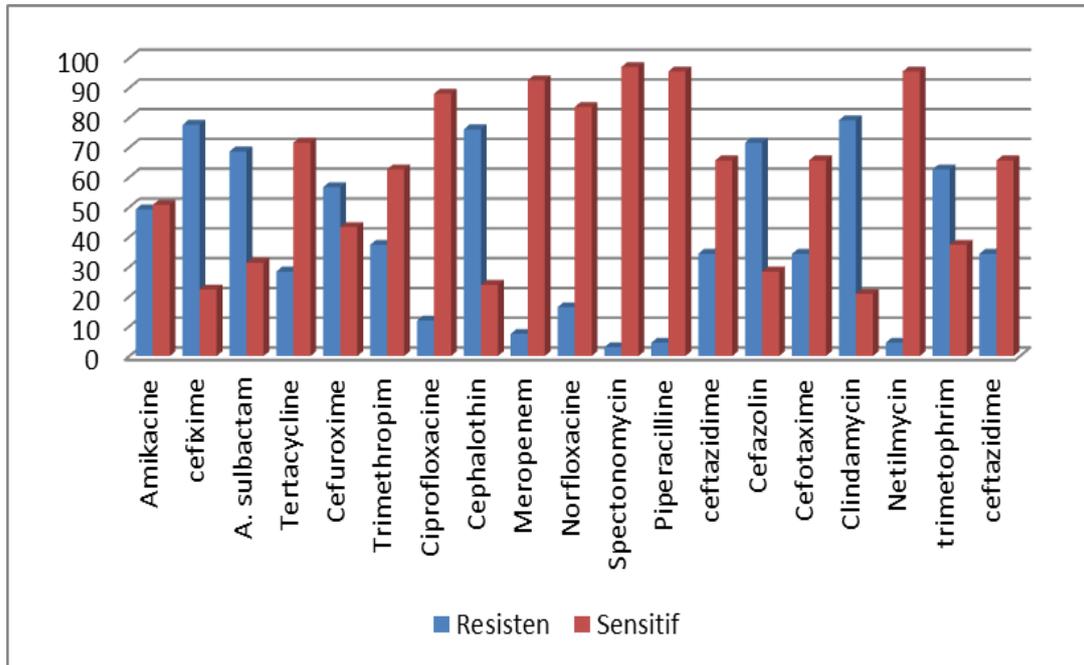
Figure 2. The results of the sensitivity test of bacteria to antibiotics

The results of this study found 12 species of bacteria obtained from 67 isolates taken from 12 treatment rooms. In Table 1, it can be seen that each ward found different bacteria. The number of most bacterial species are *Klebsiella pneumonia,* ie 14 isolates (20.90%) obtained from 14 sample points, whereas the bacteria *Proteus morganii* (1.49%) was found only in one sample point, the wall of the treatment of disease in men (D5).

The bacteria *Klebsiella pneumonia* (20.90%), *Klebsiella oxytoca* (5.97%), *Alcaligenes faecalis* (13.43%) and *Pseudomonas aeruginosa* (11.94%) were found on the walls, floor, bed, and bathroom and maintenance space. *Bacterium Citrobacter sp.* (5.97%) were found on the walls, the floor, and the bed. The bacteria *E. coli* (5.97%) was found in the walls, floors, and bathrooms. The bacteria *Proteus Vulgaris* (2.99%) and *Proteus rettgeri* (2.99%) was found in the bathroom and the bed, while *Proteus morganii* (1.49%) were found on the walls only. The discovery of the bacteria on the walls, the floor and the bed in the infirmary, founded the research results of Oktarini (2013), who get *Staphylococcus sp, Klebsiella pneumonia, Pseudomonas aerogenes* and *E. coli* in the walls and floor of the ICU. Hidayat (2014) found *Staphylococcus sp* 37 %, *Klebsiella sp* 20%, *Pseudomonas sp* 7% in the ICU.

