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The Relationship Between Knowledge and Behavior Toward Antibiotic Stewardship Among Healthcare Workers at Referral Hospital, West Borneo

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ABSTRACT

Irrational use of antibiotics is currently still a major health problem in the world. Worldwide around 50% of medicines are sold, distributed, and given to patients inappropriately. Irrational use of antibiotics can trigger antibiotic resistance. Knowledge and behavior regarding antibiotic stewardship are important in preventing antibiotic resistance. This cross-sectional research was conducted to determine the relationship between knowledge and behavior regarding antibiotic stewardship among healthcare workers. This study's 58 respondents were general practitioners/dentists, specialist doctors/dentists, and pharmacists. The instrument used in this study was a valid and reliable questionnaire. The data analysis used was univariate analysis and Spearman analysis with IBM SPSS Statistics 26 and significance set as $p>0.05$. In this study, the results showed that the majority of respondents worked as specialist doctors/dentists (53.44%), aged in the range 26-35 years (36.20%), of the type female (58.62%), have work experience for more than 10 years (39.65%) and all of the surveyed respondents have good knowledge and behavior (100%). Spearman's rank analysis showed no significant relationship between knowledge and antibiotic stewardship behavior ($p>0.05$). The high level of expertise of respondents does not significantly affect the level of behavior because it can influence several factors, both internal and external. Further study is needed to identify other factors influencing antibiotic stewardship and rational use of medicine.

INTRODUCTION

Irrational antibiotic stewardship is a major challenge facing health systems across the world. Around the world, more than 50% of all antibiotics are dispensed, sold, and inappropriately prescribed. Irrational antibiotic stewardship can cause antibiotic resistance. The surveillance results by the Antimicrobial Resistance Control Committee under the Ministry of Health in 2017 showed that 60-80% of antibiotics were given irrationally (Mardhia *et al.*, 2022). Furthermore, the World Health Organization (WHO), in the Antimicrobial Resistance: Global Report on Surveillance in 2022, reported that Southeast Asia ranks at the top of the highest number of antibiotic resistance cases in the world (World Health Organization, 2022). Antibiotic resistance is a condition in which bacteria change over time so that they are resistant and not susceptible to drugs designed

to kill them (Marston *et al*., 2016). Antibiotic resistance can make infections more difficult to treat, as well as increase disease severity, increase the risk of disease spread and death (Handayani, Siahaan and Herman, 2018). It is estimated that by 2050, antibiotic resistance will have a negative impact on the global economy, particularly in developing countries, unless more proactive action is taken to address the global threat (World Bank, 2017).

Knowledge and behavior regarding antibiotic stewardship play a crucial role in preventing antibiotic resistance, as they minimize the irrational use of antibiotics. However, according to Herawati *et al*., a study conducted on health workers at Surabaya Private Hospitals and District Hospitals in Mojokerto and Pasuruan, showed that 19% of respondents had lower scores of knowledges about antibiotic stewardship, and 39% of respondents had low scores about their belief in antibiotic stewardship (Herawati *et al*., 2021). Moreover, research conducted on doctors in Riyadh, Saudi Arabia, showed that 44.8% of doctors were unsure about their knowledge of antibiotic stewardship (Baadani *et al*., 2015). This low belief and knowledge level will greatly influence the increase in antibiotic resistance.

Accordingly, antibiotic stewardship is needed. Controlling antibiotic resistance is the shared responsibility of all people around the world, especially for health workers. Antibiotic stewardship aims to suppress resistance, prevent toxicity, and reduce costs due to the unwise use of antibiotics (Ministry of Health Republic Indonesia., 2021). Efforts to reduce antibiotic resistance are not primarily about restricting access to antibiotics but ensuring that antibiotics are used appropriately (Ministry of Health Republic Indonesia., 2021). Apart from that, health workers, especially doctors and pharmacists, must also collaborate. Collaborative practice between health workers plays an important role in preventing antibiotic resistance. In one study, there was a 34% risk reduction in the average level of antibiotic use with increased collaborative practice (Dukhovny *et al*., 2019).

