Rationality of antibiotic prescribing in basic- and intermediate-level accredited primary health centres in Depok, Indonesia

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Abstract

Background: Previous research has identified a high irrationality of antibiotic usage among accredited Primary Health Centres (PHCs). Implementing health system accreditation in Indonesia will encourage health facilities to rationalise antibiotic use. **Objective:** To evaluate antibiotics' prescribing pattern and rationality in basic and intermediate accredited PHCs after implementing health system accreditation. **Method:** A cross-sectional study was conducted at each of two basic- and intermediate-accredited PHCs in Depok, Indonesia. All antibiotic prescriptions from January to March 2020 were included in the prescribing pattern, while 384 prescriptions from each PHC were randomly sampled to evaluate the rationality using the PHCs clinical guidelines. **Result:** Amoxicillin was the most prescribed in the basic accredited PHCs (61%) and intermediate accredited PHCs (83.9%). Most of the antibiotics were used to treat respiratory tract (64.1%), teeth (12.0%), skin (7.8%), and other kind of infections. Irrational prescribing of antibiotics was found in basic and intermediate health centres in the form of duration of administration (75.7% and 79.3%), selection (18.6% and 14.2%), frequency (14.4% and 3.4%), and dosage (11.8% and 1.4%) respectively. **Conclusion:** After implementing the accreditation system, irrational use of antibiotics remains common, but PHCs with higher accreditation levels tend to show more rational antibiotic use.

Introduction

Antibiotic prescribing is a common practice in health systems across the globe. These drugs are prescribed to patients by trained healthcare professionals following thorough diagnoses. It is important to apply rationality while prescribing antibiotics to patients. Notably, the irrational use of antibiotics can lead to antibiotic resistance, morbidity, mortality, and treatment costs (O'Neill, 2016). The Centres for Disease Control and Prevention (CDC) stated that in the United States, up to 2019, antibiotic resistance was the cause of 35,000 deaths yearly, with the figure forecast to reach 10 million people/year by 2050 (Ledingham, 2019). This worsening trend highlights the critical importance of the rational use of antibiotics. A study conducted in various low and middle countries showed that while antibiotics are prescribed widely in primary healthcare, rationality needs improvement (Sulis *et al*., 2020), including the paediatrics (Graham *et al*., 2016; Zhang *et al*., 2017; Xue *et al*., 2019). In Indonesia, various studies have uncovered widespread inappropriate prescribing of antibiotics at the primary health centre level (Andrajati *et al*., 2017; Ambarwati *et al*., 2018; Prasetio *et al*., 2019). In Indonesia, primary health centres (PHCs) constitute the first-line health service in primary healthcare organisations at the community level, which means that the irrational use of drugs here can harm the wider community. To increase the rational use of antibiotics, intervention is required from many stakeholders, including the government as the regulator. In 2015, the Indonesian Minister of Health established a PHCs accreditation system to ensure healthcare facilities improve their quality of service and implement risk management. Implementing health system accreditation in Indonesia is expected to encourage

health facilities to provide better service, including in their use of antibiotics. However, even after the implementation of the PHC accreditation system, data on the rationality of antibiotic use remains limited. This study was therefore designed to assess and compare the rationality of antibiotic use in PHCs following the government's accreditation system implementation.

Methods

Study design, setting, and sampling

A cross-sectional study design was employed to evaluate the rational use of medicine in four PHCs in Depok City, Indonesia. In this study, the two PHCs in Depok City from two kinds of level accreditation were recruited by non-randomized convenient sampling. The PHC samples comprised two PHCs with basic accreditation and two PHCs with intermediate accreditation.

Total sampling from all outpatient antibiotic prescriptions for oral and parenteral administration, from January to March 2020 and for all ages, were included in this study to investigate the pattern of antibiotic use in each PHC. Prescriptions with incomplete patient and drug regimen records were excluded. Simple random sampling led to the selection of 384 outpatient prescriptions from each PHC to analyse the rational use of antibiotics. It was conducted by numbering all the prescriptions and randomising the desired number of samples using Microsoft Excel.

