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Identification and Resistance Testing of Bacteria Causing Nosocomial Infections in Surgery Inpatient Rooms

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ABSTRACT

Background: Nosocomial infections are the most common infections that occur when patients are under medical care in hospitals. The most common pathogenic bacteria that cause nosocomial infections are *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Enterobacter spp*, and *Klebsiella pneumonia*. One of the factors causing a nosocomial infection is the environment. The spread of nosocomial infections in dr. Doris Sylvanus can occur in the surgical ward environment. Therefore, it is necessary to study and know the identification of bacteria and knowing the pattern of antibiotic resistance of bacteria that cause nosocomial infections in the surgical inpatient ward of dr. Doris Sylvanus Hospital. **Methods**: This type of research used an observational method with a descriptive approach. The research at dr Doris Sylvanus Hospital. The population is dahlia room which consisted of floors, sheets, patient beds, tables, and door handles. **Results**: Bacterial identification was *Staphylococcus aureus* at 13.4% and *Staphylococcus* non-*coagulase* at 10%, also found Gram-negative bacteria suspected *Salmonella sp.* 3.3% and other bacteria at 73.3% The results of the Trimethoprim-sulfamethoxazole antibiotic resistance test on *S. aureus* bacteria had a sensitivity of 50% and Oxacillin had a sensitivity of 75%, while the Trimethoprim-sulfamethoxazole resistance test results on *S. non-coagulase* bacteria had a sensitivity of 66.7% and Oxacillin had a sensitivity of 100%. **Conclusion**: The Trimethoprim-sulfamethoxazole antibiotic resistance test on *S. aureus* bacteria has moderate sensitivity and the Oxacillin antibiotic has a fairly high sensitivity while on *S. non-coagulase* bacteria have a fairly high sensitivity and oxacillin antibiotics have high sensitivity.

Introduction

Infection can be caused by pathogenic microorganisms that enter the body and multiply in the body. Nosocomial or healthcare infections *Healthcare-Associated Infections* (HAIs) are infections that appear in patients undergoing medical treatment at hospitals or other healthcare facilities that were not present at the time the patient was admitted to the hospital [1]. The prevalence of HAIs in world hospitals reaches 9% or approximately 1.40 million inpatients in hospitals around the world who are affected by nosocomial infections. Based on data from the *World Health Organization* (WHO) shows that around 8.70% of 55 hospitals in 14 countries in Europe, the Middle East, Southeast Asia

and the Pacific show HAIs [2]. Survey data that has been conducted by the Ministry of Health of the Republic of Indonesia, namely the proportion of nosocomial infections in government hospitals, the incidence of nosocomial infections totaling 1,527 cases out of 160,417 patients at risk, namely 55.1%, while in private hospitals there are 991 patients out of 1,672 patients at risk that is equal to 9.1% [3]

Nosocomial infection is still a serious problem and is one of the most frequent causes of mortality and morbidity in hospitals. Nosocomial infections occur at least within 3x24 hours since the patient received treatment at a hospital or other health care center [4]. Nosocomial infections can be caused by endogenous factors originating from the patient's own normal flora, or through exogenous factors if the bacteria that cause infection are obtained from contaminated people or objects in the hospital environment [5]. Approximately 10-20% of nosocomial infections can also be caused by several factors such as air quality, floors, walls, sheets, and tables in hospital rooms [6]. According to research, the most common pathogenic bacteria that cause nosocomial infections are *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Enterobacter spp*, and *Klebsiella pneumonia* [7]. Treatment of nosocomial infections is closely related to the use of antibiotics. Ineffective use of antibiotics will lead to resistance to bacteria [8].