One of the strategies carried out by the Indonesian government to control antibiotic resistance is to raise understanding and awareness of antibiotic resistance, especially among health workers, as well as increasing knowledge and scientific evidence (Coordinating Minister for Economic Affairs, 2021). However, currently, most factors contributing to antibiotic resistance are caused by the irrational use of antibiotics (Baadani *et al*., 2015).

Dr. Soedarso Hospital is a national referral hospital in West Kalimantan, and based on our knowledge, there are no data available concerning the knowledge and behavior of their health workers regarding antibiotic stewardship. Thus, we conducted the study to demonstrate the relationship between knowledge and behavior of West Borneo Referral Hospital healthcare workers towards antibiotic stewardship.

METHODS

Materials

The instrument used was a closed questionnaire modified by Herawati *et al*. whose validity and reliability were tested after being modified (Herawati *et al*., 2021). The questionnaire used in this research consists of two parts, namely the knowledge section and the behavior section. The knowledge section consists of 25 question items with “correct” or “incorrect” answers, and the behavioral section consists of 24 statement items, which are answered using a Likert scale (16 statements answered by doctors and pharmacists, 4 statements answered only by doctors, and 4 statements answered only by pharmacists. The values shown on the Likert Scale for positive statements use "always" (score 3), "rarely" (score 2), and "never" (score 1). In contrast, for negative statements, the values from the Likert scale are applied in reverse, with 1 representing always and 3 representing never. This questionnaire is divided into several topics. The knowledge section is divided into 3 topics, i.e., the causes of antibiotic resistance, controlling antibiotic resistance, and the impact of antibiotic resistance. The behavior questionnaire is classified into four topics, i.e., performance of Antimicrobial Resistance Control Program (ARCP), controlling antibiotic prescribing, performance of preventing the spread of resistant microbes, and good antibiotic prescribing.

Methods

This study was descriptive and observational analytic with a cross-sectional approach. The study was conducted at Dr. Soedarso Hospital, Pontianak in July-August 2023. The inclusion criteria were general practitioners/dentists, specialist doctors/dentists, and pharmacists on duty at the hospital. Dr. Soedarso, Pontianak. A total of 58 respondents were obtained using consecutive sampling techniques, which were then divided proportionally into each profession, consisting of

19 general practitioners/dentists, 31 specialist doctors/dentists, and 8 pharmacists. The independent variable in this study is the level of health workers' knowledge regarding antibiotic stewardship, and the dependent variable used in this study is the level of health workers' behavior.

Data collection was carried out after giving informed consent to respondents. Collected data were analyzed by SPSS Statistics 26 (IBM Corp., Chicago). The data analysis used was univariate analysis and Spearman analysis. Univariate analysis was used to determine the characteristics of respondents and the frequency and percentage of respondents' answers. Spearman analysis was conducted to determine the association between knowledge and behavior in antibiotic stewardship. This study was carried out after approval by the Health Research Ethics Committee, RSUD Dr. Soedarso Pontianak by issuing ethical permit number 55/RSUD/KEPK/VI/2023.

RESULTS AND DISCUSSION

Frequency distribution of respondent characteristics

A total of 58 respondent health workers from five professions constituted the study sample. The results from the study indicate that the majority of respondents were specialist doctors/dentists 53.44%, women 58.62%, aged 26 – 35 years old 36.20%, 39.65% of the respondents had been practicing in their profession for 10 years or less, and 56.89% had attended ARCP training. The complete result in this section is presented in Table 1.

Some of the respondents in this study work as specialist doctors. One factor that influences knowledge and behavior is a person's level of education. The higher a person's level of education, the better the knowledge they have, and vice versa (Damayanti and Sofyan, 2022). In this study, the majority of respondents were in the 26-35 year range. A person's age also influences a person's ability to understand and their mindset (Putra and Podo, 2017).

