

Original Article

A cross-sectional assessment of Indonesian female health cadres' knowledge and attitude towards antibiotics

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Abstract

Introduction: Health cadres have a key role in building awareness related to irrational antibiotic use and antibiotic resistance in Indonesia. Cadres help to bridge the gap between the shortage of health professionals and the need to reach the broader population. This study aimed to identify cadres' background, antibiotic knowledge and attitudes in an Indonesian setting.

Methodology: A paper-based questionnaire survey was validated and conducted among purposefully selected cadres attending a seminar in Malang Indonesia. A 5-point Likert scale was used to identify attitudes, while true/false statements determined their knowledge. A total of 112 cadres responded, giving a 100% response rate.

Results: The majority had been cadres for >2 years with previous counseling experience. Their attitudes on antibiotic use, were shown by the lower levels of disagreement to the statements "when I get a sore throat, I prefer to use antibiotics" (37.5%); "I would take antibiotics if I have had a cough for more than one week" (41.1%); and, "when I get influenza, I would take antibiotics to help me recover sooner" (47.3%), within the "indications" domain. For knowledge, lower scores were reported for domains related to "indications" (mean 1.49 ± 0.82/3), "resistance" (mean 1.06 ± 0.94/3), and "storage and disposal" (mean 1.23 ± 0.78/3).

Conclusions: These findings indicated a need to improve cadres' attitudes and knowledge prior their involvement as change agents for improving the rational use of antibiotics to minimise antibiotic resistance in Indonesia.

Key words: Indonesia; antibiotics; education; cadre; knowledge; attitudes.

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Introduction

The rapid emergence of antibiotic resistance is a major threat to global health [1-4]. This has been attributed to the overuse or misuse of currently available antibiotics and a dearth of new antibiotics development [5-7]. In many countries, including Indonesia, antibiotics can be easily accessed without a medical prescription, due to the lack of regulations or their enforcement, thus causing their overuse in the community [8-12]. Misuse or inappropriate use of antibiotics, such as ceasing antibiotics early (failing to take a complete course), has also contributed to the promotion of resistant bacteria [13,14]. The World Health Organisation (WHO) has promoted the provision of independent information and public education as part of 12 key interventions to promote rational medicine use [15]; specific to antibiotics, the first objective of the WHO Global Plan on

Antimicrobial Resistance is to improve public awareness and understanding of the problem [5].

Many countries have launched information campaigns to improve public knowledge, from which some positive outcomes have been reported [16-19]. In 2015, the Indonesian Government initiated an information campaign, namely 'Smart Use of Medicine Movement' (*Gerakan Masyarakat Cerdas Menggunakan Obat, GeMa CerMat*), to promote rational use of medication, including antibiotics [20]. Considering issues of limited health funding and related workforce as well as the large Indonesian population (more than 240 million) [21,22]; the Government have involved health cadres as 'change agents' within the population. Health cadres are local community members who were trained to assist health activities organised by the local Community Health Centres (*Pusat Kesehatan Masyarakat, Puskesmas*). Health

cadres have the potential to become change agents since they have close contact with the local communities, and they have been established as community health counselors by the Government [23]. In spite of this potential, little is known regarding cadres' understanding regarding antibiotics.

Thus far, studies related to antibiotic knowledge and attitudes in Indonesia have focused on the general public [24–28]. To the best of our knowledge, only one report has considered antibiotic knowledge involving cadres in Indonesia [29]. Unfortunately, that research only included information on cadres' overall knowledge, which was considered adequate, however no details were provided regarding what areas of knowledge were being evaluated. Detailed information on cadres' profiles and capability would be important in providing appropriate support for cadres to be effective change agents. Hence, this study aimed to identify antibiotic knowledge and attitudes among cadres in Malang, Indonesia, as well as to provide relevant information on cadre demographics, antibiotic use and counseling profiles.

Methodology

This study was approved by Malang City Health Office (Reference number: 072/352/35.73.302/2019), and Committee of Research Ethics of Universitas Surabaya (No: 082/KE/VII/2019).

