Original Article

Public knowledge and attitudes towards antibiotic usage: a cross-sectional study among the general public in the state of Penang, Malaysia

Ai Ling Oh[1], Mohamed Azmi Hassali[2], Mahmoud Sadi Al-Haddad[3], Syed Azhar Syed Sulaiman[1], Asrul Akmal Shafie[2], Ahmed Awaisu[4]

[1]*Discipline of Clinical Pharmacy, School of Pharmaceutical Sciences, Universiti Sains Malaysia, 11800 Penang, Malaysia*
[2]*Discipline of Social and Administrative Pharmacy, School of Pharmaceutical Sciences, Universiti Sains Malaysia, 11800 Penang, Malaysia*
[3]*College of Pharmacy, Taif University, Taif, Saudi Arabia*
[4]*Clinical Pharmacy and Practice Section, College of Pharmacy, Qatar University, Doha, Qatar*

Abstract

Introduction: Public knowledge and attitudes towards antibiotics play a vital role in the success of the treatment process. This study aimed to assess public knowledge and attitudes toward antibiotic usage which could serve as baseline data for future studies within a government hospital setting in Malaysia.

Methodology: A self-administered cross-sectional survey involving 408 respondents was conducted using a validated questionnaire at an outpatient pharmacy department in Penang Hospital, Malaysia, from February to March 2009.

Results: Nearly 55% of the respondents had a moderate level of knowledge. Three quarters of the respondents (76.7%) could correctly identify that antibiotics are indicated for the treatment of bacterial infections. However, 67.2% incorrectly thought that antibiotics are also used to treat viral infections. About 59.1% of the respondents were aware of antibiotic resistance phenomena in relation to overuse of antibiotics. With regard to attitudes, 38% believed that taking antibiotics when having cold symptoms could help them to recover faster, while 47.3% expected antibiotics to be prescribed for common cold symptoms. Age, race and educational level were among the demographic characteristics significantly associated with knowledge and attitudes toward antibiotic use. Poor level of knowledge was found in less than one-third of the respondents whereas more than one-third of the respondents wrongly self-medicate themselves with antibiotics once they have a cold.

Conclusion: Educational interventions are needed to promote prudent use of antibiotics among the public.

Key words: antibiotic usage; public knowledge; attitudes; Malaysia

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Introduction

The escalation of antibiotic resistance poses a significant threat to human health globally. The World Health Report 2007 highlighted the issue of antibiotic resistance as one of the major threats to public health security in the 21st century [1]. Furthermore, the decline in the development of novel antibiotics to combat the menace of antibiotic resistance has created an upheaval public health challenges to health policy makers, health-care workers, and the population around the world [2]. This trend is expected to continue until prudent use of antibiotics is actively promoted, unnecessary use is avoided, and the problem of antibiotic resistance is curbed.

Antibiotic consumption is a key driver of resistance although the relationship is complex [3]. According to the Malaysian Statistics on Medicine 2005, antibiotics were the most commonly prescribed anti-infective agents by both public and private health-care sectors with 9.55 defined daily dose (DDD)/1,000 population/day [4]. The penicillin group is the most commonly used, accounting for 47% of the total use of antibiotics [4]. Malaysia (9.55 DDD/1,000 population/day) has lower antibiotic usage compared to Greece (31.4), France (28.97), the United States (24.92), Europe (19.04), and British Columbia (17.9), and is comparable to countries with relatively lower antibiotics consumption such as Austria (12.5), Latvia (11.7) and in the Netherlands (9.78) [5-7].

The pattern of antibiotic usage in six general hospitals in Malaysia shows that about two thirds were prescribed for therapeutic purposes and the most

common infections treated were lower respiratory tract infections [8]. However, there was a lack of compliance with antibiotics guidelines issued by the Ministry of Health [8]. In the public primary care setting, it was found that half of all the antibiotics prescribed were for upper respiratory tract infections (URTIs) [9]. Overuse of antibiotics for URTIs has been reported even though the majority of these infections are caused by viruses, against which antibiotics have little or no clinical benefit [10,11].