Based on patient infection data in the dahlia room at dr. Doris Sylvanus in 2021, judging by the examination of pus and blood cultures, it was found that the infection was caused by *Escherichia coli* and *Staphylococcus epidermidis* bacteria. The bacteria are resistant to the antibiotics piperacillin, benzylpenicillin, trimethoprim-sulfamethoxazole, amoxicillin, ampicillin-sulbactam, ceftazidime, ciprofloxacin, ceftriaxone, and aztreonam [9]. *Methicillin-Resistant Staphylococcus aureus* (MRSA) is a strain of *Staphylococcus aureus* bacteria that is resistant to the antibiotic Methicillin. Infections caused by MRSA account for 30-70% of all infections caused by *Staphylococcus aureus* in all hospitals in the world. *Extended-spectrum beta-lactamase* (ESBL) is an enzyme produced by certain bacteria that is capable of hydrolyzing penicillins, cephalosporins of generation I, II, III, and aztreonam. These enzyme-producing bacteria are very effective against the action of lactam antibiotics such as ceftazidime, ceftriaxone, cefotaxime, and oxyimino monobactam [10]. Seeing this phenomenon, researchers are interested in conducting research related to the identification and testing of bacterial resistance to antibiotics in surgical inpatient rooms at dr. Doris Sylvanus.

Materials and Method

The type of research used in this study was observational with a descriptive approach to identify and test the resistance of bacteria that cause nosocomial infections in surgical inpatient rooms, namely the dahlia room at RSUD dr. Doris Sylvanus. The population in this study was the dahlia room which consisted of floors, sheets, patient beds, tables, and door handles. The sampling technique taken was simple random sampling from 11 dahlia rooms, 6 rooms were taken randomly. The space taken is D1, D3, D12, D14, D16, D18. The number of samples is 30 samples in 6 dahlia rooms. The swab results will be cultured with MCA and BAP media. Then catalase, coagulase, biochemistry, and resistance tests were carried out using MHA (*Kriby-Bauer*).

The materials used in this study were Nutrient Agar (NA) media, BAP, Mac Conkey, MHA, TSIA, SIM, SC, H2O2 10-30%, coagulase and catalase reagents, Kovac reagent, urea broth, distilled water, Lugol, Safarin, crystal violet solution, 95% alcohol. The tools needed in this study were Petri dishes, test tubes, round loops, microscopes, foam objects, glass objects, sterile cotton swabs, tube racks, incubators, markers, aluminum foil, plastic wrap, and ice boxes.

The method of data processing used in this study is to use data from research results that are processed in the form of tables and narratives. The data analysis that will be carried out in this study is to describe the types of bacteria found on floor swabs, bed sheets, patient beds, tables, and doorknobs in the dahlia room. Then analyze the interpretation of the results from measuring the diameter of the inhibition zone around each antibiotic disc, namely Trimethoprim-sulfamethoxazole, Oxacillin, Ampicillin, Gentamicin, Piperacillin-tazobactam, and Ceftazidime using calipers and recorded in millimeters and matched in the CSLI table.

Results and Discussion

Results

Table 1 shows the results of the identification of Gram (+) bacteria or Gram (-) bacteria, the shape, size, and color of the bacteria found by observing the bacterial colonies and Gram staining for each bacterial colony found in the Dahlia D1, D3, inpatient rooms D12, D15, D16, D18. From the results of gram staining in Table 1, the shapes of cocci, diplococci, tetra cocci, bacilli, and cococci were obtained. The results of a purplish-blue Gram stain show Gram-positive (+) bacteria, because the peptidoglycan layer of Gram-positive bacteria is much thicker than Gram-negative bacteria. The lipopolysaccharide layer can dissolve in the decolorizer so it is unable to bind to crystal violet paint, so Gram-negative bacteria (-) will have a reddish color.