Study Design and Participant Recruitment

This study was a cross-sectional study using a paper-based questionnaire survey. This study was conducted in Malang City, the second largest city in East Java Province, Indonesia. Malang City has an area of 110.06 km² comprising five districts (*kecamatan*), including: Kedungkandang, Sukun, Klojen, Blimbing, and Lowokwaru. In 2017, its population was approximately 861,000 [30]. With the introduction of national health coverage in Indonesia (*Jaminan Kesehatan Nasional, JKN*) in 2014, a referral system has been implemented; Community Health Centres (*Pusat Kesehatan Masyarakat. Puskesmas*) which are technical units of the Regional Health Office have been

charged to provide primary level health care at the district level, from which referrals can be made to hospitals for secondary/tertiary care [31]. The Regional Health Office has the responsibility to manage health resources in their area, including: health facilities, infrastructure, and personnel [32]. In 2019, there were 6,058 cadres in Malang City (Muarif H, personal communication, March 10, 2019).

Approximately 100 cadres were purposefully selected by the Malang City Health Office staff which included those actively involved in local health activities. This method considered the best option [33], as there were no data available on the activity level of cadres, from which a random sample could be obtained.

Questionnaire Development

A questionnaire was initially developed by one of the researchers who has expertise in infectious diseases and was based on relevant literature [9,19,24,25,34-39]. Face validity was conducted in two steps: i) a research team meeting verified knowledge/attitude constructs and the representative statements; and ii) expert panel discussions (i.e. five academics with expertise in pharmacy practice and public health, three practitioner pharmacists, and two health office staff) to ensure the statements were appropriate with Indonesia's and Malang City's cultural context. The questionnaire was then piloted to 20 members of the general public to ensure that the statements were understandable. After minor changes, the final questionnaire consisted of five sections: 1) respondent demographics, 2) counseling profiles, 3) antibiotics use profiles, 4) attitudes toward antibiotic use, and 5) knowledge on antibiotic use and resistance.

The section related to "attitudes" comprised of 12 statements with 5-point Likert scales, ranging from "strongly disagree" to "strongly agree". The "knowledge" section comprised of 20 true/false statements. The statements regarding "attitudes" and "knowledge" were categorised into five and six domains, respectively (Table 1). The questionnaire was administered to the community members involved in the prior pilot study, and internal consistency of the

Table 1. Antibiotics "Knowledge" and "Attitude" domains and number of statements included in the questionnaire.

Domain	Attitude	Knowledge
	Statement numbers	Statement numbers
1. Indication	1-3	1-3
2. Access	4-6	4-5
3. Directions for use	7-9	7-10
4. Adverse drug reactions	10, 11	11-14
5. Resistance	12	15-17
6. Storage and disposal	-	18-20

questionnaire was tested with Cronbach's alpha. The resulting values of alpha were 0.693 (for "attitude") and 0.636 (for "knowledge"), which were considered as acceptable [40].

Data Collection

The selected cadres were invited to attend a seminar held at the Malang City Health Office at April 2, 2019. The questionnaires were distributed at the beginning of the seminar, and collected before the seminar materials were presented. Before distributing the questionnaires, one of researchers introduced the study and explained on how to complete the questionnaire. Participation in the study was voluntary and no incentive was given. If cadres agreed to participate, informed consent was obtained and a copy was provided to them for their personal archive.

A maximum of 30 minutes was given to the participants to complete the questionnaire, and the questionnaires were submitted directly to the research team. A total of six research team members supervised the whole process of completing the questionnaires, thus ensuring participants provided their own answers.

Data analysis

Data on respondent demographics, counseling profiles, and antibiotic use profiles were descriptively analysed and presented as mean \pm SD for continuous data or percentage (%) for categorical data. For the "attitude" data using 5-point Likert scales, the frequencies and percentages of respondents that provided answers "strongly disagree" to "strongly agree" were calculated. For statements numbers 7 and 12 (reverse questions), the responses should be interpreted reversely. For the "knowledge" section with "true"/"false" statements, a score "1" was given for the correct answers, and the score "0" was given for incorrect or "don't know" answers; the total score was then calculated for each domain, and the mean value determined. Analysis was performed with the assistance of IBM SPSS Statistics for Windows version 23 (Armonk, NY: IBM Corp.).