The respondents in this study were mostly female. Gender does not significantly influence the results of this study and is only used as additional data. Gender cannot influence the performance of health workers because both women and men have the same opportunity to receive knowledge and apply behavior (Pradana, Widiyati and Arwani, 2020). Most of the respondents in this study had worked for a long time in their position. The longer a person's working period, the more work experience they have, and this will influence the level of knowledge, behavior, and skills of health workers in their work (Purwaningsih and Widiyaningsih, 2019).

Table 1. Characteristics respondents (n=58)

No.	Characteristics	Number (n)	Percentage (%)
1.	Profession		
	a. General practitioner/dentist	19	32.75
	b. Specialist doctors/ dentist	31	53.44
	c. Pharmacist	8	7.25
2.	Age		
	a. 26 -35 Year	21	36.20
	b. 36 - 45 Year	13	22.41
	c. 46 - 55 Year	14	24.13
	d. >55 Year	10	17.24
3.	Gender		
	a. Male	24	41.32
	b. Female	34	58.62
4.	Working Experience (Year)		
	a. 1-5	16	27.58
	b. 6-10	19	32.75
	c. >10	23	39.65
5.	ARCP Training		
	a. Yes	33	56.89
	b. Never No	25	43.10

ARCP, Antimicrobial Resistance Control Program.

Table 2. Knowledge and behavior of health worker's regarding antibiotic stewardship

	General doctor/ dentist (n=19)		Specialist doctor /dentist (n=31)		Pharmacist (n=8)		Total	
	n	%	n	%	n	%	N	%
Knowledge level								
Good	19	100	31	100	8	100	58	100
Fair	0	0	0	0	0	0	0	100
Poor	0	0	0	0	0	0	0	0
Behavior level								
Good	19	100	31	100	8	100	58	100
Fair	0	0	0	0	0	0	0	0
Poor	0	0	0	0	0	0	0	0

Table 3. Knowledge of each health worker based on topics in the knowledge questionnaire

Knowledge Level	General doctor/ dentist (n=19)		Specialist doctor /dentist (n=31)		Pharmacist (n=8)		Total	
	N	%	n	%	n	%	n	%
Knowledge of Causes of Antibiotic Resistance								
Good	19	100	31	100	8	100	58	100
Fair	0	0	0	0	0	0	0	0
Poor	0	0	0	0	0	0	0	100
Knowledge of Controlling Antibiotic Resistance								
Good	19	100	31	100	8	100	58	100
Fair	0	0	0	0	0	0	0	0
Poor	0	0	0	0	0	0	0	100
Knowledge of the Impact of Antibiotic Resistance								
Good	19	100	31	100	8	100	58	100
Fair	0	0	0	0	0	0	0	0
Poor	0	0	0	0	0	0	0	100

In addition, most of the respondents in this study had attended ARCP training, which greatly influenced the level of knowledge and behavior of respondents in this study. ARCP training is one of the efforts launched by the government to prevent antibiotic resistance. Research conducted by Xu *et al*. (2022) showed routine training influences knowledge and behavior in antibiotic prescribing (Xu *et al*., 2022).

Knowledge and Behavior of Healthcare Workers Regarding Antibiotic Stewardship

In this study, based on all the questions contained in the questionnaire, the results showed that all respondents had good knowledge and behavior regarding antibiotic stewardship (100%) (Table 2). In this study, the questionnaire results were also measured in several parameters. In the knowledge section, all respondents know each parameter well (Table 3). However, in the behavior part, there are still some respondents who have a sufficient level of behavior or even less in each parameter. The second parameter, which discusses controlling the use of antibiotics, shows that there are still many general practitioners/dentists who behave adequately (73.68%), and even among specialist doctors/dentists, there are still those who have inadequate levels of behavior (25.80%)., Several factors may contribute to this discrepancy. First, clinical autonomy and reliance on personal experience may lead some specialists to deviate from established guidelines, especially in complex or uncertain clinical situations. Second, diagnostic limitations—such as delayed access to laboratory or microbiological results—often prompt empirical antibiotic use, which may not align with stewardship principles. Third, time constraints and high patient loads in tertiary settings may limit opportunities for guideline-based reflection. Lastly, external pressures from patients or families expecting antibiotic prescriptions can also influence prescribing behavior, even when not clinically indicated. These factors underscore the need for ongoing training, accessible institutional guidelines, and interprofessional collaboration to reinforce

