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Knowledge and attitudes towards antibiotic resistance among health profession students in Indonesia

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ABSTRACT

Abuse and overuse of antibiotics cause the increasing prevalence of antibiotic resistance. Doctors, nurses, midwives, and pharmacy professionals play an essential role in providing information and education on the use of antibiotics to the public. This study aims to compare and identify the factors that influence the knowledge and attitudes of students' medicine, midwifery, pharmacy, and nursing toward antimicrobial resistance. An online cross-sectional survey involving 530 medical, midwifery, pharmacy, and nursing students who are currently in the clinical or professional study stage. The Mann–Whitney U test and the Kruskal–Wallis test was run to assess differences in the mean scores of knowledges and attitudes. Factors related to knowledge and attitudes regarding antibiotic resistance were analyzed using linear regression. Most (93%) students have a good level of knowledge and have a positive attitude 49.81%, neutral 43.78%, and negative 6.41%. There was a relationship between age (p=0.012), major (p=0.000), source of information (p=0.013), and knowledge and attitudes about antibiotics (p<0.05). We conclude that there are differences in knowledge and attitudes toward antibiotic resistance among clinical-stage students of medicine, midwifery, pharmacy, and nursing. We found that essential knowledge and attitudes should be revised regarding antibiotic resistance.

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1. INTRODUCTION

Antibiotic resistance is a major challenge to global public health, especially in developing countries [1]. Antibiotic resistance occurs when bacteria evolve over time and no longer respond to drugs, making the infection more difficult to treat and increasing the risk of its spread. illness and death [2]. Antimicrobial resistance has the potential to affect people at every stage of life, involving various sectors such as the health

industry, veterinary medicine, and agriculture [3]. Data in Pontianak and Surabaya, both in Indonesia, showed all urinary bacterial isolates had high resistance towards ampicillin and demonstrated multidrugs resistance [4], [5]. Data from global antimicrobial surveillance system also demonstrated an increased in antimicrobial resistance percentage in Indonesia [6]. As infectious diseases increase, the need for antimicrobial use increases. Increasing antimicrobial resistance reduces drug efficacy and makes treating patients complicated and expensive [7], which results in prolonged illness and increased mortality [8], [9]. The problem that often occurs is when patients do not comply with the rules of taking medication so that resistance occurs. If this happens, then the antimicrobial must be replaced, or the dosage changes, and this causes the healing process to take a long time and can be hampered.

WHO has declared that antibiotic resistance is one of the top 10 global threats to public health [1]. The results of a systematic review of developing countries for health professionals show that antibiotic resistance is a common problem (75.2%), a global problem (84.7%), and a national problem (88.0%), problems of medical facilities (71.9%). and problems in daily practice (71.7%). Antibiotic resistance is a multifaceted problem that society can address with responsible use [10]. The main cause of antibiotic resistance is the inappropriate use of antibiotics in healthcare settings and the role of healthcare professionals throughout the community is crucial in educating Educate the community about the appropriate use of antibiotics [11], [12]. The potential benefit of increasing awareness of the impact of antibiotic resistance on healthcare professionals is that it helps prevent all types of infections, reducing the occurrence of the condition. drug resistance and promote effective drug use [13], [14]. In addition, Simegn et al.'s study identified the problem of information gaps regarding antimicrobial resistance among healthcare professionals. Indonesia is one of the five most populous countries in the world, which is also experiencing abuse and excessive use of antibiotics due to widespread inadequate knowledge and wrong attitudes [10]. The level of training of healthcare professionals and the field of clinical practice have also been identified as determinants of the level of awareness of antibiotic resistance [14]. In Italy, a study conducted at the University of Torino among health professions students also revealed the gap between knowledge and practice [15]. Although much research has been conducted on antibiotic resistance, data on knowledge and attitudes towards antibiotic resistance among health profession students in Indonesia has yet to be published. The data used in our study is an online cross-sectional survey involving medical, pharmacy, nursing, and midwifery professional students not only in one region but also data obtained from various regions in Indonesia. Therefore, this study aims to compare and identify the factors that influence the knowledge and attitudes of student's medicine, midwifery, pharmacy, and nursing against antimicrobial resistance throughout Indonesia.

