

Analysis of Factors Related to The Incidence of Methicillin-Resistant Staphylococcus Aureus (MRSA) At Makassar City Hospital

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Abstract

Introduction: Nosocomial infections, including those caused by Methicillin-Resistant Staphylococcus aureus (MRSA), pose a significant challenge for the global health system. MRSA, a resistant bacterium that increases morbidity and mortality, is often found in healthcare facilities and is associated with inappropriate antibiotic use and suboptimal patient management practices.

Methods: This research employs an analytical observational design with a cross-sectional approach. The sample consists of 70 inpatient medical records that meet the inclusion criteria, with data collected from positive MRSA microbiological cultures. Analysis was conducted using SPSS.

Results: The results indicate a significant relationship between the type of laboratory examination ($p=0.049$), use of medical therapeutic devices ($p=0.023$), type of antibiotics ($p=0.015$), and duration of treatment ($p=0.033$) with MRSA incidence. Patients in the ICU and PICU had a higher prevalence, as did those receiving antibiotic treatment such as penicillin ($p=0.015$). A treatment duration of more than 7 days also increased the risk of MRSA infection ($p=0.033$). Additionally, devices such as catheters showed a significant association with infection ($p=0.023$).

Conclusion: This study highlights the importance of strict infection surveillance and control in high-risk care units, appropriate antibiotic use, and monitoring of medical therapeutic devices. The findings can serve as a foundation for more effective infection prevention policies to minimize the risks and impacts of MRSA in healthcare facilities.

Keywords: Methicillin-Resistant Staphylococcus aureus (MRSA), nosocomial infections, risk factor MRSA

Introduction

Healthcare-associated infections (HCIs), or nosocomial infections, remain a significant challenge in global health systems despite advancements in preventing and treating infectious diseases. One of the main factors exacerbating this issue is Methicillin-Resistant Staphylococcus aureus (MRSA), a resistant bacterium that can cause serious patient complications. This bacterium prolongs hospital stays and increases morbidity and mortality rates, particularly in healthcare facilities. A report by Nuryah et al. (2019)

indicates that the prevalence of MRSA has continued to rise from 2015 to 2018, highlighting the urgent need for tighter surveillance and evidence-based treatment approaches.

In Indonesia, the challenges of managing nosocomial infections are particularly evident, especially concerning the unwarranted use of antibiotics. According to the Ministry of Health (2015), approximately 30% to 80% of hospital antibiotic use occurs without clear indications. A study at Hasanuddin University Hospital in 2017 noted that 29.13% of patients were carriers of *Staphylococcus aureus*, with 20% of these detected as MRSA (Ilhamjaya et al., 2019). This situation reflects an evolving threat in healthcare facilities and the risk of infection spreading to the broader community.

MRSA can develop resistance to various antibiotics, including methicillin, oxacillin, and cephalosporins. Key risk factors for MRSA infections include inappropriate antibiotic use, poor sanitation practices, and inadequate patient management. Diagnostic technologies such as Polymerase Chain Reaction (PCR) have proven to enhance the accuracy of detecting this bacterium compared to traditional methods (Rahman et al., 2023). However, the lack of consistent implementation of these technologies remains a significant obstacle in various healthcare facilities.

Another challenge is the lack of awareness regarding the importance of infection control and prudent antibiotic management. Besides being resistant to common antibiotics, MRSA requires longer treatment durations, increasing the cost burden and ecological effects in hospitals. According to WHO (2019), healthcare workers, particularly nurses, are crucial in reducing the risk of nosocomial infections. Adherence to hygiene measures, patient isolation, and strict monitoring of antibiotic use are vital components of this strategy. MRSA can cause skin and soft tissue infections, leading to severe conditions such as bacteremia, septicemia, toxic shock, staphylococcal scalded skin syndrome, and even death if left untreated (Shoaib et al., 2023). Additionally, MRSA can spread among patients, causing outbreaks that are difficult to control and increasing the risk of nosocomial infections in hospitals (Junnila et al., 2020).

A holistic approach is necessary to address these issues, including policies supporting antibiotic management, education for healthcare providers, and implementing evidence-based interventions. The study by Nuryah et al. (2019) shows that appropriate antibiotic use regarding dosage, timing, and type can prevent further resistance. Moreover, stringent surveillance in intensive care units with high MRSA prevalence is an important step to reduce the bacterium's spread.

However, there are gaps in previous research that tend to focus on MRSA prevalence and general antibiotic use. The relationship between specific risk factors, such as the type of treatment area, duration of care, and the use of medical devices, with MRSA incidence has not been explored extensively. This study aims to fill that gap by analyzing the risk factors influencing MRSA incidence at Tadjuddin Chalid Hospital in Makassar. The MRSA (Methicillin-resistant *Staphylococcus aureus*) infection rate at Tajuddin Chalid Hospital is very high, indicating serious challenges in infection control. By understanding the relationships between these variables, the study's findings are expected to support the development of more effective policies for preventing nosocomial infections.