Furthermore, a considerable body of evidence has demonstrated widespread problems in knowledge, attitudes, beliefs and behaviors among consumers which influence the antibiotic usage [12-18]. In the year 2000, the World Health Organization (WHO) report titled *Overcoming Antimicrobial Resistance* identified three key issues for public involvement: 1) improving access to medical services; 2) reducing unnecessary use of antimicrobial drugs and taking a full course of treatment; and 3) not sharing medication with other people or keeping part of the course for another occasion [19]. Therefore, changing public attitudes and improving the knowledge of the people regarding antibiotics use will be an important early strategy to preserve antibiotic effectiveness in the era of resistance.

In Malaysia, pharmacoepidemiologic studies concerning this issue are limited to parental knowledge without a wider coverage to the general public [20,21]. Thus this study sought to explore the current knowledge and attitudes towards antibiotic usage among the general public, which could serve as baseline data and provide further insight in planning and developing strategies for local health education purposes.

Methodology

Study design and population

A cross-sectional survey using a validated self-administered questionnaire was conducted from February to March 2009 among the general public including patients and other hospital attendees (*e.g.*, patient's family members, relatives and friends) attending the Outpatient Pharmacy Department of Penang Hospital. The study was approved by the ethics committee of the Clinical Research Centre, National Institute of Health, Malaysia.

The monthly average number of patients attending the department was 33,000. This number was used as a guide to calculate the sample size needed for this study. We assumed the response distribution to be 50% and determined the confidence interval at 95% with the margin of error 5%. By using the sample size calculator from the Raosoft web site [22], the minimum effective sample size estimated for the survey was 380. The calculation was based on normal distribution and the assumption that we would have more than 30 respondents [22]. Four hundred and twenty participants were included in this study to account for a 10% non-response rate. The subjects were selected using a convenient sampling method. Participants were eligible to be included if they: 1) were above 18 years old; 2) understood English or Malay language and; 3) were aware of the term "antibiotics". Those who did not meet any of those criteria were excluded from the study.

Development of questionnaire

The questionnaire was adapted from previous studies and modified to suit the local population [12,17,18,23]. The questionnaire was comprised of four parts. Part 1 obtained the demographic characteristics of the respondents. Part 2 was designed to assess recent antibiotic usage among the respondents for the past one month. Respondents were requested to provide further information regarding the source and reason for taking antibiotics if they had taken antibiotics within this period. Part 3 of the questionnaire consisted of 14 statements to evaluate knowledge of, and attitudes towards, antibiotics. Areas assessed pertained to the role of antibiotics (five statements), identification of antibiotics (four statements), dangers of antibiotics (antibiotic resistance, allergic reaction and side effects: one statement for each), and completion of treatment course (2 statements). Respondents were requested to choose among three options provided: "Yes", "No", or "Not Sure". A further eight statements addressing public attitudes toward antibiotic usage were included in Part 4, including usage of antibiotics during colds, patients' expectations of the doctor, completion of treatment course, antibiotic sharing, keeping antibiotic stocks for emergency use, using leftover antibiotics, and compliance with following the instruction on the label and reading the expiry date before taking antibiotics. A five-point Likert scale ranging from "Strongly Agree" to "Strongly Disagree" was used to assess the responses of the participants. To simplify the analysis, we classified those who answered "Strongly Agree" and "Agree" as having agreed and those who answered "Strongly Disagree" and "Disagree" as having disagreed. Positive attitudes/responses would imply the appropriateness of antibiotic usage and vice versa. The option "Disagree"

Table 1. Reliability analysis of attitude statements

No.	Attitudes Statements	Corrected Item-Total Correlation	Alpha if Item Deleted
1	When I get a cold, I will take antibiotics to help me get better more quickly.	0.371	0.739
2	I expect antibiotics to be prescribed by my doctor if I suffer from common cold symptoms.	0.488	0.706
3	I normally stop taking antibiotics when I start feeling better.	0.569	0.685
4	If my family member is sick, I usually will give my antibiotics to them.	0.677	0.666
5	I normally keep antibiotic stocks at home in case of emergency.	0.380	0.725
6	I will use leftover antibiotics for a respiratory illness.	0.480	0.716
7	I will take antibiotics according to the instruction on the label. *	0.385	0.730
8	I normally will look at the expiry date of antibiotics before taking it. *	0.277	0.741
	Cronbach's alpha score = 0.76		

*Reverse scoring was used for statements 7 & 8.

for statements 1 to 6 and "Agree" for statements 7 and 8 in the attitude domain indicated a positive attitude/response.