Ethical approval

The research protocol was approved by the Ethical Committee of the FKUI-RSCM with protocol number 20-03-0327.

Data processing and analysis

The rational use of antibiotics was analysed in line with the Clinical Practice Guidelines for Doctors in Indonesian Primary Care 2017 and 2007 (for tooth disease) published by the Indonesia Minister of Health (Ikatan Dokter Indonesia, 2017). Two pharmacy students collected and processed the screening of antibiotics regimen, patient characteristics, and diagnostics from prescriptions. After that, expert judgment involving two clinical pharmacists was conducted to review and compare the data in the prescription and the guidelines used. The discrepancy between prescriptions and guidelines was categorised as irrationality and was sub-categorised into four groups, namely "*the accuracy of antibiotic selection*", "*dosage*", "*frequency*", and "*duration of the antibiotic administration*".

The irrationality of antibiotic selection was identified if the antibiotic and diagnostic stated in the prescription were not in line with the guideline-recommended antibiotic. The irrationality of dosage was defined if the antibiotic dosage strength prescribed was either more than the guideline recommended or less. Frequency and duration of administration irrationality were defined if the regimen and number of drugs prescribed were not the same as the guideline recommended, respectively. Data processing and analysis were performed using Microsoft Excel softwar*e.*

Results

Sample distribution

A total of 2103 antibiotic prescriptions from basic-accredited PHCs and 1980 antibiotic prescriptions from intermediate-accredited PHCs were included in this study. The distribution of prescriptions in each PHC can be seen in Figure 1.
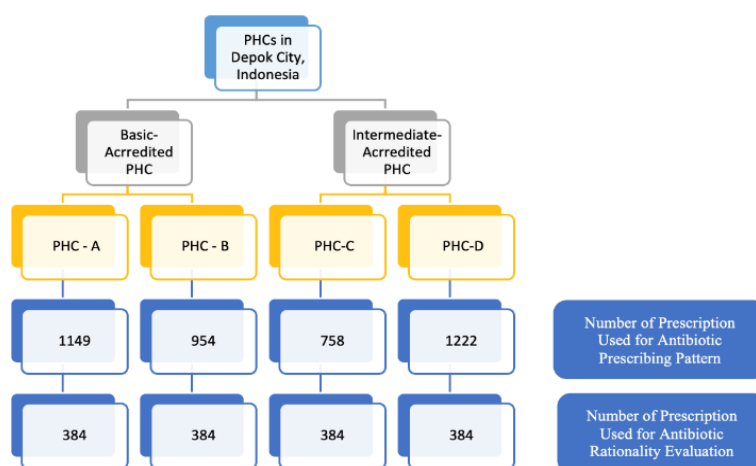

Figure 1: Sample distribution of prescriptions used for the study

Prescribing pattern by the type of antibiotics and diseases found in PHCs

All the antibiotic types used in PHCs were prescribed based on the Indonesian National Formulary. Amoxicillin was the most used antibiotic in basic (61%) and intermediate (83.9%) PHCs. In basic accredited PHC, cotrimoxazole (21.4%) and chloramphenicol (6.7%) were also frequently used. Whereas other antibiotics that were widely used in intermediate accredited of PHC are ciprofloxacin (4.8%) and erythromycin (4.6%). The varying patterns of antibiotic usage between the basic- and intermediate-accredited PHCs can be seen in Figure 2.
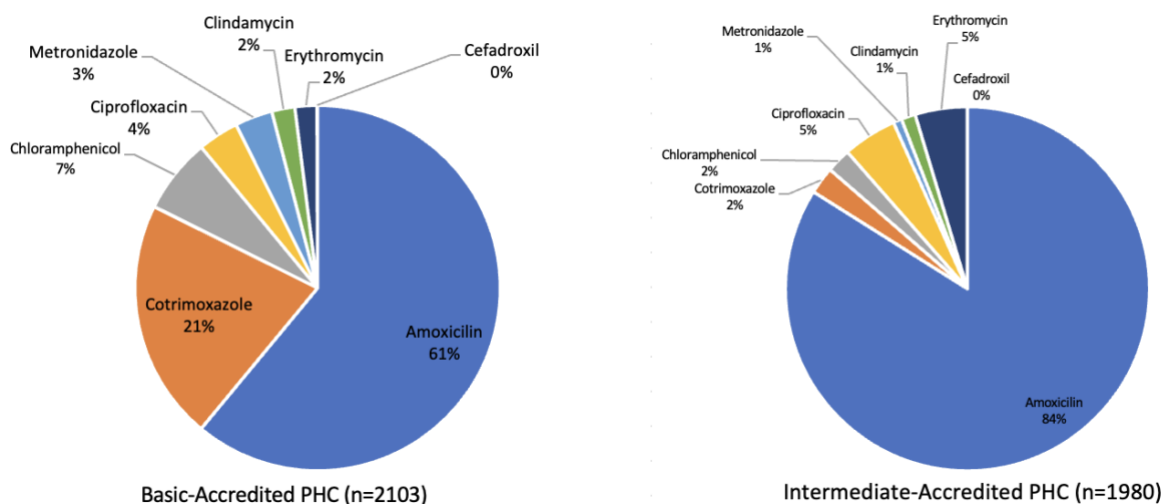