From across the room air samples obtained the bacterial species Staphylococcus genus *Staphylococcus aureus* (8.96%), Staphylococcus saprophyticus (11.94%), and Staphylococcus epidermidis (7.46%). Apart from the air, Staphylococcus saprophyticus is also found on the floor of the heart disease treatment room (L8), and inpatient floor space THT diseases (L9). At the same time, *Staphylococcus epidermidis* was also found in heart disease hospitalisation bathroom space (KM 8). In this study, bacterial isolates are from all sampling points in all

rooms. The results are consistent with research of Sinaga (2014), who gets bacterial strains in medical devices, and as many as five types of bacteria in the air isolates, finding 13 species of bacteria in the hospital emergency room, Abepura, Jayapura.

The results of microscopic examination with Gram obtained two groups of bacteria that are a group consisting of Gram-Negative bacteria *Citrobacter sp., E. coli, Proteus Vulgaris, Proteus rettgeri, Proteus morganii, Klebsiella pneumonia, Klebsiella oxytoca, Alcaligenes faecalis,* and Pseudomonas aeruginosa. The group consists of Gram-Positive bacteria *Staphylococcus aureus, Staphylococcus saprophyticus,* and Staphylococcus epidermidis. These results are consistent with the research of Zeynudin et al. (2018); the bacterium *Klebsiella pneumoniae get, Klebsiella oxytoca, Escherichia coli, Proteus mirabilis, Pseudomonas aeruginosa,* and *Alcaligenes* faecalis from clinical isolates of patients in the treatment room at Jimma Hospital in Ethiopia.

The bacteria *Escherichia coli, Proteus Vulgaris, Proteus rettgeri, Proteus morganii, Citrobacter sp., Klebsiella pneumonia,* and *Klebsiella oxytoca* – comprise the Enterobacteriaceae family groups – namely the healthy flora of the gastrointestinal tract and urinary tract (Dorries, 2014). *Klebsiella pneumonia* can cause pneumonia in the respiratory tract (Brooks et al, 2008). *Alcaligenes faecalis* bacteria are included in the family *Alcaligenaceae*, which can cause urinary and respiratory tract infections. Alcaligenes can be found in various locations, including soil and water environments (Jawet, 2007). *Pseudomonas sp.* the healthy intestinal flora and the human skin, *Pseudomonas sp.* thrives in a water bath, also in a disinfectant solution, so that the bacteria very easily spreads rapidly on the patient and in the environment in the hospital (Ducel, 2002). The *Staphylococcus* genus are healthy flora bacteria on the skin, nose, throat and mucous membranes of man, but these bacteria can cause opportunistic infections (attacking people with weakened immune systems). S. epidermidis infection can occur due to these bacteria form biofilms on medical devices in hospital and infect people in a hospital environment (called nosocomial diseases). Clinically, these bacteria attack the people who are vulnerable or of low immunity, such as people with AIDS, critically ill patients, drug addicts (narcotics), newborn baby, and patients treated in hospital for a long time (Artati, Hurustiaty, and Armah, 2018).

The discovery of bacterial isolates from each sampling point in every hospital room in Bandar Lampung City (12 rooms) shows the infectious disease control system has not run optimally. The process of infection depends on the interaction between host susceptibility, contagious agents (pathogenicity, virulence, and dose) and modes of transmission. Identification of risk factors in the host and control of certain infections can decrease the incidence of nosocomial infection, either inpatients or health care workers. The strategy of prevention and control of infectious diseases can be done in several ways, such as inactivation of the causative agent of infection, cutting the chain of transmission, post-exposure preventive measures against health workers (Kemenkes RI, 2011).

In each treatment chamber were found different bacteria, both species of bacteria and their patterns of resistance to antibiotics. This is possible because in each room there are patients with various diseases. In one place was found 4-6 species of bacteria with varying resistance patterns. The lowest obtained sensitive bacteria 9.52% (*Klebsiella oxytoca*), and the highest of 100% (*Alcaligenes faecalis* and *E. coli*), while the lowest-resistant bacteria is 9.52% (*Staphylococcus aureus, Staphylococcus epidermidis and Klebsiella oxytoca*) and the highest is 90.48 % (*Klebsiella oxytoca*).