The questionnaire was designed in two language versions: English and Malay (the national language of Malaysia). The English version of the questionnaire was developed initially and was then translated into Malay language. Face and content validation of the questionnaire was done by three senior faculty members (two with expertise in survey and pharmacy practice research and one with clinical expertise and teaching experience in infectious diseases) and two registered pharmacists (both clinical pharmacists with experience in infectious disease management). Modifications were made based on feedback provided, and consensus was reached following a meeting with all experts who were involved in revising the questionnaire. A pilot study was conducted with 20 subjects randomly selected from the study site. From the pilot study, respondents were found to be able to understand and answer the questionnaire provided. Consequently, no further modification of the questionnaire was done prior to the actual survey. Reliability testing was conducted for the attitudes responses from the pilot testing. The results showed internal consistency of the items tested with the Cronbach's α value of 0.76 (Table 1).

Data analysis

In the section assessing the antibiotic knowledge of the respondents (Part 3), one mark was awarded for each correct answer and zero for each wrong or unsure response, with a maximum obtainable correct score of 14. An arbitrary scoring system was used to assess the level of knowledge based on the answers provided. The total knowledge score was categorized into three levels indicated by poor (0-4), moderate (5-9) and good (10-14). All data were analyzed using the Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA) version 13.0. Descriptive statistics were used to summarize the data regarding demographic characteristics, recent use of antibiotics, and knowledge and attitudes toward antibiotic usage. The influence of demographic characteristics on knowledge and attitude was tested using Chi Square or Fishers Exact tests wherever appropriate. A default Monte Carlo simulation in the SPSS software was used to estimate Fisher Exact p-values as the data set was large and normal exact computation required a great amount of computer time and memory [24,25]. Spearman rank correlation was also applied to analyze the direction and degree of the relationship between knowledge and attitudes wherever applicable. The level of statistical significance was set at $p < 0.05$.

Results

A total of 420 questionnaires were distributed to the general public at the Outpatient Pharmacy Department of Penang Hospital. However, 12 of the questionnaires

Table 2. Summary of demographic characteristics

Characteristics	Number (n = 408)	Percentage (%)
Age		
18-30	93	22.8
31-40	91	22.3
41-50	93	22.8
51-60	83	20.3
> 60	48	11.8
Gender		
Male	220	53.9
Female	188	46.1
Race		
Malay	191	46.8
Chinese	146	35.8
Indian	64	15.7
Others	7	1.7
Highest Educational Status		
Primary or lower	13	3.2
Secondary	209	51.2
College/University	186	45.6
Monthly Income		
None	102	25.0
< RM1000 (< USD336)	52	12.7
RM1000-2000 (USD336-672)	118	28.9
RM2001-4000 (USD673-1344)	103	25.2
> RM4000 (> USD1344)	33	8.1

Table 3. Usage of Antibiotics

Recent use (within 1 month)	Number (n = 408)	Percentage (%)
Yes	118	28.9
No	290	71.1
Sources of antibiotic		
Prescribed	109	92.4
Clinic without prescription	3	2.5
Retail pharmacy	6	5.1
Reasons of taking antibiotic		
Fever	48	40.7
Respiratory illness	27	22.9
Pain/Inflammation	18	15.3
Urinary Tract Infection	14	11.9
Skin problem/wound	14	11.9
Others	11	9.3

Table 4. Level of knowledge

Level of Knowledge	Total Score	n (%)
Poor	0-4	118 (28.9)
Moderate	5-9	223 (54.7)
Good	10-14	67 (16.4)

were found incomplete and therefore were excluded from the analysis (useable rate of 97.14%). As shown in the summary of demographic characteristics in Table 2, there was almost an equal distribution of the respondents for all age groups, except those greater than 60 years old, who accounted for only 12% of the total respondents. The mean age of the respondents was 43 years (SD = 14). The majority of the respondents were male (53.9%) and Malay (46.8%). Almost all the respondents (96.8%) had completed at least secondary school. From the results obtained regarding the usage of antibiotics (Table 3), 28.9% (n = 118) of the respondents reported using antibiotics one month prior to the survey. Of those who took antibiotics, the majority (92.4%) were prescribed after consultation with the doctor, while the remaining 7.6% reported that their antibiotics were obtained without prescription either from a retail pharmacy or private clinic without consultation. The reasons for taking antibiotics were mostly due to fever (40.7%) or respiratory illness (22.9%).