Figure 2: Antibiotic prescribing patterns based on antibiotic type for two different levels of accredited Primary Health Centres

Figure 3 shows the uses of the prescribed antibiotics with the most indications. Most of the antibiotics were used to treat diseases related to respiratory infections such as upper acute respiratory infections, common cold, and pneumonia. In PHCs, dentists also frequently prescribe antibiotics to treat tooth infections such as periodontitis, periapical abscess, gingivitis, and pulpitis. Additionally, antibiotics were frequently prescribed to treat skin infections such as skin abscesses, furuncles, carbuncles, impetigo, and dermatitis. Parasitic diseases for which antibiotics were often prescribed included typhoid fever, scabies, and suspected tuberculosis. Antibiotics were also sometimes prescribed for gastrointestinal ailments such as dyspepsia, gastroenteritis, and diarrhoea.
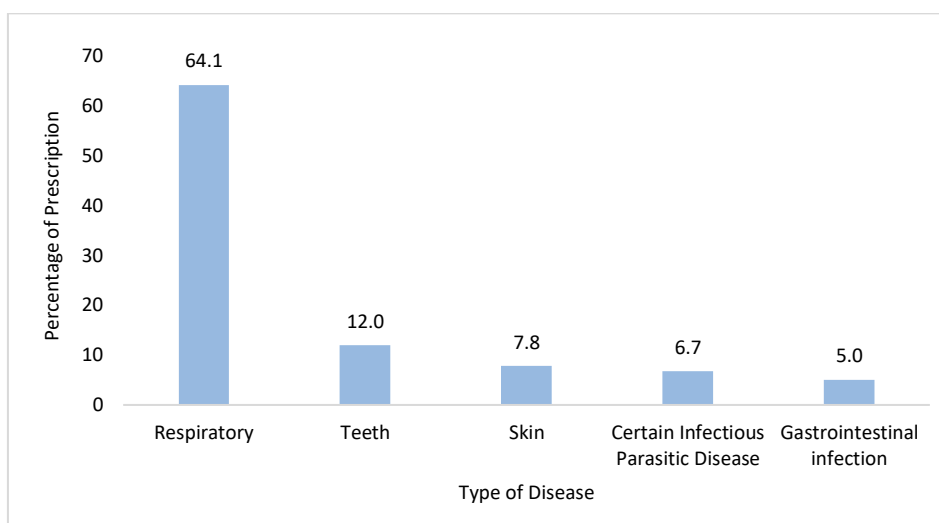

Figure 3: The top five diseases for which antibiotics were prescribed (n=4083)

Rationality of antibiotic prescribing

Table I shows a comparison of inaccurate use of antibiotics identified between basic and intermediate accredited PHCs. This study found that the irrational use of antibiotics remains a feature in all the PHCs for all assessment criteria. The highest irrationality was found in the duration of administration. PHCs with a higher level of accreditation tend to have lower irrational use of antibiotics compared to those with a lower accreditation level.