The results of this study showed any bacterial resistance pattern is different, even with the same species but from a separate room, as can be seen in bacteria *Klebsiella oxytoca* originating from accident is still sensitive on walls at 90.48%. In contrast, those coming from the heart disease shower room still sensitive amounted to 9.52%. This difference may be due to that the bacteria came from a different source. These bacteria can come from the patient, the nurse or medical personnel, or from people who come to visit the hospital.

Based on Table 3, note that the range of lowest to highest is sensitive 28.57% - 85.71%, and the range of most moderate to highest resistance that is 14.29% - 71.43%. Bacteria with a low sensitive of *Proteus Vulgaris* (28.57%), and highest sensitive *Staphylococcus epidermidis* (85.71%), while the lowest is bacteria resistant *Staphylococcus epidermidis* (14.29%) and highest resistant *Proteus Vulgaris* (71.43%.).

The results are consistent with the results of the meta-analysis by Muhie (2019) in Ethiopia, which is getting the prevalence of resistant bacterial strains to various antibiotics at 59.7%.

The entire antibiotic range (19 kinds of antibiotics) used in the susceptibility test has been resistant. Seven kinds of antibiotics have been resistant above 50%, namely Clindamycin (79.10%), Cefixime (77.61%), Cephalotin (76.12%), Cefazoline (71.64%), Amphicillin sulbactam (68.66%), Trimetophrim (62.69%), and Cefuroxime (56.72%).

The presence of an antibiotic that has been resistant, was also obtained by Dessie et al (2016) in Ethiopia, namely ampicillin, amoxicillin, penicillin, cefazolin, and tetracycline. The cause of bacterial resistance to antibiotics, includes the use of antibiotics that are not appropriate. Muhie results of a meta-analysis (2019) show that has occurred from improper use of antibiotics as 49.2%, and the purchase of antibiotics without prescription in Ethiopia at 43.3%.

Although this study shows the whole antibiotic resistant with low occurrence rate of 2.99% and the highest 79.10%, there is still a sensitive antibiotic for more than 70%, shown sequentially as follows: spectinomycin (97.01%), piperacillin (95.52%), netilmicin (95.52%), meropenem (92.54%), ciprofloxacin (88.06%), norfloxacin (83.58%), and tetracycline (71.64%). Nurlita (2017), Dessie et al (2016), and Merga D (2018) found that ciprofloxacin is the most sensitive antibiotic in their research. Dilnessa and Bitew (2016) in Ethiopia found that S. aureus is

resistant to penicillin (96.4%) and remains susceptible to clindamycin (11.9%) and vancomycin (5.1%). MRSA strain is entirely immune to penicillin G, erythromycin, trimethoprim-sulfamethoxazole, and sensitive to vancomycin (29.4%).

Conclusion

The conclusion of this research found that 67 isolates were classified into 12 species of bacteria, as well as 8 species of bacteria is a Gram-negative bacteria, and the third group of bacterial species is a group of Gram-positive: the bacterial species *Klebsiella pneumonia* (20.90%), *Klebsiella oxytoca* (5.97%), *Alcaligenes faecalis* (13.43%), *Citrobacter sp.* (5.97%), *E. coli* (5.97%), *Proteus Vulgaris* (2.99%), *Proteus rettgeri* (2.99%), *Proteus morganii* (1.49%) and *Pseudomonas aeruginosa* (11.94 %), *Staphylococcus aureus* (8.96%), *Staphylococcus saprophyticus* (11.94%), and *Staphylococcus epidermidis* (7.46%). Patterns of bacterial resistance to antibiotics are the highest resistance obtained by 71.43% occurred in the bacteria *Proteus Vulgaris,* whereas with the lowest resistance of bacteria is *Staphylococcus epidermidis* (14.29%). Of the 12 species of bacteria obtained, bacteria resistant to antibiotics Cefixime (77.61%) is still sensitive to the antibiotic spectinomycin (97.01%).

The study results represent database patterns of bacterial resistance in the hospital treatment room, which can be used to prescribe antibiotics to patients in a rational way to reduce the incidence of bacterial resistance to antibiotics. This research can be continued to see nosocomial bacteria that infect patients in each treatment room.

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