appropriate antibiotic use. Then, the third parameter, which discusses the principles of preventing the spread of resistant microbes, shows that the majority of general practitioners/dentists and specialist doctors/dentists have a good level of behavior. However, all pharmacists have poor behavior in this parameter (100%). Pharmacists' poor behavior in preventing the spread of resistant microbes may be due to limited patient interaction and minimal involvement in infection control activities, resulting in low awareness and perceived responsibility. Lack of interdisciplinary collaboration and unclear roles may also contribute. Finally, in the fourth parameter, which discusses the wise use of antibiotics, the majority of health workers have adequate behavior (65.52%) (Table 4).

This study identified that all of the health workers in Dr. Soedarso Hospital, Pontianak, have good knowledge of antibiotic stewardship (Table 3). This finding is similar to research conducted by Karasneh *et al*. and Al-Taani *et al*., which showed that general practitioners/ dentists, specialist doctors/dentists, and pharmacists have good knowledge regarding antibiotic stewardship and antibiotic resistance (Karasneh *et al*., 2021; Al-Taani *et al*., 2022). Research conducted by Xu *et al*. (2021) showed that routine training of ARCP influenced knowledge and behavior in antibiotic prescribing (Xu *et al*., 2021). Good knowledge among health workers about antibiotic stewardship is also very important to prevent ineffective treatment, increased risk to patient safety, and the spread of resistance (Rukmini, Siahaan and Sari, 2019).

This study also assessed respondents' knowledge based on three main topics, i.e., causes of resistance, control of resistance, and the last topic regarding the impact of resistance. The results obtained for the three topics from each profession show good knowledge of the three topics related to the causes, control, and implications of antibiotic resistance. The high level of knowledge each profession can be caused by the fact that some respondents are specialist doctors, and the higher a person's level of education will have an effect on the higher their knowledge(Damayanti and Sofyan, 2022) . Furthermore, most respondents have >10 years of work experience, and most respondents have attended ARCP training, which makes the knowledge of the respondents good (Xu *et al*., 2021).

The results of the respondents' questionnaire answers in this parameter showed good results, but many respondents were incorrectly in answering questions regarding the use of antibiotic combination therapy; only 48.27% of respondents answered correctly. The use of combination antibiotics is needed to increase the activity of antibiotics in specific infections (synergistic or additive effect), such as Multidrug-resistant organisms (MDRO) or TB infections. Apart from that, it can also be used to treat cases of life-threatening infections (septic shock), and the cause of the bacteria is unknown

Table 4. Behavior of each health worker based on topics in the behavior questionnaire

Behavior Level	General doctor/ dentist (n=19)		Specialist doctor /dentist (n=31)		Pharmacist (n=8)		Total	
	N	%	n	%	n	%	n	%
First Topic: Performance Antimicrobial Resistance Control Program (ARCP)								
Good	19	100	31	100	8	100	58	100
Fair	0	0	0	0	0	0	0	0
Poor	0	0	0	0	0	0	0	0
Second Topic: Controlling Antibiotic Prescribing								
Good	5	26.3	4	12.3	8	100	17	29.3
Fair	14	73.6	19	61.3	0	0	33	56.9
Poor	0	0	8	25.8	0	0	8	13.8
Third Topic: The Performance of Preventing the Spread of Resistant Microbes								
Good	8	42.1	16	51.6	0	0	24	41.4
Fair	8	42.1	7	22.5	0	0	15	25.9
Poor	3	15.8	8	25.8	8	100	19	32.8
Fourth Topic: Good Antibiotics Prescribing								
Good	3	15.8	16	51.8	1	12.5	20	34.5
Fair	16	83.2	15	48.3	7	87.5	38	65.5
Poor	0	0	0	0	0	0	0	0