Results

A total of 112 cadres attended the seminar and all provided their consent, thus a response rate of 100% was achieved. The respondents represented cadres from all 5 districts in Malang City. The majority of respondents were senior high school graduates (60.7%) and had no background in health education (95.5%). Detailed information regarding respondent demographics are provided in Table 2. More than 75%

of respondents had been cadres for more than two years and had previous counseling experience. Details on respondents' counseling profiles are reported in Table 3.

In regard to cadres' profiles on antibiotic use, 45 respondents (40.2%) stated that they had used antibiotics in the last six months (Table 4). More than 50% of them confirmed their antibiotics were provided by a doctor's prescription; two medical conditions commonly resulted in antibiotics being prescribed were cough (19.6%) and toothache (17.9%). Furthermore, most of the respondents specifically mentioned that they 'have never recommended to other people they purchase antibiotics without a doctor's prescription' and 'have never given their remaining antibiotics to other people' (78.6% and 84.8%, respectively).

Table 2. Respondent demographic information (N = 112).

Characteristics	Frequency n (%)
Gender	
Female	112 (100.0)
Male	0 (0.0)
Age (years, mean \pm SD)	47.3 \pm 8.2
District of origin	
Klojen	23 (20.5)
Blimbing	23 (20.5)
Kedung Kandang	25 (22.3)
Sukun	16 (14.3)
Lowokwaru	25 (22.3)
Marital status	
Married	96 (85.7)
Not married	1 (0.9)
Widow	11 (9.8)
Highest education level*	
None	0 (0.0)
Elementary school/equal	1 (0.9)
Junior high school/equal	20 (17.9)
Senior high school/equal	68 (60.7)
Diploma (1-3)	6 (5.4)
Undergraduate (Bachelor)	16 (14.3)
Postgraduate (Master's or Doctoral)	0 (0.0)
Health education background*	
No	107 (95.5)
Yes	2 (1.8)
Employment status*	
Not working	91 (81.3)
Currently working	17 (15.2)
Working:	
Civil servant	0 (0.0)
Employee	0 (0.0)
Self-employed/Entrepreneur	5 (4.5)
Others [†]	12 (10.7)

*Some missing data; [†]such as labourer, merchant, teacher, tailor, trader, washer.

Table 3. Cadres' counseling profiles (N=112).

No.	Questions	Frequency (n)	Percentage (%)
1	How long have you been a health cadre?^a		
	<1 year	10	8.9
	1 – 2 years	12	10.7
	>2 years	86	76.8
2	Who was the one recommending you to become a health cadre?^b		
	Myself	22	19.6
	Others (specify):	89	79.5
	<i>Posyandu</i>	50	56.3
	Community members	25	28.1
	Others ^c	14	15.6
3	Have you given health counseling to the community (including those within home visits and/or <i>Posyandu/Puskesmas</i> programs)?^a		
	No	21	18.8
	Yes (specify):	86	76.8
	1. Healthy diet	34	39.5
	2. Traditional medicines	25	29.1
	3. Disease (such as hypertension, diabetes mellitus, cough)	40	46.5
	4. Use of medications	19	22.1
	5. Mosquito Larvae Monitoring (<i>Juru Pemantau Jentik, JUMANTIK</i>)	69	80.2
	6. Pregnancy and breastfeeding	71	82.6
	7. Others ^d	51	59.3
4	Have you participated in training regarding health counseling (held by Region Health Office or other parties)?^a		
	No	10	8.9
	Yes (specify)	101	90.2
	1. Healthy diet	37	36.6
	2. Traditional medicines	35	34.7
	3. Disease (such as hypertension, diabetes mellitus, cough)	57	56.4
	4. Use of medications	55	54.5
	5. Mosquito Larvae Monitoring Technique (<i>Juru Pemantau Jentik, JUMANTIK</i>)	36	35.6
	6. Pregnancy and breastfeeding	67	66.3
	7. Others ^e	27	26.7
5	Have you, as a health cadre, received any transport allowance or reimbursement when you provide health counseling?^a		
	No	50	44.6
	Yes	54	48.2