2. METHOD

This research is an online cross-sectional survey involving medical, pharmacy, nursing, and midwifery professional students from various regions in Indonesia. The territory of the Republic of Indonesia is divided into three time zones, including Western Indonesia Time (WIT) which covers several regions such as Sumatra, Java, Madura, West Kalimantan, and Central Kalimantan. Central Indonesia Time (CIT) covers several areas, such as Bali, South Kalimantan, East Kalimantan, North Kalimantan, Sulawesi, and Nusa Tenggara. Eastern Indonesia Time (EIT) which covers the Maluku Islands and Papua as shown in Figure 1. The population of medical, pharmaceutical, nursing, and midwifery students was taken from the database of the Ministry of Education and Culture of the Republic of Indonesia (Kemendikbud) totaling 532935 as of March 26, 2022. Sample calculations used Raosoft with a 95% CI and a 5% margin of error gets a minimum sample size of 384 students.

Figure 1. Distribution of respondents' institutional locations

Data collection via google form consists of socio-demographic questions, sources of information, knowledge, and attitudes. Questions for the knowledge variable consisted of 10 and questions for the attitude variable consisted of 12. Correct answers to knowledge questions had a score of 1, while incorrect answers had a score of 0. Total number of responses The correct answer for the knowledge variable is 10. Participants' overall knowledge is categorized using the modified Bloom's cut point, whether the score is between 80 and 100% (8-10 points), moderate if the score is between 50 and 79% (5-7.9 points), and poor if the score is less than 50% (<5 points). To assess attitudes, we used a five-point Likert scale ranging from 1 to 5. A score of "1" is given to the fewest answers that strongly disagree, a score of "2" for disagree answers, a score of "3" for undecided answers, a score of "4" for agree with answers, and "5" for strongly agree answers. The lowest score for attitude is 12, while the highest score is 60. Overall attitude level is categorized using Bloom's original cut-off point as positive if the score is 80–100% (48-60 points), neutral if the score is 60–79% (36-47 points), and negative if the score is less than 60% (<36 points). Test the validity and reliability of the questionnaire involving 30 respondents. Validity was checked using the Pearson correlation test. The results are declared valid if the value of r count >r table. Reliability test using Cronbach's Alpha method. The reliability test result of the questionnaire is 0.835.

Descriptive statistics present the proportion, range, mean and standard deviation. The Kolmogorov Smirnov test tests the normality of knowledge and attitudes. Based on the normality test, the data is not normally distributed, so it uses non-parametric statistics. Mann–Whitney U test and Kruskal–Wallis test were performed to evaluate differences in mean knowledge and attitude scores. The Mann-Whitney U test was used for two-group (sex) independent variables. Kruskal–Wallis was run for independent variables with more than two groups (age, region, major, and sources of information about antibiotics). Factors related to knowledge and attitudes regarding antibiotic resistance were analyzed using linear regression. Variable knowledge and attitudes for linear regression analysis is a score as an interval scale. Data analysis used SPSS version 25. A $p<0.05$ was considered statistically significant. This research has received a certificate of passing ethical review with 063/PE/KE/FKK-UMJ/IV2022.

3. RESULTS AND DISCUSSION

Of the 534 students who participated in this study, 530 filled out the questionnaire completely. Of the 530 respondents, 85.1% were female, and 14.9% were male. As many as 63.2% of students aged 18-22 years. The region of origin of the university from WIR by 70%, EIR by 27.4%, and CIR by 2.6%. Medicine was the major at 33.6%, midwifery at 33%, pharmacy at 27.5%, and nursing at 5.8%. As many as 61.3% of students got knowledge about antibiotics from academics as shown in Table 1.

Table 1. Characteristics of participants

Characteristic	n	%	Characteristic	n	%
Gender			Major		
Male	79	14.9	Medicine	178	33.6
Female	451	85.1	Midwifery	175	33
Age (Years)			Pharmacy	146	27.5
18-22	335	63.2	Nursing	31	5.8
23-27	139	26.2	Sources of Information about Antibiotics		
28-32	22	4.2	Academic	325	61.3
33-37	18	3.4	Journal Article	116	21.9
38-42	9	1.7	Television	2	0.4
>=43	7	1.3	Social Media/Internet	80	15.1
Regional			Other	6	1.1
West Indonesia region (WIR)	371	70	Never	1	0.2
Central Indonesia region (CIR)	145	27.4			
East Indonesia region (EIR)	14	2.6			

There are ten questions to assess the level of knowledge of respondents. Most (93%) medical, midwifery, nursing, and pharmacy students have a good level of knowledge. There are no students who have a low level of knowledge. The average score for student knowledge is 8.51, with a standard deviation of ±1.21 as presented in Table 2. More than 50% of students answered all knowledge questions about antibiotics correctly. Table 3 shows 12 questions to assess student attitudes regarding antibiotic use and resistance. The average score of student attitudes is 46.65, with a standard deviation of ±6.6. Most medical, midwifery, nursing, and pharmacy students had a positive attitude of 49.81%, 43.78% neutral, and 6.41% negative. Based on the results of the Mann-Whitney and Kruskall Walis tests, there were differences between age, majors, and sources of information about antibiotics on students' knowledge and attitudes towards antibiotic resistance ($p>0.05$).

