

# Impact of Educational Programs on the Knowledge and Attitude of Healthcare Professionals in Antimicrobial Stewardship

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## ABSTRACT

**Introduction:** The main concern related to antimicrobial use is the increasing incidence of resistance. **Objective:** This study aims to assess the impact of educational programs on the knowledge, attitudes, and practices of healthcare providers concerning antimicrobial Stewardship (AMS) in hospitals. **Materials and Methods:** This is a quasi-experimental study with one group pretest-posttest design. Health professionals were requested to complete an online questionnaire before and after educational programs. This is a 2-day workshop conducted through the virtual zoom platform. **Results:** Regarding the basic prior knowledge, all respondents completely agree that inappropriate use of antibiotics can lead to resistance, can lead to ineffective treatment and burdens patients with additional medical costs and majority agree that inappropriate use of antibiotics can worsen side effects (91.7%). Regarding familiarity of health professionals, very familiar/familiar with the term of antimicrobial stewardship (75.0%), term of antibiotic resistance (86.1%), term of DDD/DOT (52.8%), while the majority of health professionals were not familiar/not all familiar with the term of antibiogram (66.7%) and Gyssens (55.6%). About the effectiveness of antimicrobial stewardship, all respondents 100% answered that antimicrobial stewardship was effective in reducing resistance and health care costs, improving patient safety (97.2%) and only 11.11% answered not effective to improve outcomes. The level of knowledge of health professionals did not change significantly, but the perception increased significantly after the educational intervention,  $p$ -value<0.005. **Conclusion:** The educational program implemented is effective in improving the attitudes of health professionals about antimicrobial stewardship.

**Keywords:** Education, Antimicrobial stewardship, Knowledge, Attitude, Healthcare professional.

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## INTRODUCTION

Antimicrobials are very useful in saving lives, however, the consequences of improper use need to be considered.<sup>1</sup> The main concern related to antimicrobial use is the increasing incidence of resistance, which is manifested by an increase in the incidence of Clostridium Difficile Infections (CDI) and health care costs including those incurred from the side effects of its use.<sup>1,2</sup> Antimicrobial resistance, according to,<sup>3</sup> has increased the economic burden, and therefore, it is a growing global health problem that requires urgent attention. Several studies have

shown that more than half of the antibiotic prescriptions in Europe and the US are considered inappropriate.<sup>4</sup> The risk of increasing antibiotic resistance is a worrying condition and the situation is exacerbated in developing countries by its irrational use.<sup>5</sup>

A prospective cross-sectional study of knowledge, attitudes, and professional practice at Fitch Hospital in Ethiopia, with a sample of all healthcare professionals except laboratory technicians and radiologists, shows that from 107 respondents, 68.2% had good knowledge, 16% had a positive attitude towards fighting antibiotic resistance, and 78% had good practices.<sup>6</sup> The results of the KAP study on the control of antibiotic resistance among pharmacists, doctors, and hospital administrations show that the majority of respondents are familiar with the term “antibiotic resistance control” and it is considered necessary. Most pharmacists and



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doctors agree that antibiotics are overused in respondents' hospitals, however, they are more likely to think of antibiotic resistance as a local problem. Furthermore, pharmacists perceive restrictions as a rational way to control the overuse of antibiotics and doctors are less familiar with the Infectious Diseases Society of America (IDSA) guidelines and generally rely on infectious disease specialists. Most respondents strongly agree with stronger antimicrobial education,<sup>7</sup> this is evident in their responses in a study of nurses conducted in Florida that antibiotic resistance has become a local and countrywide problem. When administering or prescribing antibiotics, nurses worry about resistance and they agree that a more appropriate use could reduce resistance. Respondents lack knowledge of managing anaerobic infections and resistant gram bacteremia.<sup>8</sup>

Antibiotic management education for health professionals including medical students provides basic knowledge and facilities to support optimal prescription. Education using passive techniques is quite effective for increasing prescriber knowledge, while those using active techniques are more effective for changing prescribing behavior. Additionally, effective educational techniques are recommended to increase knowledge about antibiotics and improve their use.<sup>9</sup> A cross-sectional study in Shiraz, southern Iran, on knowledge, attitudes, and health professional practices in controlling antimicrobial resistance, reports that the majority of the respondents (88.1%) agree with the improvement of local guidelines, 94.4% consider that antibiotic education can help decrease antimicrobial resistance. Also, 72.2% believed that limiting antibiotic use will not disrupt good patient care. Antimicrobial resistance control requires more training and education for better performance in reducing resistance patterns.<sup>10</sup>