In room D1 samples of gate algae were found colonies 1 and colonies 2 showing Gram (+) bacteria with coccal shape, the results of Gram staining were blue-purplish, and the color of the colonies on the media was grayish. In room D3 the floor sample was found colony 1 showing Gram (+) bacteria with a coccal shape, the result of Gram staining was blue-purplish. Colony 2 in space D3 shows Gram-negative bacteria (-) with cocci form, the result of Gram staining is reddish. In room D12 the sample sheets were found to be colony 1 showing Gram (-) bacteria with a coccal shape, the result of a reddish Gram stain. Colony 2 showed Gram-positive (+) bacteria with tetracoccus form, the result of Gram staining was blue-purplish. Floor samples found colony 1 and colony 3 showing Gram-negative (-) bacteria with cocci form and reddish Gram staining results, while colony 2 showed Gram-negative (-) bacteria with diplococcal form and reddish Gram staining results. Pintu samples found colonies 1, 5, and 7 showing Gram-negative bacteria (-) with diplococcal form and the results of Gram staining were reddish. Colony 2 showed Gram-positive (+) bacteria with tetracoccal form and the results of Gram staining were blue-purplish. Colony 3 and colony 6 showed Gram-negative (-) bacteria with cocci form and Gram anger staining results. Colony 4 showed Gram-negative bacteria with tetracoccal form and reddish Gram stain results (Table 1).

In room D15 the sample bed found colony 1 and colony 2 showing Gram-negative bacteria (-) with a cocci shape and the results of a reddish Gram stain. In the sheet sample, colony 1 showed Gram-negative (-) bacteria with cocci form and reddish Gram staining results, while colony 2 showed Gram-positive bacteria (+) with tetracoccal form and blue-purplish Gram staining results. Floor samples found colonies 1, 2, and 3 showing Gram-negative (-) bacteria with a coccal shape and the results of a reddish Gram stain. The gate algae sample was found in colony 1 and colony 2 showing Gram (-) bacteria with tetracoccal form and reddish Gram staining results, while colony 3 showed Gram-positive bacteria (+) with cocci form and Gram staining results blue-purplish. In room D16 table sample found colony 1 showing Gram-positive bacteria (+) with cocci form and the results of Gram staining blue purplish. On the floor sample, colony 1 was found to show Gram (+) bacteria with coccobacillus form and Gram-blue-purplish staining results, while colony 2 showed Gram-negative (-) bacteria with cocci form and reddish Gram stain results. In samples of gate algae, colonies 1, 3, 5, and 6 showed Gram-negative (-) bacteria with cocci form and reddish Gram staining results, while colony 2 showed Gram (+) bacteria with cocci form and blue-purplish Gram staining results. Colony 4 shows Gram (-) bacteria with diplococcal form and reddish Gram stain results. In room D18 the sample bed found colony 1 showing Gram-positive bacteria (+) with coccal shape and the results of Gram staining were blue-purplish. Floor samples found colony 1 and colony 2 showing Gram-positive bacteria (+) with bacilli form and Gram staining results blue-purplish. In the gate algae sample, colony 1 showed Gram-negative bacteria (-) with bacilli form, while colony 2 showed Gram-negative bacteria (-) with coccus form and the results of Gram staining in colonies 1 and 2 were reddish (Table 1).

Table 2 on BAP and MCA media shows positive growth results (+) that inoculated bacteria grow on selective media. Tables 3 show that the growth results can be seen by the different colors of the bacterial colonies on the growing media. In room D1, the gate algae samples of colony 1 and colony 2 showed the results of bacterial growth (+) with a grayish-white colony color. In room D3, the sample on the floor of colony 1 showed the results of bacterial growth (+) with a grayish-white colony color. In room D15 the sample of colony 3 algae showed the results of bacterial growth (+) with a grayish-white colony color. In room D16 the sample table colony 1 shows the results of bacterial growth (+) with a grayish-white colony color, while the gate algae sample 2 shows the

results of bacterial growth (+) with a grayish-white colony color. In room D18, colony bed sample 1 showed the results of bacterial growth (+) with a grayish-white colony color. In room D18 the MCA media sample of colony 1 algae showed the results of bacterial growth (+) with a yellow or transparent colony color.