More than half of the respondents (54.7%, n = 223) had a moderate level of knowledge with a median total knowledge score of 6 out of 14 (Table 4). A statistically significant difference in knowledge level was noted between age groups ($p = 0.003$), ethnicities ($p < 0.001$), levels of education ($p < 0.001$), and monthly income ($p < 0.001$) (Table 5). Poor level of knowledge was found in the younger generation between the ages of 18 and 30 (39.8% vs. others < 32%), with a higher preponderance among Malays (36.1% vs. others < 34%), a primary or lower educational level (53.8% versus others < 36%), and lower income group RM < 1000 (< USD336) (51.9% versus others < 31%).

From the assessment of the knowledge regarding the role of antibiotics (Table 6), it was found that the highest correct response in the knowledge domain was in identifying antibiotics as a means of treating bacterial infection (76.7%). However, 67.2% incorrectly thought that antibiotics are used to treat viral infection, which was the highest incorrect response in the knowledge domain. Income was the only significant predictor for the statement "Antibiotics are medicines that can kill bacteria" whereby the higher income group (> RM4,000) responded mostly with an incorrect answer (24.2% vs. others < 8%, $p = 0.001$). As for the identification of

Table 5. Association of demographic characteristics with level of knowledge

Characteristics	Level of Knowledge			P value (χ^2 test/ Fisher Exact test)
	Poor (0-4)	Moderate (5-9)	Good (10-14)	
Age				
18-30	37 (39.8%)	49 (52.7%)	7 (7.5%)	0.003
31-40	29 (31.9%)	50 (54.9%)	12 (13.2%)	
41-50	25 (26.9%)	54 (58.1%)	14 (15.1%)	
51-60	21 (25.3%)	43 (51.8%)	19 (22.9%)	
> 60	6 (12.5%)	27 (56.3%)	15 (31.3%)	
Race				
Malay	69 (36.1%)	107 (56.0%)	15 (7.9%)	< 0.001*
Chinese	26 (17.8%)	77(52.7%)	43 (29.5%)	
Indian	22 (34.4%)	34 (53.1%)	8 (12.5%)	
Others	1 (14.3%)	5 (71.4%)	1 (14.3%)	
Educational Status				
Primary or lower	7 (53.8%)	6 (46.2%)	0 (0.0%)	< 0.001*
Secondary	76 (36.4%)	105 (50.2%)	28 (13.4%)	
College/University	35 (18.8%)	112 (60.2%)	39 (21.0%)	
Monthly Income				
None	27 (26.5%)	60 (58.8%)	15 (14.7%)	< 0.001
< RM1000 (< USD336)	27 (51.9%)	22 (42.3%)	3 (5.8%)	
RM1000-2000 (<USD336-672)	37 (31.4%)	58 (49.2%)	23 (19.5%)	
RM2001-4000 (USD673-1344)	23 (22.3%)	65 (63.1%)	15 (14.6%)	
> RM4000 (> USD1344)	4 (12.1%)	18 (54.5%)	11 (33.3%)	

*P values from Fisher Exact test.