(Ministry of Health Republic Indonesia., 2021). The use of combination antibiotics is considered for the reason of broadening the spectrum of therapeutic activity, obtaining synergism, and preventing resistance. The use of combination antibiotics with different mechanisms of action is effective in preventing resistance (Prawesti, Mursiany and Walid, 2022). Most respondents answered incorrectly because some felt that there was still little evidence of the success of antibiotic combination therapy for cases of bacterial infection other than Mycobacterium tuberculosis (Fauzia, 2017). Apart from that, health workers consider the effects of using antibiotic combinations, such as increased costs, higher risk of drug toxicity, and superinfection with more resistant bacteria. However, on the other hand, these results are similar to research conducted by Wushouer *et al*. (2020), which showed that doctors with a higher level of knowledge about antibiotics were less likely to prescribe combinations of antibiotics to patients (Wushouer *et al*., 2020).

The results of this study reveal that all respondents have good behavior regarding antibiotic stewardship. This is similar to research conducted by Martina Barchitta *et al*. (2021), which shows that all health workers have prescribed and provided advice on treating infections or using antibiotics wisely (Wushouer *et al*., 2020). In this study, the level of behavior was also measured based on four topics i.e., performance of antimicrobial resistance control program, controlling antibiotic prescribing, performance of preventing the spread of resistant microbes, and good antibiotic prescribing.

In the first topic, to examine the level of respondent behavior in the realization of ARCP, such as providing explanations regarding the use of antibiotics to patients, collaborating in the use of antibiotics, and providing and recommending antibiotics according to the results of laboratory and microbiology examinations. All respondents have good behavior in the performance ARCP. Doctors and pharmacists are skilled at providing information about antibiotics to patients and can collaborate and coordinate in the administration of antibiotics to patients. Collaborative practice between health workers plays an important role in preventing antibiotic resistance. In one study, there was a 34% risk reduction in the average level of antibiotic use with increased collaborative practice (Dukhovny *et al*., 2019).

The second topic discusses controlling the use of antibiotics in hospitals. This topic aims to observe the behavior of respondents in controlling the use of antibiotics in hospitals, based on general guidelines for antibiotics, and the formulary in providing antibiotics to patients. All pharmacists have good behavior in controlling antibiotic prescribing in hospitals by always using the hospital formulary before providing antibiotics to patients. Meanwhile, general practitioners/dentists and specialist doctors/dentists answered that they sometimes never even use antibiotic usage guidelines when administering antibiotics. Several respondents reported that there were no antibiotic usage guidelines in the hospital. Antibiotic usage guidelines play a valuable role in antibiotic rational use. Research conducted by Rosdiana *et al*. showed that there is an increase in the percentage of rational use of antibiotics after the implementation of antibiotic usage guidelines in the hospital (Rosdiana *et al*., 2018).

The third topic discusses preventing the spread of resistant microbes. The majority of general practitioners/dentists and specialist doctors/dentists have good behavior, but there are still some who have fair or even poor behavior. This is different from pharmacists; in this topic, all pharmacists have poor behavior. All pharmacists showed poor behavior in preventing the spread of resistant microbes, likely due to limited involvement in infection control activities and lack of role clarity. Inadequate integration into ARCP teams and minimal training on infection prevention may also contribute. Strengthening interprofessional collaboration and emphasizing pharmacists' roles in infection control are needed to address this gap. All health workers should be able to collaborate in this ARCP, so it is hoped that not only doctors will recommend room cleaning to the infection prevention and control team, but pharmacists can also play a role in this matter. Room cleaning that was previously occupied by patients infected with resistant bacteria may decrease the risk of subsequent infection or colonization with the resistant bacteria (Mitchell *et al*., 2015).