Puskesmas, Pusat Kesehatan Masyarakat (Community Health Centre – a health unit at district level); *Posyandu, Pusat Kesehatan Terpadu* (Integrated Community Health Service – a health unit at village level); ^aSome missing data; ^bsuch as *Puskesmas*, local community members, region health office; ^csuch as toddler weight monitoring in *Posyandu*, Healthy and Wealthy Small Family Program (*Keluarga Kecil Bahagia Sejahtera, KKBS*), Counseling for Family with Toddler (*Bina Keluarga Balita, BKB*), Counseling for Family with Teenager (*BKR; Bina Keluarga Remaja*), Family Planning Program, Healthy Living Movement (*Gerakan Masyarakat Hidup Sehat, GERMAS*); ^dsuch as toddler weight monitoring, family planning, Sanitation, Healthy and Clean Living Behaviors (*PHBS; Perilaku Hidup Bersih dan Sehat*), Healthy Living Movement (*GERMAS; Gerakan Masyarakat Hidup Sehat*), illegal cosmetics, Nutrition for Toddlers.

Table 4. Cadres' profiles regarding antibiotic use (N=112).

No	Questions	Frequency (n)	Percentage (%)
1	Have you ever used antibiotics in the past 6 months?^a		
	No	58	51.8
	Yes,		
	a. once	24	21.4
	b. twice	15	13.4
	c. ≥ 3 times	6	5.4
2	What medical conditions have made you use antibiotics most often?^a		
	Cough	22	19.6
	Toothache	20	17.9
	Influenza	19	17.0
	Fever	11	9.8
	Runny nose	8	7.1
	Throat inflammation	6	5.4
	Others ^f	21	18.8
3	In the past 6 months, how do you get your antibiotics?^a		
	Doctor's prescription	57	50.9
	Purchasing without doctor's prescription	25	22.3
	Leftovers from previous medication	4	3.6
	Other people gave me	3	2.7
	Others ^g	10	9.0
4	Have you received information on how to use your antibiotics (including dose, frequency, duration)?^a		
	No	13	11.6
	Yes (specify)	77	68.8
	But not a complete directions	9	11.7
	Rarely	31	40.3
	Sometimes	37	48.0
Of those received information (N=77):			
5	Who have provided you with the information on how to use antibiotics? (you can select more than one)		
	Doctor	51	66.2
	Pharmacist	24	31.2
	Medicine brochure	5	6.5
	Relative/parents/children	4	5.2
	Others ^h	6	7.8
6	How often do you follow the directions provided when using the antibiotics?^a		
	Never	0	0.0
	Sometimes	19	24.7
	Always	57	74.0
7	Have you ever recommended other people to purchase antibiotics without a doctor's prescription?^a		
	Never	88	78.6
	Sometimes	22	19.6
	Always	0	0.0
8	Have you ever given your remaining antibiotics to other people (including relatives, colleagues, etc)?^a		
	Never	95	84.8
	Sometimes	15	13.4
	Always	0	0.0

^aSome missing responses; ^fsuch as dysuria, diarrhoea, urinary tract infection, gastritis, cramps, backpains, fever, dizziness, headache, sore throat, illness for more than three days, post cyst surgery, and appendicitis; ^gsuch as *Puskesmas* (not specifically mentioned), prescriptions from midwives; ^hsuch as friends, neighbours, *Puskesmas* (not specifically mentioned), social media, midwives, previous prescriptions.

Related to information on antibiotics use, 77 respondents (68.8%) stated that they had received information on how to use antibiotics; the information was mainly provided by doctors (66.2%) and pharmacists (31.2%). Of the respondents that received the information, most reported to always follow the directions (74.0%). Details on cadres’ profiles regarding antibiotic use are included in Table 4.

Regarding the attitudes of cadres toward antibiotics use, three statements with lower awareness were “When I get a sore throat, I prefer to take antibiotics” (‘strongly disagree’/‘disagree’: 37.5%), “I would take antibiotics if I have had a cough for more than one week”

(‘strongly disagree’/‘disagree’: 41.1%), and “when I get influenza, I would take antibiotics to help me recover sooner” (‘strongly disagree’/‘disagree’: 47.3%); all of which were within the “indication” domain. While three statements with highest awareness were “I do not have to consult health professionals when redness appears on the skin after consuming antibiotics” (‘strongly disagree’/‘disagree’: 92.0%), “I can change how I use my antibiotics without consulting health personnel” (‘strongly disagree’/‘disagree’: 86.6%), and “Antibiotics must be used as directed and must be finished” (‘strongly agree’/‘agree’: 86.6% - reversed

Table 5. Cadres’ attitudes towards antibiotics use (N = 112).