The implementation of health worker education programs in Egypt reportedly improves the knowledge, attitudes, and practices of health workers. However, there are no intervention studies have in Indonesia to improve the knowledge, attitudes, and practices of healthcare providers towards antimicrobial stewardship. Therefore, this study aims to assess the impact of educational programs on the knowledge, attitudes, and practices of healthcare providers concerning Antimicrobial Stewardship (AMS) in hospitals.

## MATERIALS AND METHODS

### Study design and participant

This is a quasi-experimental study with one group pre-test-post-test design conducted in August 2021 to determine the impact of education in increasing health professionals' knowledge and attitudes towards antimicrobial stewardship. The collaborating health care professionals include medical doctors, pharmacists, pharmaceutical technical experts, nurses, and laboratory analysts. Furthermore, all health care professionals that are willing to

participate were included and a workshop was held for 2 sessions on 2 consecutive days through the virtual zoom platform. This workshop was an initial program before preparing the automatic stop-order for antibiotics in hospitals, in the region of Central Java, Indonesia. Also, the trainers providing workshop materials have national certificates in antimicrobial resistance control.

Health professionals were requested to complete an online pretest questionnaire, which was delivered via chat rooms before the first workshop session began; they were given 20 min to finish the form before the link was disabled. After attending the second workshop, the same subject group was provided the same questionnaire to assess the impact of the workshop on boosting knowledge and attitudes concerning antimicrobial stewardship.

### Educational Workshop

This is a 2-day workshop conducted through the virtual chat room from Wednesday, August 18<sup>th</sup> to Thursday, August 19<sup>th</sup>, 2021. PowerPoint presentations and case scenarios are included in each 2-hr session and the trainers providing the materials have national certificates in antimicrobial resistance control. This workshop is an initial program before preparing the automatic stop-order antibiotics for pediatrics in hospitals, in the region of Central Java, Indonesia. Four materials were prepared, namely the basic principles of correct infection control; an overview of the implementation of the antimicrobial stewardship program at Dr. Sardjito General Hospital, Yogyakarta; the role of pharmacists in antimicrobial stewardship programs in hospitals; and how to evaluate the quantity and quality of antibiotic use.

### Ethical considerations

The study protocol was submitted to the ethics committee of the Faculty of Medicine, Gadjah Mada University KE/FK/0960/EC/2020 for approval. The healthcare professionals were asked to sign an electronic information agreement and were informed that their participation was voluntary, they have the right to withdraw, and that their responses would be kept confidential and anonymous.

### Statistical analysis

Data were analyzed using Statistical Packages for Social Science (SPSS) version 21. Descriptive analysis was performed using mean and Standard Deviation (SD) for continuous variables and percentages for qualitative variables. The Shapiro-Wilk test was used for testing the normality of the data and a  $p$ -value of  $> 0.05$  indicates a normally distributed continuous variable. Furthermore, the Wilcoxon sign rank test was used to evaluate pre-post-education changes, and Aiken was adopted to evaluate the validity of the questionnaire, with the analysis value of  $> 0.8$  and  $0.4-0.8$  for high and moderate criteria, respectively. The results of AIKEN showed high validity. Meanwhile,  $A$   $p$ -values of  $0.05$  are considered statistically significant for all statistical analyses.

**Four questions to measure knowledge about resistance to antibiotics using a 5-point Likert scale.**

Strongly agree	Agree	Disagree	Strongly disagree	No opinion
5	4	3	2	1

**Five questions to measure familiarity with terms including antimicrobial stewardship, antibiogram terms, antibiotic resistance terms, DDD and DOT, and Gyssens criteria using a 5-point Likert scale.**

Very familiar	Familiar	Somehow familiar	Not familiar	Not all familiar
5	4	3	2	1

**Instrument**

The questionnaire was created based on previous studies with the same goal.<sup>11</sup> The instrument for data collection used A four-part questionnaire, which is the instrument for data collection containing questions about the demographic characteristics of health professionals, knowledge of antimicrobial resistance, familiarity with the terms antimicrobial surveillance, antibiogram, antibiotic resistance, the role of antimicrobial stewardship, overall attitudes about antimicrobial resistance and antimicrobial stewardship, practice (related to prescribing) were distributed among healthcare professionals that met the inclusion criteria and were willing to participate in the study.