Methods

This study used an analytical observational design with a cross-sectional approach to analyze the relationship between risk factors and the occurrence of MRSA infections. The research was conducted at Tadjuddin Chalid Hospital, Makassar, from August to October 2024. The study population was selected using a sampling technique, including inpatients with MRSA infections undergoing antibiotic therapy and laboratory examinations with inclusion criteria, namely patients with positive MRSA microbiological culture results, and exclusion criteria, namely patients with incomplete clinical data or factors that influence laboratory results. Independent variables include type of care room, use of medical therapy devices, duration of treatment, medical history, and antibiotic use. In contrast, the dependent variable is the occurrence of MRSA infection. Data were collected secondarily through patient medical records and laboratory results, then analyzed using SPSS. The data analysis began with univariate analysis to describe the characteristics of the study population, followed by bivariate analysis to identify factors associated with MRSA infection. Subsequently, multivariate analysis was performed to calculate the odds ratio and confidence interval, providing deeper insights into the relationships between the studied variables. This study uses Chi-square statistical tests and linear regression. This approach is designed to provide relevant findings for managing MRSA infections in healthcare facilities. This research has passed a research permit by Tadjuddin Chalid Hospital with number DP.04.03/D.XXVII.2/9727/2024.

Results

1. Univariate Analysis

The distribution of respondents by age shows that the largest group is adults (20-64 years) with 37 patients (52.9%), while the smallest group is adolescents (10-19 years) with eight patients (11.4%). The distribution of frequency based on the location of inpatient care shows that the highest number of patients is in the Lily ward, with 38 patients (54.3%), and the lowest is in the Bougenville ward, with two patients (2.9%). The types of culture tests conducted include pus, blood, urine, feces, peritoneal fluid, and mucous membranes, with the highest number of tests being blood cultures at 35 samples (50%) and the lowest being urine cultures at two samples (2.9%).

Regarding the use of medical devices, patients received intravenous lines (for medication and infusions), catheters, and wound care instruments, with the highest number being wound care instruments used by 37 patients (52.9%). The distribution of frequency based on the types of diagnoses for hospitalized patients, such as abscesses, sepsis, pneumonia, osteomyelitis, cancer, diabetic foot ulcers, burst abdomen, and other diagnoses, shows that the most common diagnosis is an abscess, with 19 patients (27.1%). In contrast, the least common is cancer, with three patients (4.3%).

The distribution of frequency based on the types of antibiotics given to patients includes ceftriaxone, gentamicin, ampicillin-sulbactam, vancomycin, levofloxacin, metronidazole, meropenem, cefixime, ciprofloxacin, and cefazolin. The most commonly used antibiotic is ceftriaxone, with 14 patients (20%), while the least used are ciprofloxacin and cefazolin, with three patients each (4.3%). The distribution of frequency based on the duration of patient hospitalization is categorized into (2-7 days), (8-15 days), and (16-23 days). The most common duration of hospitalization is (8-15 days) with 33 patients (47.1%), while the least common duration is (16-23 days) with six patients (8.6%).

Table 1. Frequency Distribution Based on Respondent Characteristics RSUP Dr. Tadjuddin Chalid Makassar

Variable	Category	(n)	%
Age	Children (0-9 years)	16	22,9
	Adolescents (10-19 years)	8	11,4
	Adults (20-64 years)	37	52,9
	Elderly (>64 years)	9	12,9
Inpatient Room	Bougenville	2	2.9
	Edelweiss	4	5.7
	Lily	38	54.3
	Seruni	10	14.3
	ICU	5	7.1
	NICU	6	8.6
	PICU	5	7.1
Type of Specimen	Pus	28	40.0
	Blood	35	50.0
	Urine	2	2.9
	Mucus	5	7.1
Medical Device/ Therapy Usage	IV Line	26	37.1
	Urinary Catheter	6	8.6
	Wound Care Instrument	37	52.9
	Others	1	1.4
Medical Diagnose	Abscess	19	27.1
	Sepsis	8	11.4
	Pneumonia	6	8.6
	Osteomyelitis	12	17.1
	Cancer	3	4.3
	Diabetic Foot	3	4.3
	Burst Abdomen	5	7.1
	Others	14	20.0
Type of antibiotics	Ceftriaxone	14	20.0
	Gentamicyn	7	10.0
	Ampicillin Sulbactam	7	10.0
	Vancomycin	4	5.7
	Levofloxacin	4	5.7
	Metronidazole	10	14.3
	Meropenam	13	18.6
	Cefixime	5	7.1
	Ciprofloxacin	3	4.3
	Cefazolin	3	4.3
Length of Stay	2 - 7 Days	31	44.3
	8 - 15 Days	33	47.1
	16 - 23 Days	6	8.6