Table 6. Association of demographic characteristics with knowledge statements

Statement	Correct Answer	Incorrect Answer	Unsure	P value (X^2 test/ Fisher Exact test)				
				Age	Gender	Race	Education	Income
Role of Antibiotic								
Antibiotics are medicines that can kill bacteria.	313 (76.7%)	27 (6.6%)	68 (16.7%)	0.785	0.916	0.813*	0.057*	**0.001**
Antibiotics can be used to treat viral infections.	55 (13.5%)	274 (67.2%)	79 (19.4%)	0.704	0.912	0.372*	0.682*	0.593
Antibiotics can cure all infections.	182 (44.6%)	104 (25.5%)	122 (29.9%)	0.740	0.730	**< 0.001***	**0.003***	**0.001**
Antibiotics are indicated to relieve pain/ inflammation.	126 (30.9%)	208 (51.0%)	74 (18.1%)	0.517	**0.043**	**0.022***	0.560*	0.566
Antibiotics are used to stop fever.	155 (38.0%)	190 (46.6%)	63 (15.4%)	0.063	0.423	**< 0.001***	0.358*	**0.028**
Identification of Antibiotic								
Penicillin is an antibiotic.	184 (45.1%)	55 (13.5%)	169 (41.4%)	**0.009**	0.078	**< 0.001***	**< 0.001***	**0.032**
Aspirin is a new generation of antibiotic.	139 (34.1%)	84 (20.6%)	185 (45.3%)	**< 0.001**	**0.042**	**0.002***	0.074*	**0.015**
Paracetamol is considered as an antibiotic.	232 (56.9%)	56 (13.7%)	120 (29.4%)	**0.002**	0.545	**0.046***	**< 0.001***	**0.017**
Diphenhydramine is not an antibiotic.	43 (10.5%)	48 (11.8%)	317 (77.7%)	**0.001**	0.253	0.810*	0.398*	0.122
Dangers of Antibiotic								
Overuse of antibiotics can cause antibiotic resistance.	241 (59.1%)	21 (5.1%)	146 (35.8%)	**< 0.001***	0.424	**0.005***	0.191*	0.277
Antibiotics may cause allergic reaction.	220 (53.9%)	63 (15.4%)	125 (30.6%)	0.165	0.610	**0.036***	0.103*	**0.015**
All antibiotics do not cause side effects.	186 (45.6%)	94 (23.0%)	128 (31.4%)	0.797	0.440	**< 0.001***	**0.001***	0.223
Completion of Treatment Course								
You can stop taking a full course of antibiotic if your symptoms are improving.	290 (71.1%)	91 (22.3%)	27 (6.6%)	**0.009**	0.724	0.333*	**0.004***	0.427
The effectiveness of treatment is reduced if a full course of antibiotic is not completed.	253 (62.0%)	90 (22.1%)	65 (15.9%)	0.050	0.273	0.063*	0.055*	0.863

antibiotics, more than half of the respondents could correctly identify paracetamol as not an antibiotic as compared to other medicines tested in this section. However, it is important to note that the unsure responses to the questions in this section were the highest when compared to other sections in the knowledge domain. In addition, about 59% of the respondents knew that overuse of antibiotics could cause antibiotic resistance. Fewer respondents in the younger age group (18-30 years old) (43% vs. others > 53%, $p < 0.001$) and among Malay (51.3% vs. others >56%, $p = 0.005$) correctly replied to the statement regarding antibiotic resistance. As for the feedback pertaining to the need to comply with the full treatment course of antibiotic, a high percentage (> 70%) among the cohort gave a positive response. However, a weak correlation was noted between knowledge (statement 13) and attitude (statement 3) in this area ($r = 0.276$, $n = 408$, $p < 0.001$). For all the knowledge statements tested, inadequate knowledge was mostly found among respondents between 18 to 30 years, Malay, primary or lower educational level, and lower income group (< RM1000).

Respondents were generally found to have more positive attitudes toward antibiotics with results over 50% for almost all dimensions studied (Table 7). Nevertheless, the expectation of a doctor to prescribe antibiotics for common colds accounted for 47.3%, the

Table 7. Association of demographic characteristics with attitude statements

Statement	Agree	Disagree	Unsure	P value (X^2 test/ Fisher Exact test)				
				Age	Gender	Race	Education	Income
When I get a cold, I will take antibiotics to help me get better more quickly.	155 (38.0%)	217 (53.2%)	36 (8.8%)	0.086	0.782	**< 0.001***	**0.003***	0.315
I expect antibiotics to be prescribed by my doctor if I suffer from common cold symptoms.	193 (47.3%)	172 (42.2%)	43 (10.5%)	0.057	0.237	**0.014***	**0.010***	0.200
I normally stop taking antibiotics when I start feeling better.	151 (37.0%)	244 (59.8%)	13 (3.2%)	**< 0.001***	0.881	**0.004***	**0.006***	0.061*
If my family member is sick, I usually will give my antibiotics to them.	37 (9.1%)	360 (88.2%)	11 (2.7%)	0.512*	0.303	**0.028***	**< 0.001***	0.097*
I normally keep antibiotics stocks at home in case of emergency.	61 (15.0%)	327 (80.1%)	20 (4.9%)	**0.005***	0.438	0.205*	0.092*	**0.007**
I will use leftover antibiotics for a respiratory illness.	13 (3.2%)	361 (88.5%)	34 (8.3%)	**0.038***	0.516	0.779*	0.265*	0.387*
I will take antibiotics according to the instruction on the label.*	380 (93.1%)	18 (4.4%)	10 (2.5%)	0.395*	0.197	0.445*	0.507*	0.296*
I normally will look at the expiry date of antibiotics before taking it.*	376 (92.2%)	18 (4.4%)	14 (3.4%)	0.736*	0.155	0.446*	0.749*	0.744*