There were no differences between gender and region in students' knowledge and attitudes toward antibiotic resistance ($p<0.05$) as shown in Table 4.

Table 2. Participants' knowledge of antibiotics among medical, midwifery, pharmacy, and nursing students

	Questions	Respondents answer Correct N (%)	Wrong N (%)	Mean ± SD	Level of knowledge Poor (<50%)	Moderate (50-70%)	Good (>70%)
1.	Are there bacteria in the human body that are good for our health?	510 (96)	20 (4)	8.51 ± 1.21	0 (0%)	37 (6.99%)	493 (93.01%)
2.	Can antibiotics inhibit/kill bacteria?	517 (97)	13 (2)				
3.	Can antibiotics inhibit/kill viruses?	322 (61)	208 (39)				
4.	Is Amoxicillin an antibiotic	527 (99)	3 (1)				
5.	Antibiotics must be consumed according to the amount prescribed by the doctor	527 (99)	3 (1)				
6.	One of the mechanisms of action of antibiotics is to inhibit the synthesis of the bacterial cell wall	516 (97)	14 (3)				
7.	Antibiotic resistance causes the body's protection to weaken, so bacteria that are beneficial to health become a source of disease	379 (71)	151 (28)				
8.	Antibimicrobial-resistant organisms are found in humans, animals, food, plants, and the environment (in water, soil, and air)	485 (92)	45 (8)				
9.	Someone who has the flu can be given antibiotics immediately	412 (78)	118 (22)				
10.	Antibiotics can reduce fever	314 (59)	215 (41)				

Table 3. Attitudes of participants regarding the use and resistance of antibiotics among students of the doctor, midwifery, pharmacy, and nursing professions

Respondents answer											Attitude		
SA	%	A	%	D	%	DA	%	TD	%	Mean±SD	Positive 80%-100% (48-60 poin)	Neutral 60-79% (36-47 poin)	Negative <60% (<36 poin)
Question 1. Antibiotics can be purchased directly without a doctor's prescription if there is a fever.													
24	4.53	49	9.25	46	8.68	114	21.51	297	56.04	46.65±6.6	264 (49.81%)	232 (43.78%)	34 (6.41%)
Question 2. The misuse and overuse of antibiotics and poor infection prevention and control accelerate antibiotic resistance.													
271	51.13	137	25.85	61	11.51	40	7.55	21	3.96				
Question 3. Never share or use leftover antibiotics													
332	62.64	111	20.94	47	8.87	20	3.77	20	3.77				
Question 4. Antibiotics can only be prescribed when needed according to current guidelines													
331	62.45	145	27.36	26	4.91	14	2.64	14	2.64				
Question 5. Antibiotic resistance occurs naturally, but the process can be accelerated if there is an abuse of antibiotics in humans and animals													
201	37.92	180	33.96	96	18.11	33	6.23	20	3.77				
Question 6. Antibiotic resistance occurs when bacteria change over time and no longer respond to medications, making infections more difficult to treat.													
237	44.72	188	35.47	64	12.08	26	4.91	15	2.83				
Question 7. As cases of disease caused by bacteria increase, antibiotics become less effective and more difficult to cure.													
101	19.06	153	28.87	127	23.96	102	19.25	47	8.87				
Question 8. If antibiotics are prescribed according to the doctor's prescription and the disease has not healed, the patient can buy antibiotics again													
27	5.09	72	13.58	966	18.2	137	25.85	198	37.36				
Question 9. Antibiotic resistance is one of the greatest threats to global health, food security, and development today													
192	36.23	198	37.36	86	16.23	33	6.23	21	3.96				
Question 10. Antibiotic resistance leads to more extended hospital stays, higher medical costs, and increased mortality													
193	36.42	149	28.11	106	20.00	49	9.25	33	6.23				
Question 11. Antibiotic resistance can affect anyone of all ages and in any country.													
286	53.96	171	32.26	45	8.49	12	2.26	16	3.02				
Question 12. As health professionals can prevent and control antibiotic resistance by ensuring the health of themselves and their environment													
312	58.87	159	30.00	33	6.23	9	1.70	17	3.21				