Table 1. Gram Staining Test on Samples

Room	Sample	Sample Code	Number of Colonies	Results	Description	Color
D1	Handle Door	P	K1	+	Coccus	Purplish Blue
			K2	+	Coccus	Purplish Blue
D3	Floor	L	K1	+	Coccus	Purplish Blue
			K2	-	Coccus	Redness
D12	Sheet	S	K1	-	Coccus	Redness
			K2	+	Tetracoccus	Purplish Blue
			K3	-	Coccus	Redness
	Floor	L	K1	-	Coccus	Redness
			K2	-	Diplococcus	Redness
			K3	-	Coccus	Redness
	Handle Door	P	K1	-	Diplococcus	Redness
			K2	+	Tetrakokus	Purplish Blue
			K3	-	Coccus	Redness
			K4	-	Tetracoccus	Redness
			K5	-	Diplococcus	Redness
			K6	-	Coccus	Redness
			K7	-	Diplococcus	Redness
D15	Bed	B	K1	-	Coccus	Redness
			K2	-	Coccus	Redness
	Sheet	S	K1	-	Coccus	Redness
			K2	+	Tetracoccus	Purplish Blue
	Floor	L	K1	-	Coccus	Redness
			K2	-	Coccus	Redness
			K3	-	Coccus	Redness
	Handle Door	P	K1	-	Tetracoccus	Redness
			K2	-	Tetracoccus	Redness
			K3	+	Coccus	Purplish Blue
D16	Table	M	K1	+	Coccus	Purplish Blue
	Floor	L	K1	+	Coccobacillus	Purplish Blue
			K2	-	Coccus	Redness
	Handle Door	P	K1	-	Coccus	Redness
			K2	+	Coccus	Purplish Blue
			K3	-	Coccus	Redness
			K4	-	Diplococcus	Redness
			K5	-	Coccus	Redness
			K6	-	Coccus	Redness
D18	Bed	B	K1	+	Coccus	Purplish Blue
	Floor	L	K1	+	Basil	Purplish Blue
			K2	+	Basil	Purplish Blue
	Handle Door	P	K1	-	Basil	Redness
			K2	-	Coccus	Redness

Note: D1: Dahlia Room 1; D3: Dahlia Room 3; D12: Dahlia Room 12; D15: Dahlia Room D15; D16: Dahlia Room D16; D18: Dahlia Room; K1: Colony 1; K2: Colony 2; B: bed; S: Sheet; M: Table; L: Floor; P: Handle Door. Then incubation was carried out for 24 hours.

Table 2. The Results of Planting on BAP and MCA Media

Room	Sample	Sample Code	Colony	Result	Description
D1	Handle Door	P	K1	+	Grayish white
			K2	+	Grayish white
D3	Floor	L	K1	+	Grayish white
D15	Handle Door	P	K3	+	Grayish white
D16	Table	M	K1	+	Grayish white
	Handle Door	P	K2	+	Grayish white
D18	Bed	B	K1	+	Grayish white
	Handle Door	P	K1	+	Yellow or transparent

From the results of the catalase test and coagulase test to confirm Gram-positive cocci-shaped bacteria, the results are shown in Table 3, namely, room D1 with colony gate 1 sample confirmed *Staphylococcus aureus* with catalase test results (+) and coagulase test (+). Colony 2 was confirmed as non-coagulase *Staphylococcus* bacteria with catalase (+) and coagulase (-) test results. In room D3 with the floor sample of colony 1 confirmed *Staphylococcus aureus* with catalase (+) and coagulase (+) test results.

In room D15, the gate sample of colony 3 was confirmed as non-coagulase *Staphylococcus* bacteria with the results of the catalase test (+) and the coagulase test (-). In room D16 with sample table colony 1 confirmed *Staphylococcus aureus* with catalase (+) and coagulase (+) test results. Colony gate 2 samples were confirmed as non-coagulase *Staphylococcus* bacteria with catalase (+) and coagulase (-) test results.