No	Statements	SD n (%)	D n (%)	U n (%)	A n (%)	SA n (%)
Indication						
1	When I have influenza, I would take antibiotics to help me recover sooner*	17 (15.2)	36 (32.1)	8 (7.1)	46 (41.1)	3 (2.7)
2	When I get a sore throat, I prefer to take antibiotics*	13 (11.6)	29 (25.9)	6 (5.4)	58 (51.8)	3 (2.7)
3	I would take antibiotics if I have had cough for more than one week*	13 (11.6)	33 (29.5)	14 (12.5)	44 (39.3)	7 (6.3)
Access						
4	I will give antibiotics to a family member when they are sick*	32 (28.6)	51 (45.5)	4 (3.6)	22 (19.6)	2 (1.8)
5	I usually keep a stock of antibiotics in my home for future needs*	33 (29.5)	55 (49.1)	3 (2.7)	16 (14.3)	3 (2.7)
6	I use the remaining antibiotics from previous treatments when experiencing the same medical condition*	43 (38.4)	52 (46.4)	3 (2.7)	11 (9.8)	1 (0.9)
Directions for use						
7	Antibiotics must be used as directed and must be finished**	6 (5.4)	3 (2.7)	4 (3.6)	59 (52.7)	38 (33.9)
8	I can change how I use my antibiotics without consulting health personnel*	57 (50.9)	40 (35.7)	2 (1.8)	11 (9.8)	1 (0.9)
9	I usually stop consuming antibiotics when I feel better (although there were some antibiotics remaining)*	34 (30.4)	45 (40.2)	4 (3.6)	22 (19.6)	5 (4.5)
Adverse drug reactions						
10	I do not have to consult health professionals when redness appears on skin after consuming antibiotics*	57 (50.9)	46 (41.1)	3 (2.7)	4 (3.6)	2 (1.8)
11	Allergic reactions (for example, redness on skin) after consuming antibiotics are not alarming	39 (34.8)	56 (50.0)	10 (8.9)	5 (4.5)	2 (1.8)
Resistance						
12	Using antibiotics without a doctor’s prescription can cause bacteria to become resistant†	5 (4.5)	7 (6.3)	16 (14.3)	60 (53.6)	23 (20.5)

SD: Strongly Disagree; D: Disagree; U: Unsure; A: Agree; SA: Strongly Agree; SD: Standard Deviation; *Some missing responses; †Reverse questions – answers should be interpreted reversely.

Table 6. Cadres’ knowledge on antibiotics (N = 112).

No.	Statements	Respondents with correct answers n (%)
Domain 1: Indication		
1	Antibiotics are effective against bacteria (T)	97 (86.6)
2	Antibiotics can treat all infections (F)	30 (26.8)
3	Recovery of influenza would be sooner with the use of antibiotics (F)	40 (35.7)
Total score* (mean ± SD, possible range 0-3) = 1.49 ± 0.82		
Domain 2: Access		
4	Leftover antibiotics can be stored in the house for future needs (F)	97 (86.6)
5	Antibiotics can be purchased without a doctor’s prescription (F)	57 (50.9)
6	Antibiotics can be obtained from relatives or friends without having to see a doctor (F)	93 (83.0)
Total score* (mean ± SD, possible range 0-3) = 2.21 ± 0.89		
Domain 3: Directions for use		
7	I can stop using antibiotics when symptoms have resolved (F)	77 (68.8)
8	Antibiotics would work faster when we take double the prescribed dose (F)	82 (73.2)
9	We should always follow directions for using antibiotics (T)	111 (99.1)
10	All antibiotics can be taken with meals (F)	56 (50.0)
Total score* (mean ± SD, possible range 0-4) = 2.91 ± 0.89		
Domain 4: Adverse drug reactions		
11	Antibiotics effectiveness can decrease when the full course is not taken (T)	71 (63.4)
12	Antibiotics can trigger allergic reactions (T)	67 (59.8)
13	Antibiotics do not cause side effects (F)	66 (58.9)
14	Antibiotics must be stopped immediately when new symptoms appear, such as redness on the skin (T)	98 (87.5)
Total score* (mean ± SD, possible range 0-4) = 2.06 ± 0.93		
Domain 5: Resistance		
15	Humans can develop immunity towards antibiotics (F)	20 (17.9)
16	Antibiotics resistance means that antibiotics can no longer kill the bacteria (T)	53 (47.3)
17	Antibiotic resistance can spread across bacteria (T)	46 (41.1)
Total score* (mean ± SD, possible range 0-3) = 1.06 ± 0.94		
Domain 6: Storage and Disposal		
18	Unused or expired antibiotics can be directly disposed to garbage bin (F)	54 (48.2)
19	Unused or expired antibiotics should be returned to the pharmacy or the doctor’s clinic or Puskesmas (T)	17 (15.2)
20	All antibiotics must be stored in a refrigerator (F)	67 (59.8)
Total score* (mean ± SD, possible range 0-3) = 1.23 ± 0.78		