2. Bivariate Analysis

According to the Chi-square test results for the age variable in Table 2, the obtained p-value is 0.029; $p < 0.05$, indicating a relationship between age and the incidence of MRSA infection, where the older a person is, the greater the likelihood of MRSA infection. In addition, the analysis of the relationship between the location of care and the incidence of MRSA infection showed a p-value of 0.727; $p > 0.05$, meaning there was no relationship between the location of care and the incidence of MRSA infection. Then, the p-value of 0.049; $p < 0.05$ in the analysis of the relationship between the type of specimen examination showed a relationship between the type of specimen examination and the incidence of MRSA infection, with blood culture associated with a higher incidence of MRSA infection.

Analysis of the relationship between the length of hospitalization and the incidence of MRSA infection produced a p-value of 0.033; $p < 0.05$, meaning there was a relationship between the length of hospitalization and the incidence of MRSA infection, where the longer the hospitalization, the greater the risk of MRSA infection. Furthermore, the p-value was 0.023; $p < 0.05$ indicates a relationship between the use of wound care devices and the incidence of MRSA infection; this indicates that patients treated with these devices have a higher risk of MRSA infection than patients who use other devices such as infusions or catheters.

The type of antibiotic given more than one type is also associated with the incidence of MRSA infection with a p-value of 0.015; $p < 0.05$. However, in the analysis of the relationship between medical diagnosis and the incidence of MRSA infection, there was no significant relationship between the diagnosis of abscess and the incidence of MRSA infection with a p-value of 0.086; $p > 0.05$. Patients with medical diagnoses other than abscesses also have a risk of MRSA infection, such as in osteomyelitis.

Table 2. Analysis of Factors Associated with MRSA Infection Incidence RSUP Dr. Tadjuddin Chalid Makassar

Variable	Category	Group				P Value
		Non MRSA		Infeksion MRSA		
		(n)	%	(n)	%	
Age (Years)	Children (0-9 years)	13	37,1	3	8,6	0,029
	Adolescents (10-19 years)	3	8,6	5	14,3	
	Adults (20-64 years)	14	40	23	65,7	
	Elderly (>64 years)	5	14,3	4	11,4	
Type of Specimen	Pus	17	48.6	9	25.7	0.023
	Blood	0	0	6	17.1	
	Urine	18	51.4	19	54.3	
	Mucus	0	0	1	2.9	
Medical Diagnose	Abscess	5	14.3	14	40	0.086
	Sepsis	5	14.3	3	8.6	
	Pneumonia	4	11.4	2	5.7	
	Osteomyelitis	6	17.1	6	17.1	
	Cancer	1	2.9	2	5.7	
	Diabetic Foot	2	5.7	1	2.9	

	Burst Abdomen	1	2.9	4	11.4	
	Others	11	31.4	3	8.6	
Type of antibiotics	Ceftriaxone	7	20	7	20	0.015
	Gentamicin	3	8.6	4	11.4	
	Ampicillin Sulbactam	3	8.6	4	11.4	
	Vancomycin	0	0	4	11.4	
	Levofloxacin	2	5.7	2	5.7	
	Metronidazole	5	14.3	5	14.3	
	Meropenam	8	22.9	5	14.3	
	Cefixime	3	8.6	2	5.7	
	Ciprofloxacin	2	5.7	1	2.9	
	Cefazolin	2	5.7	1	2.9	
Length of Stay	2 - 7 Days	13	37.1	18	51.4	0.033
	8 - 15 Days	16	45.7	17	48.6	
	16 - 23 Days	6	17.1	0	0	

3. Multivariate Analysis

The variables included in the multivariate analysis are those with $p < 0.05$: age, type of examination, use of instruments, type of medication, and length of stay. The multivariate analysis was conducted using logistic regression. According to the logistic regression test results, age, type of examination, use of instruments, type of medication, and length of stay achieved statistical significance with $p < 0.05$. However, the most dominant variable is the type of medication, with an Odds Ratio (OR) of 6.049 and a 95% Confidence Interval (CI).

Table 3. Analysis of Multivariate Analysis of MRSA Infection Incidence RSUP Dr. Tadjuddin Chalid Makassar

No	Variable	OR	CI: 95 %	P Value
1	Age	3,32	1,52 – 7,27	0,002
2	Medical Diagnose	4,48	1,68 – 11,94	0,002
3	Use of instruments	3,004	1,67 – 5,41	0,000
4	Type of antibiotic	6,049	1,87 – 19,61	0,002
5	Length of stay	3,66	1,85 – 7,29	0,000

Discussion

The results of the univariate analysis show that most respondents are adults (20-64 years old), comprising 52.9% of the total patients. This aligns with previous studies indicating that the adult age group is more vulnerable to nosocomial infections, including MRSA infections, due to a weakened immune system and comorbidities (Bussini et al., 2022).