In room D18 with colony 1 bed samples confirmed *Staphylococcus aureus* with catalase (+) and coagulase (+) test results. In table 5 room D18 with sample colony 1 confirmed Gram-negative bacteria with the TSIA biochemical test showing slope (alkaline), basic (acidic), no gas (-), and no sulfur (-) produced. The SIM biochemical test showed the results of indole (+) bacteria being able to decompose protein, motile (+) bacteria moving, and sulfide (-) bacteria not producing tryptophan and hydrogen sulfide. SC biochemical test showed (-) and urease (-). D18 colony door sample 1 Gram-negative bacteria with bacilli form showing *Salmonella sp*. The need for other tests to further confirm these bacteria (Table 4).

Table 3. Catalase and Coagulase Test Results (Gram-positive bacteria)

Room	Sample	Colony	Catalase Test	Coagulase Test	Result
D1	P	K1	+	+	*S. aureus*
D1	P	K2	+	-	*S. non-coagulase*
D3	L	K1	+	+	*S. aureus*
D15	P	K3	+	-	*S. non-coagulase*
D16	M	K1	+	+	*S. aureus*
D16	P	K2	+	-	*S. non-coagulase*
D18	B	K1	+	+	*S. aureus*

Table 4. Biochemical Test Results (Gram Negative Bacteria)

Room	Sample Code	Colony	TSIA	SIM	SC	Urease	Result
D18	P	K1	Slope (base) Base (acid) Gas (-) Sulfur (-)	Indol (+) Motil (+) Sulfide (-)	(-)	(-)	Suspect *Salmonella sp.*

From the results of bacterial identification in Table 5 in the Dahlia room, 4 samples in 4 Dahlia rooms were identified as S.aureus with a percentage of 13.4%. Then 3 samples were found in 3 Dahlia rooms which were identified as *S. non-coagulase* with a percentage of 10%. Also found 1 sample in 1 Dahlia room which was identified as suspected *Salmonella sp.* with a percentage of 3.3%.

Then in Dahlia rooms, D3, D12, D15, D16, and D18 with different numbers of colonies, Gram-positive bacteria (+) were found in the form of *tetracocci, coccobacillus*, and *bacilli* and Gram-negative bacteria (-) with the form of *cocci, diplococci*, and *tetracocci* with a percentage of 73.3% found other bacteria besides the bacteria studied by researchers.

Then for Gram-negative bacteria with bacilli forms, namely *Escherichia coli*, *Klebsiella pneumonia*, and *Pseudomonas aeruginosa*, they were not found in Dahlia rooms D1, D3, D12, D15, D16, and D18 (Table 5). It can be seen from the results of the identification of bacteria, that there is a chance that the patient will be infected with a disease caused by bacteria present in the Dahlia room environment. The current large percentage showed Gram-positive bacteria with coccal form found in 7 samples in 4 Dahlia rooms examined, while Gram-negative bacteria with bacilli form were only found in 1 sample in 1 Dahlia room examined (Table 5).

Tabel 5. Bacterial Identification Results

Type of bacteria	Number of Samples	Percentage (%)
S. aureus	4	13.4
S. non koagulase	3	10
Suspect *Salmonella sp.*	1	3.3
Other bacteria	22	73.3

After identification of the bacteria, then an antibiotic test was carried out on *Staphylococcus aureus* and non-coagulase *Staphylococcus* bacteria to determine the presence of bacterial resistance to the antibiotics Trimethoprim-sulfamethoxazole and Oxacillin. The antibiotics used are antibiotics from the first class referring to CLSI and adjusted to the data on the map pattern of hospital germs on bacterial antibiotic resistance (Table 6).