*P values from Fisher Exact test. Positive attitudes/responses – 'disagree' for statement 1-6 and 'agree' for statement 7 and 8

highest rate of negative response in this section. This was followed by 38% of the respondents who wrongly believed that taking antibiotics when having a cold could help them recover faster. Consistent with the knowledge section, younger age (18-30 years old), Malay ethnicity, and primary or lower educational status were the most frequent groups significantly associated with negative attitudes towards antibiotic usage.

Discussion

The findings have shown that the study population was less knowledgeable pertaining to the indication of antibiotics for the treatment of viral infections. The proportion of respondents who thought that antibiotics are effective for viral infection (67.2%) was comparable with a survey conducted in New Jersey (70%) [23], but higher than proportions reported from Britain, Europe, Denver, Wisconsin and Minnesota (54-55%) [16,26-28]. The possible reason for inadequacy of knowledge in this area could be due to the term "germ", which was normally used during counseling or provision of medical advice to the public/patients instead of using the microbiological term "bacteria" or "virus".

It was found that the respondents generally lacked knowledge to differentiate between antibiotics and other commonly used medicines. Several factors could have contributed to the inadequate knowledge in this dimension: the public were more familiar with trade names instead of generic names, had never heard about or used these medicines, seldom took note of the names of medicines they were taking, or did not get enough information from health-care providers. Further investigation is needed to gain more insight pertaining to this issue.

Most of the respondents (71.1%) had correct knowledge of the need to complete the full course of antibiotics when symptoms of infection are improving. A higher proportion of respondents with correct knowledge was noted in the current study when compared with other studies done in Hong Kong (58%) [17] and Taiwan (50.1%) [29]. In contrast, only 59.8% agreed that they would continue with antibiotic treatment when they start feeling better. A weak positive correlation between knowledge and attitudes was noted pertaining to these statements ($r = 0.276$, $n = 408$, $p < 0.001$); that is, those who knew the need for completing the full course did not necessarily practice it. Therefore, our results suggest that better knowledge does not necessary imply appropriate attitude in relation to antibiotics use. Besides, 62% had correctly agreed that the effectiveness of treatment would reduce without completion of the full course of antibiotics, which is 9% less as compared to 71.1% who know the need to complete the full treatment

course of antibiotics. This showed that the general public might not truly understand the reason and importance of the need to comply with the full treatment course of the antibiotic regimen.

In the present study, 38% of the respondents would take antibiotics for a cold, which was the same percentage as in a British community who thought antibiotics could relieve most cough and cold symptoms [16]. The proportion found in our study was, however, higher than those reported in the US (27%) [12], Hong Kong (17%) (17) and Sydney (3%) (30). Frequent prescribing of antibiotics for viral respiratory infections, which could be self-limiting, has influenced public thought of the effectiveness of antibiotics in treating these illnesses [11,31,32]. Subsequently, the misuse of antibiotics could be a repeated cycle which is detrimental in an era of increasing antibiotic resistance [32]. Such misconceptions have contributed to the high expectation of antibiotic treatment for the common cold. For our present cohort, the expectation of antibiotic treatment for common cold symptoms was shown to have the highest percentage (47.3%) of inappropriate response in the attitude domain. This finding is comparable with that of a survey from the United States which reported that 48% of respondents would ask for antibiotics for cold symptoms [12]. However, lower percentages were reported in surveys from other studies [17,26,29,30].