Table I: Distribution of rationality of antibiotics used in each PHC and different levels of primary health centres

Accreditation level	PHC	Antibiotic selection		Dosage		Frequency of administration		Duration of administration	
		n=384	n=768	n=384	n=768	n=384	n=768	n=384	n=768
Basic	A	94 (24.5%)	143 (18.6%)	65 (16.9%)	91 (11.8%)	84 (21.9%)	111 (14.5%)	265 (69.0%)	581 (75.7%)
	B	49 (12.8%)		26 (6.8%)		27 (7.0%)		316 (82.3%)	
Intermediate	C	49 (12.8%)	109 (14.2%)	2 (0.5%)	11 (1.4%)	10 (2.6%)	26 (3.4%)	303 (78.9%)	609 (79.3%)
	D	60 (15.6%)		9 (2.3%)		16 (4.2%)		306 (79.7%)	

Examples of inappropriate drug selection in basic accredited PHC included the use of clindamycin and cotrimoxazole for acute pharyngitis and the use of metronidazole and amoxicillin for cystitis. The use of ciprofloxacin and amoxicillin to treat skin infections such as abscesses, furuncles, and carbuncles was the highest number of irrational antibiotic selections found in intermediate accredited PHC.

Inappropriate dosage selection in basic and intermediate accredited PHC was especially recorded for amoxicillin in paediatric patients. However, in basic accredited PHC, the incorrect dosage had a higher number involving the sub-dose of ciprofloxacin and cotrimoxazole in adult patients.

An inappropriate administration frequency in basic accredited PHC was found in the prescribing of amoxicillin, chloramphenicol, ciprofloxacin, clindamycin, and erythromycin. The kind of inappropriate administration frequency was lower in intermediate accredited PHC and involved amoxicillin and erythromycin only. Most of the inappropriate frequencies were caused by the insufficient frequency of use in comparison with the guideline.

Inappropriate treatment durations were found mostly in the short-term use of amoxicillin to treat respiratory infections both in the basic and intermediate accredited PHC. Other antibiotics that were also found to be less prescribed than as stated in the guideline, are chloramphenicol, ciprofloxacin, cotrimoxazole, erythromycin, and clindamycin.

Discussion

The pattern of antibiotic prescriptions identified in this study aligns with that of previous studies conducted in Indonesia, where were widely used to treat patients with infections, especially for the outpatients (Limato et al., 2022; Muslim et al., 2023). The broad-spectrum properties of amoxicillin mean it is frequently used to treat many different types of infections as an empirical antibiotic treatment. Respiratory tract infection showed the most indications for treatment with antibiotics, which aligns with the high prevalence of these infections in Depok in 2018. However, it is important to ascertain whether the prevalence of respiratory tract infections was caused by bacteria since not all of them can be treated by antibiotics.

This study identifies that the irrational prescription of antibiotics remains common in all PHCs concerning dosage selection and treatment duration. Various cases of dosage error were identified in child patients. Child dosing is more prone to errors since many drugs do not have a paediatrics-specific dosage formulation. Weight errors can also occur and the dosage conversion often results in the wrong dose of all prescribed drugs (Hirata et al., 2019). The frequency and duration of drug administration must be appropriate for each disease to optimise the treatment outcome, ensure that antibiotic usage is maintained within the therapeutic window, minimise adverse drug reactions and antibiotic resistance (Bielicki et al., 2015), and prevent economic burden for patients (Ledingham, 2019).

Various factors were found to contribute to the high level of irrational medicine usage, including the literature used, health care providers, and health systems. The criteria for assessing the rationality of antibiotics prescribed were based on their suitability with the Clinical Practice Guide for Doctors in Primary Health Care Facilities. Therefore, irrational antibiotic selection can occur due to the different references used, a limited range of independent drug information sources, or outdated references. Another concern is the physician's knowledge. Based on a previous study, physicians who have attended training on the rational use of medicines and have shorter working periods tend to be more rational in prescribing antibiotics (Andrajati *et al.*, 2017). A third factor relates to patients, where considerations such as recovery expectations, complaints, pain experiences, and the severity of their condition can influence a physician's decision in prescribing drugs (Ali Murshid & Mohaidin, 2017).