In room D1, the colony gate 1 sample, *S. aureus*, experienced resistance to the antibiotic Trimethoprim-sulfamethoxazole with an inhibition zone (-), while D1, the colony door sample 2, namely *S. non-coagulase* bacteria, was still sensitive to the antibiotics Trimethoprim-sulfamethoxazole and Oxacillin with an SXT inhibition zone. (27.7mm) and OX (26.5mm). In room D3, the sample on the floor of colony 1, *S. aureus*, was still sensitive to the antibiotics Trimethoprim-sulfamethoxazole and Oxacillin with SXT (43.8 mm) and OX (38.7 mm) inhibition zones. In room D15, the gate sample of colony 3, namely *S. non-coagulase* bacteria, was still sensitive to the antibiotics Trimethoprim-sulfamethoxazole and Oxacillin with SXT (27.7 mm) and OX (26.8 mm) inhibition zones. In room D16 the sample of colony table 1, namely *S. aureus*, experienced a decrease in antibiotics or intermediate to Trimethoprim-sulfamethoxazole with an inhibition zone of 14.9 mm and experienced Oxacillin resistance with an inhibition zone (-). Room D16, gate sample of colony 2, namely *S. non-coagulase* bacteria experienced resistance to the antibiotic Trimethoprim-sulfamethoxazole with an inhibition zone (-). In room D18, colony one bed samples, namely *S. aureus* bacteria, were still sensitive to the antibiotics Trimethoprim-sulfamethoxazole and Oxacillin with SXT (29.9 mm) and OX (21.0 mm) inhibition zones.

Table 6. *Staphylococcus aureus* and *S. non koagulase* Antibiotic Test Results

Room and Sample	Antibiotic	Bacteria *S. aureus/ non koagulase*	Description			Result
			S	*I*	*R*	
D1	Trimethoprim-sulfamethoxazole	-	≥16	11-15	≤10	R : SXT
K1(P) K2(P)	Oxacillin	25,6 mm	≥18	-	≤17	S : OX
D3	Trimethoprim-sulfamethoxazole	43,8 mm	≥16	11-15	≤10	S : SXT
K1(L)	Oxacillin	38,7 mm	≥18	-	≤17	S : OX
D16	Trimethoprim-sulfamethoxazole	14,9 mm	≥16	11-15	≤10	I : SXT
K1(M)	Oxacillin	-	≥18	-	≤17	R : OX
D18	Trimethoprim-sulfamethoxazole	29,9 mm	≥16	11-15	≤10	S : SXT
K1(B)	Oxacillin	21,0 mm	≥18	-	≤17	S : OX
D1	Trimethoprim-sulfamethoxazole	27,7 mm	≥16	11-15	≤10	S : SXT
K2(P)	Oxacillin	26,5 mm	≥18	-	≤17	S : OX
D15	Trimethoprim-sulfamethoxazole	27,7 mm	≥16	11-15	≤10	S : SXT
K3(P)	Oxacillin	26,8 mm	≥18	-	≤17	S : OX
D16	Trimethoprim-sulfamethoxazole	-	≥16	11-15	≤10	R : SXT
K2(P)	Oxacillin	32,6 mm	≥18	-	≤17	S : OX

Note:

1) *B: bed; S: Sheet; M: Table; L: Floor ; P: Handle Door; S: Sensitive; I: Intermediate; R: Resistant; SXT: Trimethoprim-sulfamethoxazole; OX: Oxacillin.*
2) *MIC for Trimethoprim-sulfamethoxazole antibiotics are sensitive (≥16), intermediate (11-15), and resistant (≤10), while Oxacillin is sensitive (≥18), intermediate (-), resistant (≤17).*

Discussion

In this study, there were 6 dahlia rooms identified by bacteria from a total of 11 rooms. In 1 Dahlia room, there were 5 samples that he took swab samples of, namely patient beds, sheets, tables, floors, and door handles. The total samples taken were 30 samples. Sampling was carried out on June 24, 2022, in room D1, June 29, 2022, in room D3, July 2, 2022, in rooms D15, D16, and D18, and July 4 2022 in room D12. Planting on NA media using a streak plate. Identification of

bacteria carried out on swabs of objects in the Dahlia room in this study was to determine the presence or absence of bacteria on objects in the Dahlia room which have the potential as an exogenous factor in the occurrence of nosocomial infections in patients who are being hospitalized.