T: true; F: false; *Total score for each domain was calculated by adding scores of statements in the domain; for each statement - score “1” was given for the correct answer, and the score “0” was given for wrong or “don’t know” answer.

value). Detailed information regarding the cadres' attitudes on antibiotics use can be seen in Table 5.

With regard to the knowledge of cadres have on antibiotics use (Table 6), three statements had the lowest percentages of respondents with correct answers were “unused or expired antibiotics should be returned to the pharmacy/doctor's clinic/*Puskesmas*” (15.2%) – within the “storage and disposal” domain, “humans can be develop immunity toward antibiotics” (17.9%) – within the “resistance” domain, “antibiotics can treat all infections” (26.8%) – within the “indication” domain. Meanwhile, the three statements having the highest percentages of respondents with correct answers were related to following antibiotics use directions (99.1%), stopping antibiotics use when new symptoms appear e.g. redness on skin (87.5%), and retaining the remaining antibiotics for future needs (86.6%) and using antibiotics to kill bacteria (86.6%). For each knowledge domain, the mean total score of correct answers was calculated, each based on a maximum score of three; the results were as follows: indication (1.49 ± 0.82), access (2.21 ± 0.89), direction for use (2.91 ± 0.89), adverse drug reaction (2.06 ± 0.93), resistance (1.06 ± 0.94), and storage and disposal (1.23 ± 0.78).

Discussion

This study involved 112 cadres in Malang City, Indonesia, showing that cadres have the potential to become change agents for promoting the responsible use of antibiotics. Based on the demographic data, most cadres were high school/equivalent graduates which provides a good educational basis for understanding health information. Further, the cadres were all females and the majority were not working, thus allowing a greater time commitment to assist the local communities by providing health advice/information. In parallel with this, prior research has reported that most cadres in Indonesia were female and full-time housewives [41,42]; the lack of males' involvement as cadres could be due to having more responsibility at work, especially in Indonesia where the division of tasks or responsibilities are based on gender [43,44]. With regards to the counselling profiles, the majority of respondents had some previous counselling experience and more than 75% had completed several counselling training sessions. It should be noted that the national cadre training modules have included subjects related to communication and health counselling skills [45]. Moreover, almost half of the cadres received financial rewards for counselling which could be seen as a good basis for establishing a permanent funding system to

encourage cadres' involvement and performance as a change agent.

This study reported that cadres showed a relatively appropriate attitudes and knowledge towards antibiotics. There were three areas, which require improvement for cadres to become an effective change agents. The first was related to “indication”. Less than 50% of cadres answered ‘false’ (correct answers) for “antibiotics can treat all infections” and “recovery of influenza would be sooner with the use of antibiotics”; while, most of them answered correctly (‘true’) for “antibiotics are effective against bacteria”. This might indicate that cadres might understand that antibiotics are effective against bacteria, but they were unable to identify which conditions are associated with bacterial infections. Consequently, cadres reported less disagreement with using antibiotics for symptoms commonly related to viral infections, such as influenza and sore throat. This was confirmed by cadres' antibiotic use profiles in which cadres often take antibiotics for symptoms related to viral infections, such as cough. Prior studies have also reported a lack of ability of the public to identify which conditions are caused by bacterial infections and thus required antibiotics [19,36,46].