This study uses content validity, which is estimated by testing the feasibility or relevance of the test content through rational analysis by a competent panel or expert judgment. Two experts independently verified the validity of the questionnaire's contents. Pharmacy lecturers with doctoral degrees and are experienced in developing questionnaires and administering antibiotics were requested for the study. To complete the content validity test, the expert is given a questionnaire, content validity assessment guide, and sheet at the same time.

The health care professional's knowledge scoring system and data management were based on 13 questions that were divided into three parts as shown below:

**Bottom of Form****Analysis statistic**

The data were analyzed using Statistical Package for the Social Sciences (SPSS) version 20 (SPSS Inc., Chicago, IL, USA). Normality tests were performed using the Kolmogorov Smirnov test where  $p$ -value  $<0.05$  indicated that the continuous variables did not have a normal distribution. The Wilcoxon test was used to assess continuous pre and post data that were not normally distributed.

**RESULTS**

A total of 36 (90%) out of 40 health professionals that were invited attended the workshop, from which 8 (22.2%) were medical, 17 (47.2%) pharmacists, 2 (5.60%) pharmacy technicians, 7 (19.40%) nurses, and 2 5.6% were laboratory analysts. The characteristics

of health care professionals are shown in Table 1. Antimicrobial stewardship training was effective in increasing the percentage of pre-post perception before the intervention, and this effect was statistically significant ( $p$ -value  $<0.001$ ).

This study was conducted to assess the knowledge and attitudes of health professionals about antimicrobial stewardship. For basic pre-workshop and health professional knowledge about antimicrobial stewardship, all respondents (100.0%) strongly agree/agree that inappropriate use of antibiotics leads to resistance, effective treatment, and the additional burden of medical costs on patients. Also, the majority of the respondents strongly agree/agree that inappropriate use of antibiotics increases side effects (91.7%) (Figure 1).

Regarding the pre-workshop familiarity of health professionals, most (75.0%) were very familiar/familiar with the terms 'antimicrobial stewardship', 'antibiotic resistance' (86.1%), DDD/DOT (52.8%), while the majority were unfamiliar/slightly familiar with the terms 'antibiogram' (66.7%) and Gyssens (55.6%) (Figure 2).

Regarding the pre-workshop knowledge of health care professionals about the effectiveness of antimicrobial stewardship, all respondents (100%) answered that antimicrobial stewardship was effective in reducing resistance and reducing health care costs without adversely affecting the quality of care, improving patient safety (97.2%), and only 11.1% answered antimicrobial stewardship was not effective to improve outcomes (Figure 3).

The level of knowledge of health professionals before and after the workshop has no significant changes. However, their perception increased significantly after the provision of antimicrobial resistance control training (Table 2).

**DISCUSSION**

This study aims to evaluate the impact of education on the knowledge and attitudes of health professionals about antimicrobial stewardship. Many aspects of AMS education were involved, including but not limited to the appropriate antimicrobial selection and prescribing, optimizing doses and durations, and minimizing toxicity and side-effects to optimize clinical, economic, and microbiological outcomes by reducing the occurrence of AMR. This is frequently linked with the training on

## Four questions to measure knowledge of the role of the antimicrobial stewardship on a 5 - point Likert scale.

Effective	Ineffective	Very ineffective	Don't know	Not applicable
5	4	3	2	1

Regarding the attitudes of healthcare professionals towards antimicrobial administration programs, seven questions were developed using a 5 - point Likert scale.