Gram-positive bacteria are the most common bacteria found in medical and non-medical objects in surgical inpatient rooms. This is in accordance with several studies which found that gram-positive bacteria were more dominant as contaminants, such as research on medical equipment in the emergency room where *Staphylococcus aureus* and *Staphylococcus epidermidis* were found [11,15-16]. Gram-positive bacteria can be pathogenic because they often hemolyze blood, coagulate plasma, and produce several enzymes and toxins that are stable in heat. Gram-positive bacteria are generally more sensitive to penicillin antibiotics, while Gram-negative bacteria are more sensitive to antibiotics such as streptomycin [17-18]. Gram-positive bacteria have thicker walls than Gram-negative bacteria. Gram-negative bacteria contain lipids, fats, or fat-like substances with a higher percentage than Gram-positive bacteria [21-22]. The cell wall of gram-positive bacteria contains peptidoglycan and teichoic or teicuronic acid and the bacteria may be surrounded by a protein or polysaccharide envelope. Whereas the Gram-negative cell wall contains lipopolysaccharide, peptidoglycan, protein, phospholipid, and lipoprotein [12, 19-20].

The results of the identification of bacteria on beds, sheets, tables, floors, and door handle in the Dahlia inpatient room at RSUD dr. Doris Sylvanus found *S. aureus* and *S. non-coagulase* bacteria. *S. areus* and *S. non-coagulase* are types of Gram-positive bacteria with a coccal form found in Dahlia's inpatient room samples. *Escherichia coli, Pseudomonas aeruginosa*, and *Klebsiella pneumoniai* are types of Gram-negative bacilli that are not found in Dahlia's ward. In this study, *S. aureus* was found in samples of doorways, floors, tables, and patient beds in 13.4%. *S. non-coagulase* was found in 10% of door algae samples. This is in accordance with a study that obtained results with 5 samples identified as *Staphylococcus* sp from 30 samples tested at 16.67%. 46 In a study out of 40 colonies, a total of 31 colonies were found (77%) *S. aureus* was resistant to Methicillin on surgical instruments in surgical treatment rooms such as scissors (83%), tables (87%), bed sheets (67%), and IV poles (75%) [5, 23-24].

S. aureus and *S. non-coagulase* are Gram-positive bacteria that live as normal flora of the body such as the throat, nose, skin, and vagina [25]. Has the characteristics of a single form, in pairs, or form a chain. Colonies on solid media were described as round, smooth, raised, and shiny. *S. aureus* can be spread to patients through airborne transmission and medical devices. A nasal carrier, a doctor, a nurse, or another hospital employee can also be a source of infection [26]. The bacterium *S. epidermidis* is a coagulase-negative *Staphylococcus* species [27]. These bacteria can attach to medical and non-medical equipment and form biofilms.

The inpatient room function as a place for patients who need medical treatment and nursing action within a certain period. The inpatient room provides various kinds of medical and non-medical facilities for patients, so cleaning and sterilizing objects in the Dahlia room is very necessary for patients who are undergoing treatment at the hospital. As a method of cleaning for sterilization, it is to change bed sheets regularly once a day, then clean tables, floors, and door handles using a disinfectant once a day to reduce the potential for spreading bacteria to patients with surgical wounds or patients who have the potential for infection nosocomial.