Unfortunately, data regarding the severity of the disease and patient complaints, as well as doctors' considerations, could not be obtained from this study due to limitations in the study design carried out. The health system was also a factor, typically in areas such as human resources and the healthcare service regulations in place. A limited ratio of physicians and pharmacy personnel to the overall patient population can also impact the information and decision-making of healthcare providers (Shimane, 2016). Additionally, PHC policy also could contribute to the high number of irrationalities found, especially in duration administration.

PHCs in Indonesia need to serve many patients since the health national insurance coverage era, whereas the funds and availability of medicine are limited. This then makes the PHC generally give antibiotics for short-term only. To prevent harm to patients due to antibiotic prescribing errors, pharmacists play an important role by doing the verification of the prescription before the medicine is given to the patient and giving education about what patients do if the outcome therapy is not optimal after several days.

Among efforts made by the Indonesian government to improve the quality of services at PHCs, is the implementation of an accreditation system, which also regulates patient-oriented clinical services, clinical service support management, and improvements in clinical quality and patient safety. Based on the research conducted, the levelling of healthcare facilities resulting from the accreditation system demonstrates that healthcare facilities can be improved with accreditation. When compared to a previous study in Depok City, which was conducted in

2010, before the implementation of the accreditation system, the selection of antibiotics has improved (22.7% compared to the basic (18.6%) and intermediate (14.2%)) (Andrajati *et al.*, 2017). This may be due to the efforts made by the PHCs to improve their service qualities, such as the provision and training of human resources (Dieleman *et al.* 2009).

The implementation of accreditation in health facilities is an effective strategy for improving the quality of care, along with patient safety and organisational performance (Mohammad, 2016). A systematic review of the impact of health service accreditation also showed that it increases nurses' perception of clinical quality and improves the care process, clinical outcomes, and compliance with guidelines (Brubakk *et al.*, 2015; Hussein *et al.*, 2021).

The level of accreditation of PHCs in Indonesia is decided between the scores that can be achieved by PHCs from three aspects, including management and administration, community, and patient healthcare service. Basic accredited PHCs have lower scores in those criteria compared to intermediate accredited PHCs. It also can prove the intensity of the process of improvement for the patient-oriented service made by the PHC. Since antibiotics are one of the medicines widely used at PHC in Indonesia, the rationality of antibiotics could indirectly show the patients' quality of healthcare service. Some efforts by the PHCs to improve the rationality of antibiotics included the training of healthcare providers, assuring the availability and updating of drug information references that can be used, conducting antibiotic use evaluations frequently, improving pharmacist intervention to prevent prescribing errors, and developing a technology information system to improve clinical decision maker or prescription (Odukoya & Chui, 2013; Cabri *et al.*, 2021). However, this effort must be optimised gradually to achieve better patient-oriented service.

Limitation

The limitation of this study is that the differences in antibiotic pattern and rationality were only seen in two levels of PHC. Another weakness of the study carried out was the research design, which was a cross-sectional study based on prescriptions only, and only based on guidelines issued by the Ministry of Health in Indonesia. This can lead to the possibility of overcounting the irrationality of antibiotic data since the supporting data to justify the rationality of antibiotics is unable to be retrieved. However, this research could be a representative initial study with a simple study design, a short time, and a sufficient sample size that can show what antibiotic rationality

problems should be managed and the importance of the healthcare implementation system to improve patient-oriented service for the PHC. Another study with more PHC, random sampling, different kinds of accreditation levels of PHC, and a longitudinal study is recommended to see the association between the level of accreditation and rational use of medicine statistically. The use of more sources and guidelines also can improve the accuracy of this study.

Conclusion

Although the irrational use of antibiotics persists, PHCs with higher accreditation status tend to display rational use. Additional socialisation and education about the rational use of antibiotics is therefore needed to further improve the level of rational antibiotic use.

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