Several studies have revealed that the patient's expectation is an important determinant of antibiotic prescription and that antibiotics are more likely to be prescribed under pressured clinical context [33-35]. However, inaccurate and over-estimation of patient expectations do occur which result in unnecessary prescribing [34]. Furthermore, the decision to prescribe is also greatly influenced by the doctor-patient relationship, in which the doctor would want to meet the patient's satisfaction even though the prescriber feels antibiotics are unnecessary [33]. Previous studies have suggested that patients were satisfied with a better understanding of their illnesses even when antibiotics were not prescribed [34,36].

Insufficient control of the availability of antibiotics could partly contribute to improper antibiotics use in the community. It has been reported in other countries that there was a possibility that people could obtain antibiotics without a medical prescription even though this practice was illegal [18,31]. In Trinidad and Tobago, one in five of the respondents in a survey obtained their antibiotics as over-the-counter medications at private pharmacies without a doctor's prescription [18], whereas another survey in Hong Kong demonstrated that 9% of participants obtained antibiotics without a prescription [17]. The lower percentage of antibiotic source without prescription found in this study (7.6%) could be an underestimation, as this survey was conducted in a government hospital where medications would only be given when there is a prescription and the public who usually visit this setting may be less likely to visit private health-care institutions such as general practitioners' clinics and community pharmacies. We would expect that a higher proportion of the general public obtain antibiotics without prescriptions and consultations regarding the necessity of antibiotics. This gray area, however, deserves further investigation to know the extent and relative importance of over-the-counter sales of antibiotics without prescriptions in Malaysia. A European survey reported that the dispensing of antibiotics as only prescription medicines was somehow related to the lower rate of home-stored antibiotics and subsequently the misuse of antibiotics [37].

Health-care professionals should share the responsibility of the misuse of antibiotics by the public. The inappropriate prescribing and selling of antibiotics in the community could be driven by both the patients' demands and the profit interest of the health-care providers, which may jeopardize the health-care needs of the patients as well as their safety. This is a complex situation in which a balance needs to be achieved between professionalism and profitable business goals.

In Malaysia, the Know Your Medicine Campaign was initiated in 2006, which aimed to educate and equip the public with skills to know and understand their medicines, to use medicines rationally, and to know their rights about getting information on medicines [38]. The campaign was not targeted primarily at antibiotics per se, but recently some focus has been given to antibiotics: pamphlets regarding antibiotics were made available and widely distributed nationwide in 2009. This program could be an initial step to promote better understanding of antibiotics and should be extended to larger scale educational campaigns on antibiotics, in view of the knowledge inadequacy and negative attitudes toward antibiotic usage noted among the general public in this study.

This study has several limitations. First, it was conducted in a hospital setting; thus the results may not be generalized. We were also unable to assess the different responses which might be provided by illiterate or those unable to understand the two

languages due to the limited language versions of the questionnaire despite the multi-ethnic nature of Malaysia's population. As a convenient sampling method was utilized in this study, there are possibilities for selection bias. Similarly with other public surveys, the results obtained in this questionnaire survey were based on self-reported information which very much depends on the honesty and recall ability of the respondents, as well as their understanding of the questionnaire. Finally, excluding all the respondents who had never heard about antibiotics might result in missing important information regarding this category of people.

Conclusion

Nearly more than half of the respondents had a moderate level of knowledge with a median total score of 6 out of 14. Three quarters of the respondents were able to identify that antibiotics are indicated for the treatment of bacterial infections, whereas 67.2% incorrectly thought that antibiotics are also used to treat viral infections. The public involved in this survey generally had deficiencies in some important aspects related to prudent use of antibiotics and had negative attitudes toward rational use of antibiotics. The results of this study identified areas of misconceptions and specific groups to be targeted for educational interventions regarding prudent use of antibiotics among the general public in Malaysia. It is therefore suggested that a well-planned, organized and structured educational program should be undertaken to improve the appropriate use of antibiotics.

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Corresponding author
Mohamed Azmi Hassali, PhD
Associate Professor
Discipline of Social and Administrative Pharmacy
School of Pharmaceutical Science
Universiti Sains Malaysia
11800 Minden
Penang, MALAYSIA
Tel: +604-6533888 ext: 4085
Fax: +604-6570017
Email: azmihassali@usm.my

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