Abbreviations: strongly agree (SA); agree (A); doubtful (D); don't agree (DA); totally disagree (TD)

Based on the results of multivariate analysis as shown in Table 5, there was a relationship between age ($p=0.012$), major ($p=0.000$), source of information ($p=0.013$), towards knowledge and attitudes about antibiotics ($p<0.05$). The R square coefficient value indicates that gender, age, region, major, and source of knowledge about antibiotics affect 8.9% of the knowledge variable, while the rest is influenced by other

variables. Gender, age, region, major, and source of knowledge about antibiotics affect 8.5% of the attitude variable, while the rest are influenced by other variables.

Table 4. Comparison of knowledge and attitude levels based on respondent characteristics

Variable	N	Knowledge		Attitude	
		Mean ± SD	p-value	Mean ± SD	p-value
Gender					
Male	79	8.66 ± 0.986	0.105	47.72 ± 5.079	0.530
Female	451	8.48 ± 1.241		46.23 ± 6.823	
Age (Years)					
18-22	335	8.36 ± 1.227	0.012	45.44 ± 6.282	0.000
23-27	139	8.75 ± 1.117		47.65 ± 6.590	
28-32	22	8.50 ± 1.225		47.95 ± 6.543	
33-37	19	9.00 ± 0.840		51.89 ± 3.530	
38-42	9	8.78 ± 1.716		47.67 ± 13.444	
>=43	7	9.43 ± 0.535		50.86 ± 4.100	
Regional					
West Indonesia region	371	8.56 ± 1.157	0.168	46.41 ± 6.473	0.758
Central Indonesia region	145	8.39 ± 1.324		46.51 ± 7.127	
East Indonesia region	14	8.29 ± 1.204		47.07 ± 4.682	
Major					
Medicine	178	8.84 ± 0.996	0.000	47.84 ± 6.498	0.000
Midwifery	175	8.21 ± 1.396		45.05 ± 7.469	
Pharmacy	146	8.54 ± 1.103		46.73 ± 5.564	
Nursing	31	8.10 ± 1.136		45.16 ± 4.776	
Sources of information about Antibiotics					
Academic	325	8.62 ± 1.136	0.013	47.35 ± 6.342	0.001
Journal article	116	8.59 ± 1.252		45.79 ± 6.639	
Television	2	8.50 ± 0.707		49.00 ±4.243	
Social media/Internet	80	7.95 ± 1.301		43.49 ± 6.897	
Other	6	8.17 ± 1.169		49.00 ± 5.621	
Never	1	9 ± -		48 ± -	

Table 5. Multivariate analysis results

Variable	Knowledge				Attitude			
	Regression Coefficient	Standar Error	p-value	R Square	Regression Coefficient	Standar Error	p-value	R square
Constanta	8.656				45.321			
Gender	-0.258	0.153	0.093	0.089	-1.882	0.842	0.026	0.085
Age	0.043	0.010	0.000		0.250	0.055	0.000	
Regional	-0.210	0.100	0.037		-0.046	0.551	0.933	
Major	-0.188	0.059	0.001		-0.735	0.323	0.023	
Sources of knowledge about antibiotics	-0.141	0.047	0.003		-0.807	0.256	0.002	

The high level of antimicrobial resistance (AMR) in Indonesia is caused by the inappropriate use of antimicrobials (AM) in health services [12]. Health professionals play an important role in the provision of antibiotics, education, and promotion and advocacy for the use of antibiotics [11]. Indonesia's health profession education stage is a continuation after completing undergraduate education and the final stage before someone becomes a health professional. The rational use of antimicrobials is based on the knowledge and attitudes of the health profession and the public regarding antimicrobials. Overall, student knowledge about antibiotics is in a good category at 93%. These results are better than studies in Ethiopia, Nigeria, Yemen, East Africa, Jordan, and Ghana [1], [16]–[20]. Even though students' overall knowledge was in a good category, there were still students who answered incorrectly. As many as 39.25% of students responded that antibiotics could inhibit or kill viruses. This understanding is still common among students. These results were also found in other studies [1], [19], [21]. If you don't get the proper knowledge, then in the future, students who will become health professionals, especially doctors, will be given antibiotics for viral infections. This is also related to the question of whether someone with the flu can be immediately given antibiotics. As many as 22.3% of students answered that antibiotics could be used for the flu. More than 60% of students answered all questions about antibiotics correctly. However, as many as 59.25% of students believe antibiotics can reduce fever. This result is higher than studies in Rwanda (15%) and Trinidad and Tobago (18.5%) [22], [23]. These results indicate that these students could not distinguish between the use of antibiotics to treat flu and fever. This may also result from differences in the depth of academic training and learning at the clinical stage. The medical

curriculum of various universities in various regions in Indonesia is different. This also affects students' knowledge and background about antibiotic resistance [24].