Strongly agree	Agree	Disagree	Strongly disagree	No opinion
5	4	3	2	1

**Table 1: Characteristic of health care professional.**

Characteristic	Frequency
<b>Gender</b>	
Male	6 (16.7%)
Female	30 (83.3%)
<b>Age</b>	
25-35 years	16 (44.4%)
36-45 years	17 (47.4%)
46-55 years	2 (5.6%)
>55 years	1 (2.8%)
<b>Profession</b>	
Medical doctor	8 (22.2%)
Pharmacist	17 (47.4%)
Pharmacy technician	2 (5.6%)
Nurse	7 (19.4%)
Analyst laboratory	2 (5.6%)
<b>Experience</b>	
<5 years	4 (11.1%)
5-10 years	13 (36.1%)
11-15 years	9 (25.0%)
16-20 years	4 (11.1%)
>20 years	6 (16.7%)

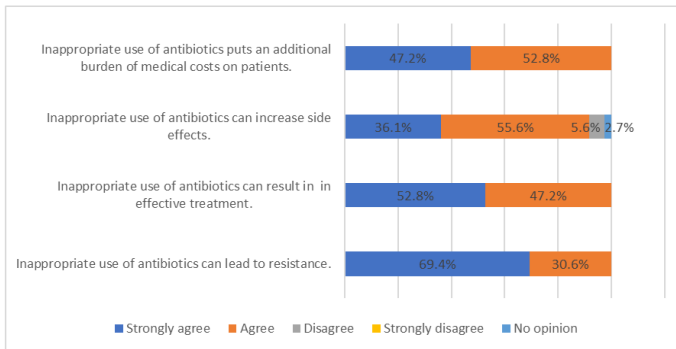
effective infection prevention and control techniques.<sup>12</sup> According to<sup>13</sup> AMR training for healthcare staff improves knowledge and awareness, promotes behavioral change, and creates momentum for long-term AMS programs. This study resulted in a significant improvement in the attitude of health care professionals after the educational intervention ( $p < 0.05$ ), indicating that this educational program was effective and beneficial for the AMS program. The results of a similar study also reported that the 2-day educational intervention showed a significant positive effect on increasing the knowledge and perception of community pharmacists. Furthermore, health professional knowledge related to antimicrobial stewardship has no significant increase after the education intervention ( $p > 0.05$ ) because the knowledge level of the majority of pre-education health professionals (97.2%) was good. Also, 36 of 40 invited health care professionals participated in this educational workshop with a response rate of 90.0% attendance. The result showed that the majority of the

respondents have knowledge about antimicrobial use. However, the familiarity of health professionals with the term “antibiogram” and “pre-educational Gyssens criteria” was still lacking. This is consistent with the report of Tegagn *et al.* that more than half of healthcare professionals were not familiar with the terms “antimicrobial stewardship” and “antibiogram”.<sup>6</sup>

The familiarity of health professionals with the terms antimicrobial stewardship, antibiotic resistance, DOT, and DDD was very good, which is consistent with the report of.<sup>6</sup> Tegagn *et al.* also found that 81.3% of healthcare professionals were familiar with antibiotic resistance. Subsequently, most health professionals were familiar with the role of antimicrobial stewardship before the implementation of the educational program. This is related to their high knowledge of the term antimicrobial stewardship.

A study of nurses from 3 hospitals in an integrated health system in Utah reported that 52.0% of nurses were not familiar with the term “antimicrobial stewardship,” although 39.6% of nurses stated that antimicrobial stewardship programs were sufficient or very important in their health care setting. The majority of the nurses believe that they should be involved in antimicrobial stewardship interventions.<sup>14</sup> Likewise, studies in Arabia reported that more than half of health care providers had low awareness of the antimicrobial stewardship program and its components. They also reported that the main obstacles to its implementation were the lack of specific policies/guidelines and sources of information about the antimicrobial stewardship program; lack of administrative awareness; lack of personnel, time constraints; limited training opportunities; lack of confidence; financial problems; or limited funding.<sup>15</sup> A study in two Ghanaian Hospitals showed that education had a statistically significant increase in the knowledge of healthcare professionals on antimicrobial resistance and the appropriate use of antibiotics. Also, education had a positive impact on participants' attitudes towards addressing the problem of antimicrobial resistance, their role in antimicrobial stewardship, and confidence in using the Ghanaian Standard.<sup>16</sup>