Further, this study indicated the need to improve cadres' knowledge regarding “resistance”. Although most cadres were aware that using antibiotics without prescriptions can result in resistance (74.1%), they had not fully grasped the concept of resistance. Less than 50% provided correct answers for “humans can develop immunity toward antibiotics” and “antibiotic resistance means that antibiotics can no longer kill bacteria”. This finding might indicate that cadres did not understand the source of the resistance (i.e. bacteria) which has also been previously reported [38,39]. The *Wellcome Trust* recommended five principles when explaining antibiotic resistance; one of which included the basic aspects of resistance, including the “object” of resistance [47]. Additionally, approximately 50% of cadres did not know that antibiotic resistance could spread amongst bacteria. Without appropriate knowledge of the basic concepts of resistance, cadres might not be able to correctly raise public awareness on the urgency of antibiotics resistance [48,49].

Understanding “storage and disposal” would be of importance for cadres as they might face a situation where patients need to stop their antibiotics before the appointed time and thus causing unused antibiotics; one reason causing the discontinuation of antibiotics might due to allergic reactions [50]. Less than 50% of cadres provided correct answers to “unused or expired

antibiotics can be directly disposed in the garbage bin” and “unused or expired antibiotics should be returned to the pharmacy or the doctor’s clinic or *Puskesmas*”. It was suggested that direct disposal of unused antibiotics in the garbage bin can increase the amount or concentration of antibiotics in the surrounding neighbourhood, thus promoting the development of resistant bacteria [51,52]. Considering the lack of such policies, the Regional Health Office could develop mechanisms or procedures for medicines disposal in their region; and it should be made public when available.

This study highlighted the need to develop education materials for cadres which are focused more on the indications for antibiotics (i.e. emphasised on providing information on the conditions related to bacterial infections), basic concepts of resistance, and disposal of unused antibiotics. Although all aspects of antibiotics are of importance, understanding the specific knowledge gaps in local cadres would ensure appropriate interventions are developed according to the cadres’ learning needs. Other studies have suggested that the application of appropriate learning methods could be considered as one factor of success in cadre education [53,54].

Study limitations

This study have some limitations. First, there is a possibility of bias as cadres were purposefully selected (selection bias), thus caution should be used when generalising the findings. The purposeful sampling, however, was the best option in this case as there was no information available regarding the profiles of cadres in Malang City. However, this study should provide adequate insights toward cadres in Malang City or other urban regions because: 1) participant selection was done by the Region Health Office without the researchers’ intervention, and 2) the characteristics of participating cadres in this study varied, in terms of district of origin, age, education background, experience, and employment; although all of the participants were female this represents the gender of almost all cadres in Indonesia. Also, some standardised national programs for cadres have been implemented in Indonesia, such as “Smart Use of Medication Movement” (*Gerakan Masyarakat Cerdas Menggunakan Obat, Gema Cermat*). Second, this study utilised self-reported data which might subject to recall bias. However, the questionnaire was designed to obtain information within a short recall period (six months). This study also involved active cadres who

tended to have interests in health, thus might lead to a better recollection.

Conclusions

Indonesian health cadres have the potential to become change agents for increasing rational antibiotic use in the community. While cadres in this study generally had past experience in providing education/counseling to their local communities; there are some areas of knowledge and attitudes requiring improvement prior their involvement as antibiotic change agents. These include antibiotic indication, resistance, and disposal. These findings should be used as a basis to develop education and training interventions appropriate for urban based cadres. Further studies should be focused on exploring education methods and facilities which are appropriate to the context of various regions across Indonesia.

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Authors’ contributions

JVC: investigation, formal analysis, writing-original draft preparation. APS: funding acquisition, conceptualisation, validation, writing-reviewing and editing. YIW: methodology, investigation, validation. SVH: investigation, formal analysis, data curation. BP: investigation, validation. ES: methodology, investigation, data curation. BS: conceptualisation, writing- reviewing and editing,

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