The fourth topic discusses the wise use of antibiotics. showed that the majority of respondents had fair behavior. Good antibiotic prescribing is important because it can reduce the spread of antibiotic resistance (Stegemann, 2023). The large number of health workers who

still behaved appropriately in this study was mostly due to concerns that they were unable to recognize bacterial infections, so all patients with fever were given antibiotics. Health workers feel it is better to make a mistake in prescribing antibiotics for a disease caused by a virus than not prescribing an antibiotic for a disease caused by bacteria, without considering the impact. This often occurs in outpatients because diagnostic facilities are limited, and doctors cannot always monitor the patient when they go home (Farida *et al*., 2008). Apart from that, in cases where the diagnosis is still unclear, health workers do not receive a detailed explanation regarding the dose, route, interval, choice of type, and duration of antibiotic therapy. This is different from diseases that already have a definite diagnosis because it is stated in detail in the antibiotic manual regarding dosage, route, interval, choice of type, and duration of antibiotic therapy.

In developing countries like Indonesia, the types of diagnostic examinations and health insurance coverage are very limited, so that a definitive diagnosis can be delayed for several days. Guidelines for recognizing indications for empiric antibiotic therapy that depend on the clinical situation (not diagnosis) will make it easier for doctors to make the right decision regarding whether or not to give antibiotics before a definite diagnosis is made (Farida *et al*., 2008).

Statistical analysis of the relationship between knowledge and behavior of health workers regarding antibiotic stewardship

Determining the hypothesis test that will be used in research can be done after a data normality test is carried out to test the normality of the data, so that the data can be analyzed parametrically or non-parametrically. The data in this research have been tested for normality, and the results obtained show that the data tested do not show a normal distribution, so the data were analyzed non-parametrically using Spearman's rank analysis. The results of the statistical test analysis of the relationship between respondents' level of knowledge on antibiotic stewardship behavior can be seen in Table 5, which shows the results of data analysis obtained from 58 respondents. The Spearman's rank correlation test revealed a p-value of 0.220 (>0.05), indicating no statistically significant relationship between knowledge and behavior regarding antibiotic stewardship. However, this finding should be interpreted with caution. All respondents were found to have high levels of knowledge and behavior, resulting in a ceiling effect, where lack of variability in the data may obscure any actual relationship. This is similar to research conducted by Mardiati *et al*. in 2021, which showed that there was no significant relationship between knowledge and attitudes towards the use of antibiotics (Mardiati *et al*., 2021). The results of this study are also similar to the statement of Irasti and Widodo (2017), which stated that good knowledge is not necessarily followed by good behavior because good behavior is not only influenced by knowledge but is influenced by other factors (Irasti and Widodo, 2017). Apart from that, Notoatmodjo explained in certain situations, stimulation can immediately lead to action, meaning that a person can act or behave without realizing it. First of all, it mainly depends on the meaning of the stimulus one receives, so that a person's actions do not have to be based on knowledge (Notoadmodjo, 2012).

The relationship between knowledge and antibiotic stewardship behavior can also be influenced by various other factors, ranging from internal to external factors. Internal factors that can influence this are the personal experience of health workers and the perception of health workers regarding the prognosis of the disease, and they are often required to leave a good impression by complying with patient requests (Mardiati *et al*., 2021). External factors that influence this antibiotic stewardship behavior can come from patients and families who put pressure on doctors to prescribe antibiotics because people think that all diseases can be cured with antibiotics (Notoadmodjo, 2012).

Table 5. Results of statistical tests on the relationship between knowledge and behavior

		Knowledge	Behavior
Knowledge	Correlation coefficient	1.000	.164
	Sig. (2- tailed)		.220
	N	58	58
Behavior	Correlation coefficient	.164	1.000
	Sig. (2- tailed)	.220	
	N	58	58

CONCLUSIONS

Based on the research results, it was concluded that 100% of the health workers at West Borneo referral hospital have a good level of knowledge and behavior regarding antibiotic stewardship. Antibiotic stewardship is very important to improve good antibiotic prescribing, which includes choosing the type of antibiotic, dose, interval, route, and duration of administration. The results showed that there was no significant relationship between knowledge and behavior regarding antibiotic stewardship.

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CONFLICT OF INTEREST

We declare there is no conflict of interest in this study.

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