Antimicrobial stewardship education is fundamental to the medical world and the baton should be passed on to the medical students by the professionals with the hope of greater improvements in antimicrobial stewardship and the use of antibiotics. Although medical students recognize the imminent

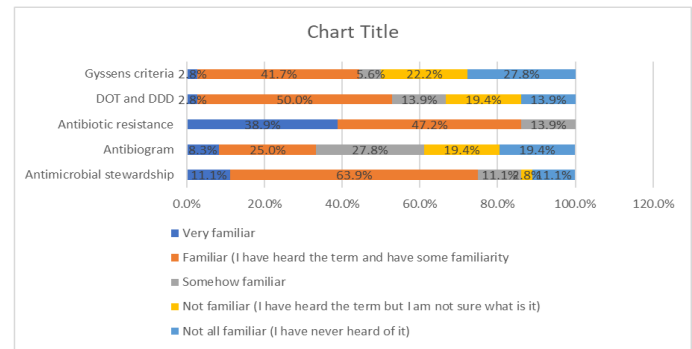


**Figure 1:** Knowledge and attitudes of health professionals about antimicrobial stewardship pre-workshop.

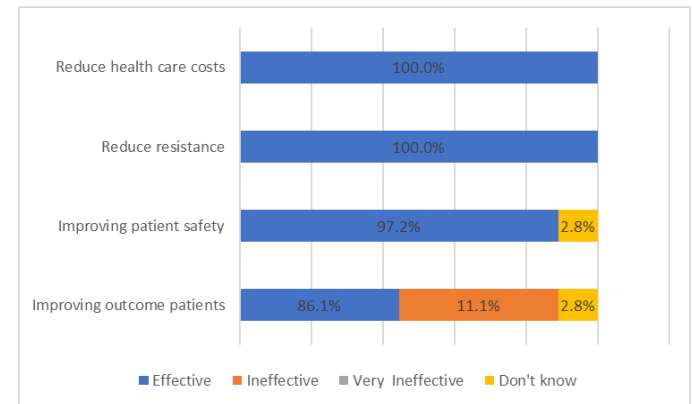
problem of over-resistance, they also lack basic knowledge of AMR. Therefore, the provision of knowledge and confidence to medical students is essential such that they will be able to face the ongoing daily clinical challenges of the future. This is achievable by incorporating effective training methods into medical curricula around the world.<sup>17</sup> Furthermore, education is widely recognized as a strategy for a successful antimicrobial stewardship program. There is evidence of a significant lack of knowledge around antimicrobial prescription among medical students and clinicians. Educational interventions increase antimicrobial prescribing.<sup>18</sup>

The results of<sup>19</sup> emphasize the need of implementing an educational antimicrobial stewardship program to improve the quality of prescription in clinical practice and possibly contribute to the reduction of antibiotic resistance globally. The effectiveness of antimicrobial stewardship programs depends on structured and convincing interventions targeted at enhancing prescribers' knowledge and compliance, as well as optimizing the care of complex diseases such as bacteremia. Moreover, the role of antimicrobial stewardship programs has increased significantly in health systems. Educational aspects are common in ASP therapies; however, guidelines suggest the implementation of in conjunction with other stewardship measures rather than as a stand-alone strategy. The majority of these interventions target prescribers (typically general practice physicians), with only a few studies focusing on other healthcare providers like pharmacists, nurses, and even members of the stewardship team. The most common, although not always, the combination of educational interventions and stewardship actions like prospective audit and feedback is presented.<sup>20</sup>

Health professionals' attitudes towards antimicrobial control significantly improved after training. This is consistent with the reports of<sup>11</sup> that educational programs are effective in improving the knowledge, attitude, and practice of health care providers about antimicrobial stewardship. According to,<sup>21</sup> most healthcare professionals believed that antimicrobial resistance was a serious problem in Australian hospitals and 58.0% agreed that increasing hospital prescription would reduce antimicrobial resistance. Most doctors consider antimicrobial resistance a serious health



**Figure 2:** Pre-workshop familiarity of health professionals.



**Figure 3:** Pre-workshop knowledge of health care professionals about the effectiveness of antimicrobial stewardship.

problem in Pakistani hospitals. Physicians agreed that the appropriate approaches to implement ASP include hospital audits and feedback (64.8%), restrictions on certain antibiotics (63.3%), easily accessible microbiological data (67.6%), and regular educational sessions (74.0%).<sup>22</sup>