Additionally, the distribution of inpatient wards indicates that the Lily ward has the highest number of patients (54.3%), which may relate to the capacity and demand for intensive care in that area. Previous research by Blot et al. (2022) suggests that more

intensive care environments tend to have higher infection rates, given the closer patient interactions with medical devices. This is in line with research by Samuel et al. (2023), which states that MRSA can contaminate various equipment such as catheters, surgical equipment, respiratory aids, and wound dressings in the ICU, which can increase the risk of infection, so regular disinfection is needed.

The bivariate analysis reveals a significant relationship between age and the incidence of MRSA infections ($p=0.029$), with the adult age group having the highest risk (65.7%). This is consistent with the findings of Falcone & Tiseo (2023), which found that increasing age is associated with a higher risk of MRSA infections. Furthermore, the analysis also shows that using medical devices, particularly wound care instruments, has a significant relationship with MRSA infections ($p=0.023$). This indicates that the management of invasive tools is crucial to prevent infections. However, while abscesses were more frequently observed in both groups, the relationship between diagnosis type and MRSA infection was insignificant ($p=0.086$), suggesting that infections can occur across various medical diagnoses.

The multivariate analysis indicates that all variables (age, type of examination, use of tools, type of medication, and duration of hospitalization) significantly contribute to the occurrence of MRSA infections. The type of medication emerged as the most dominant variable with an odds ratio (OR) of 6.049, highlighting that the appropriate selection of antibiotics is key in managing this infection. These findings align with the literature emphasizing the importance of proper antibiotic use to prevent resistance and improve treatment outcomes (Ha et al., 2019).

Blood culture examination dominated this study (50%), underscoring its importance in diagnosing infections. This is supported by findings from Buonomini et al. (2020), which emphasize that blood cultures are a primary diagnostic tool for detecting systemic infections, including MRSA. Success in obtaining and analyzing blood cultures can significantly influence therapeutic decisions, reducing morbidity and mortality from severe infections (Ombelet et al., 2019).

The focus on medical instrument usage was primarily on wound care instruments (52.9%), indicating that intensive wound management can increase the risk of infection. According to Phelan et al. (2021), using invasive tools directly correlates with an increased risk of infections, especially among patients with open wounds (Takashima et al., 2024). The most common diagnosis was abscess (27.1%), followed by osteomyelitis (17.1%). The result indicates that infections related to soft tissue and bone require more attention in infection management. Research by Lee et al. (2018) shows that abscesses are a leading cause of hospital bacterial infections, often necessitating surgical intervention.

Ceftriaxone was the most commonly used antibiotic (20%), reflecting standard practice in treating severe infections. However, strict monitoring of antibiotic resistance is crucial, as inappropriate antibiotic use can contribute to the development of MRSA (Ayele et al., 2018). The inappropriate use of antibiotics can disrupt the balance of gut microbiota, allowing resistant microbes, including MRSA, more significant opportunities to overpower vulnerable microbes, multiply, and spread genetic information coding for resistance, thereby taking over the populations of weaker microbes (Abebe & Birhanu, 2023).

The duration of patient hospitalization shows that 47.1% were hospitalized for 8-15 days. Research by Leong et al. (2018) states that more extended hospital stays are associated with a higher risk of nosocomial infections, including MRSA. This emphasizes the importance of effective patient management in reducing hospital stays without compromising patient safety. The duration of hospitalization is associated with repeated exposure that often contains resistant bacteria, including MRSA, which can adhere to surfaces, medical equipment, and even healthcare staff. The longer a patient stays in the hospital, the greater the likelihood of exposure to these bacteria can lead to infection (Miller et al., 2024).

Limitations

This study has limitations as it only tests five variables; therefore, it is recommended to conduct further research by examining various variables related to the occurrence of MRSA to gain a more comprehensive understanding of the factors influencing the spread of the infection.

Conclusion

This study highlights the importance of understanding patient characteristics and risk factors contributing to MRSA infection incidence and the necessity of stringent infection surveillance and control in high-risk care areas, appropriate antibiotic usage, and monitoring of medical therapy tools. With a more proactive approach to selecting examination types, using medical devices, and managing hospitalization duration, the incidence of this infection can be reduced in hospitals. These results can serve as a foundation for more effective infection prevention policies to minimize the risks and impacts of MRSA in healthcare facilities.

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