In this study, there were 7 bacteria in 5 Dahlia rooms, namely 4 *S. aureus* bacteria and 3 non-coagulase S. bacteria, and an antibiotic test was carried out using Trimethoprim-sulfamethoxazole and Oxacillin antibiotics. Trimethoprim-sulfamethoxazole and Oxacillin are standard first-line antibiotics in CLSI for the treatment of *Staphylococcus sp*. Trimethoprim-Sulfamethoxazole antibiotics work by inhibiting obligate enzymatic reactions in two successive stages in bacteria so that the combination of the two drugs provides a synergistic effect. The combination of trimethoprim and sulfamethoxazole inhibits folate biosynthesis, which is essential for thymidine biosynthesis, by inhibiting 2 different enzymes, Sulfonamides inhibit dihydropteroate synthase and are bacteriostatic, trimethoprim inhibits tetrahydrofolate reductase. This trimethoprim-sulfamethoxazole combination is bactericidal. Oxacillin antibiotics are antibiotics of the isoxazolyl penicillin class. This group is active against Gram-positive organisms such as staphylococci and streptococci but inactive against enterococci, anaerobic bacteria, and Gram-negative cocci and Gram-negative rods. This group is very

stable in acidic media and is adequately absorbed after oral administration. Its pharmacological property is that it strongly inhibits the growth of most penicillinase-producing staphylococci [13, 28-29].

The results of the Trimethoprim-sulfamethoxazole antibiotic test on *S. aureus* bacteria had a sensitivity of 50%, while the antibiotic Oxacillin had a sensitivity of 75%. Trimethoprim-sulfamethoxazole antibiotic test results on non-coagulase S. bacteria had a sensitivity of 66.7%, while Oxacillin antibiotics had a sensitivity of 100%. The results of the antibiotic test showed that there were differences in the sensitivity of antibiotics to bacteria in each dahlia room. In a study, the use of Trimethoprim-Sulfamethoxazole, Chloramphenicol, and Gentamycin had 100% sensitivity to MRSA bacteria [30]. The results are the same as a study that found that MRSA bacteria were 100% sensitive to the antibiotics Trimethoprim-Sulfamethoxazole and Chloramphenicol. Oxacillin antibiotics still show good sensitivity, this is following the culture data of RSUD dr. Doris Sylvanus in 2021 showed that the antibiotic Oxacillin was recorded to be still sensitive to bacteria of the *S. aureus* and *S. non-coagulase* groups [9].

In antibiotic tests, differences in the sensitivity of drug action against bacteria can occur due to the influence of genetic changes that are stable and passed down from one generation to the next as well as any processes that produce the genetic composition of bacteria such as mutation, transduction, transformation, and conjugation causing the appearance of bacterial resistance to certain antibiotics. In Gram-positive cocci, the processes of mutation, transduction, and conjugation are the main mechanisms that can cause antibiotic resistance. One of the factors of differences in sensitivity patterns or determinants of bacterial resistance to antimicrobials can be carried by genetic information outside the chromosomes, namely plasmids. *S. aureus* and *S. non-coagulase* are bacteria that have small plasmids and large plasmids that have more than one resistance gene. Antibiotic resistance occurs when bacteria can weaken and neutralize the working power of certain antibiotics. The causal factors that influence antibiotic resistance are the use of antibiotics and infection control. Antibiotic resistance can be classified into two groups: natural resistance (immature) and acquired resistance (acquired) [14].

Conclusion

The results of the identification of bacteria that cause nosocomial infections in the Dahlia room of dr. Doris Sylvanus Hospital found *Staphyloccocus aureus* and *Staphyloccocus non coagulase*. The results of the Trimethoprim-sulfamethoxazole antibiotic resistance test on *S. aureus* bacteria have moderate sensitivity and the Oxacillin antibiotic has a fairly high sensitivity while the trimethoprim-sulfamethoxazole antibiotic resistance test results on *S. non-coagulase* bacteria have a fairly high sensitivity and oxacillin antibiotics have high sensitivity. Suggestions for further research are expected to be able to improve the next line of antibiotics and can be used as a reference for future researchers who want to conduct research with modification methods or with a larger number of samples.

Declaration

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