The majority of participants in a survey conducted in Thailand believed that enhancing antimicrobial prescription will minimize antimicrobial resistance and that it should be a top priority for hospital policy. Physicians were less likely than nurses or pharmacists to agree with antimicrobial prescribing restrictions, and they were also less engaged in prescribing education. Pharmacists were more likely to agree, suggesting that a group of experts advocate prescription antimicrobial and that the feedback improved antibiotic selection. A point of disagreement among nurses is that community-based antibiotic usage leads to antibiotic resistance.<sup>23</sup> Subsequently, the majority of health care professionals at the hospital had a positive attitude towards the antimicrobial stewardship program despite their lack of knowledge. They also recommend key measures such as prospective audits with feedback and frequent educational workshops to promote the beginning and development of local antimicrobial stewardship programs for hospitals in Pakistan.<sup>24</sup> Additionally, the healthcare professionals agreed that more education and training are needed, necessitating a review of

**Table 2: Knowledge and attitude pre post workshop.**

	Pre-workshop	Post-workshop	Wilcoxon test	p value
Knowledge				
Mean + SD	82.2 +9.7	89.1 + 8.1	0.003	0.05
Attitude				
Mean +SD	82.4+11.5	84.8+9.9	0.339	0.05*

\*Significant.

pre-service and in-service education and training, as well as continuing professional development programs for practicing healthcare professionals.<sup>25</sup>

Adopting ASP Education is important for improving the quality of antimicrobial prescription in clinical practice and potentially reduces the global antibiotic resistance problem. The effectiveness of these programs depends on structured and compelling interventions aimed at enhancing prescribers' knowledge and compliance, as well as optimizing the management of complicated diseases such as bacteremia. Future studies should focus on identifying the most effective strategies for implementing an effective stewardship program in hospital settings to reduce antibiotic misuse.<sup>19</sup>

Antimicrobial stewardship education provides enormous benefits. The community pharmacists' understanding of AMS and their ability to choose the best antibiotic improved significantly as a result of this instructional workshop. Consequently, more effort is required to improve perception, awareness, and skills in applying AMS. These efforts should focus on many levels, ranging from the implementation of educational modules in universities to the frequent presentation of easy training and educational programs for community pharmacy workers.<sup>26</sup>

To the best of our knowledge, this study is the first in Indonesia and has had a good impact, but it has limitations. The main limitation of this study is that the effect of the exercise intervention measured immediately after exercise may not reflect its true effect. Therefore, more studies are needed to assess the long-term effects of exercise.

## CONCLUSION

Conclusively, the educational program implemented is effective in improving the attitudes of health professionals about antimicrobial stewardship. Hence, efforts to raise awareness and improve attitudes towards antimicrobial stewardship among healthcare professionals must continue to be carried out through various strategies, including regular training programs. Furthermore, knowledge about antimicrobial stewardship is beneficial to health professionals but it requires frequent updates to ensure that information is not missed.

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## CONFLICTS OF INTEREST

The authors declare no conflict of interest.

## ETHICAL APPROVAL

The ethical approval was obtained from the Research Ethics Commission of the Faculty of Medicine, Gadjah Mada University, Yogyakarta (KE/FK/0960/EC/2020).

## ABBREVIATIONS

**AMS:** Antimicrobial Stewardship; **DDD:** Defined Daily Dose; **DOT:** Days of Therapy; **CDI:** Clostridium Difficile Infections; **KAP:** Knowledge, Attitude, Perception; **IDSA:** Infectious Diseases Society of America; **SPSS:** Statistical Packages for Social Science; **SD:** Standard Deviation.

## SUMMARY

This study aims to assess how educational programs affect healthcare provider's knowledge, attitudes, and practices concerning antimicrobial stewardship in hospitals. The present study revealed that there are no significant differences in health professional's knowledge levels before and after the workshop. However, their perception increased significantly after the provision of antimicrobial resistance control training. The educational program implemented is effective in improving the attitudes of health professionals about antimicrobial stewardship.

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