Most students (61%) get information from academic sources. In this study, there was a difference between sources of information about antibiotics on knowledge (p=0.013) and students' attitudes toward antibiotic resistance (p=0.001). Antimicrobial stewardship education should be included at an early stage in undergraduate training. In this study, all students had graduated and were currently pursuing the professional stage. Al-Taani et al. found that a high percentage of students receiving instruction and assessment for the careful use of antibiotics and the management of infections perceived their educational methods as highly useful or helpful [19]. A survey of health profession students in Rwanda found that more than 60% of students discussed antibiotic resistance in their curriculum [22]. The Infectious Diseases Society of America has developed an antimicrobial stewardship program such as Clinical Vignettes; This approach has been reported to increase student acceptance of antibiotic stewardship approaches and encourage interprofessional collaboration [25]. Therefore, it is critical to determine whether institutions are effectively educating medical, nursing, and pharmacy students on the appropriate use of antibiotics to alter the impact of resistance on patient health [19].

Based on the results of this study, there were still students who did not agree to share the remaining antibiotics, namely D (8.87%), DA (3.77%), and TD (3.77%). These results are similar to those in Sudan and Nigeria [24], [26]. Students think that antibiotics previously prescribed by their doctor can treat infections that they feel and those of others in the future. This correlates with buying antibiotics freely. From the attitude questionnaire, it can be seen that more than 13% of students agree to buy antibiotics freely (self-medicated). This is in line with a study that showed that more than 18% of respondents would buy additional antibiotics themselves if the antibiotics prescribed by a doctor did not provide a cure. In Tanzania, 25.5% also prefer to use over-the-counter antibiotics to treat minor illnesses rather than see a doctor [27]. If this is left until the student passes the clinical phase, self-medication by healthcare professionals may be a sign that healthcare professionals are neglecting their health. This is a serious problem for both patients and professionals [28]. Residual antibiotics are among the most frequently stockpiled antibiotics in low-income countries, suggesting that frequent non-adherence to anti-infective therapy is associated with increased risk of co-administration [24].

Based on the results of the Kruskal-Wallis test, we found statistically significant differences in knowledge and attitude scores between majors (p=0.001). Medical profession students achieved better knowledge and attitude scores than other health profession students. There are several factors behind it. The primary source of differences is the curricula and scope of practice variation within their courses. Various departments in this study had pharmacology courses in their curricula, but the depth and frequency of exposure differed [1]. Medical students are more often exposed to the management of infectious diseases. The striking difference is in the graduate competency standards of medical, nursing, pharmacy, and midwifery students. In addition, every university in Indonesia has a different curriculum.

Antibiotics such as nine-edged swords and their proper use will affect the results and inhibit resistance, or vice versa. Initial treatment is usually empiric and treatment regimens are adjusted based on culture results and sensitivity testing. Doctors must choose the type of drug, route of administration, dosage, and dosing interval. They can be modified multiple times during processing [29]. However, from the results of this study, it was found that the attitudes of students regarding the use of antibiotics in cases of increasing bacterial infections, many were still hesitant and even disagreed, reaching more than half of the total respondents (52.08%). More than 10% of respondents do not think antibiotic resistance is the biggest threat to global health, food security, and development. In contrast, another study by Jairoun showed that 47.8% of medical students in the UAE believe that antibiotic resistance is a national problem [30].

4. CONCLUSION

Overall, there are differences in knowledge and attitudes among medical, pharmacy, nursing, and midwifery students. Age, major, source of information affects knowledge and attitudes about antibiotics. The majority of students have good knowledge and a positive attitude. However, what is of concern is that there are still students who need to understand the use, benefits, and administration of antibiotics. In addition, there are still perceptions that contribute to negative behavior scores. A little knowledge and wrong practice can have an enormous impact on antibiotic resistance.

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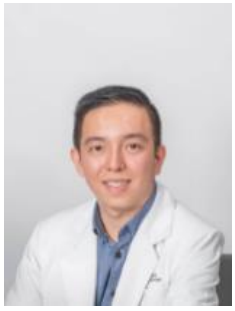

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