A Cross Sectional Study of Public Knowledge and Attitude towards Antibiotics in Putrajaya, Malaysia

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Abstract

Objective: The objective of the study was to assess public knowledge and attitudes regarding antibiotic utilization in Putrajaya, Malaysia.

Methods: A self-administered questionnaire survey was conducted among public attending a local hospital. The four-part questionnaire collected responses on demographic characteristics, recent use of antibiotics, knowledge and attitude statements. Cronbach’s alpha for knowledge and attitude statements were 0.68 and 0.74 respectively. Only questionnaires with complete responses were analysed. General linear modelling was used to identify demographic characteristics which contributed significantly to knowledge and attitude. Multiple logistic regression was used to determine the adjusted odds ratios of obtaining an inappropriate response for each knowledge and attitude statement. The relationship between antibiotic knowledge and attitude was examined using Pearson’s correlation and correlation between related statements was performed using the Chi-square test. In all statistical analyses, a p-value of < 0.05 was considered statistically significant.

Results: There was positive correlation (p<0.001) between mean knowledge (6.07±2.52) and attitude scores (5.59±1.67). Highest education level (p<0.001) and healthcare-related occupation (p=0.001) contributed significantly to knowledge. Gender (p=0.010), race (p=0.005), highest education level (p<0.001), employment status (p=0.016) and healthcare-related occupation (p=0.005) contributed significantly to attitude. The differences in score between demographic groups were small. Misconceptions that antibiotics would work on both bacterial and viral infections were reported. Approximately three quarters of respondents expected antibiotics for treatment of coughs and colds. Close to two thirds (60%) believed that taking antibiotics would improve recovery. Several demographic groups were identified as ‘high risk’ with respect to gaps in knowledge and attitude.

Conclusions: This study has identified important knowledge and attitude gaps as well as people ‘at risk’. These findings would be useful in strategizing targeted antibiotic awareness campaigns and patient counselling.

Keywords: antibiotic, attitude, knowledge, Malaysia, public, survey

Introduction

Emergence of antibiotic resistance has become a global public health concern in recent decades. Studies in Europe [1,2] indicate that resistance against antibiotics increases with higher consumption, which could be driven by irrational use of antibiotics and insufficient patient education by prescribers. [3]

While antibiotic utilization in Malaysia (9.65 defined daily doses (DDD) / 1000 population / day) [4] is low compared to European countries such as Norway (16.16), Denmark (17.8), France (21.56) and Finland (30.85) [5], the country is not free from the issue of antibiotic resistance. In fact, in 2010, the National Surveillance on Antibiotic Resistance [6] reported an increase of antibiotic resistance among common strains of bacteria such as Staphylococcus aureus, Acinetobacter and Haemophilus influenzae.

According to the Malaysian National Medicine Use Survey (NMUS) 2007, antibiotics were the 11th most utilised therapeutic
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Methods

Questionnaire Development and Structure

A questionnaire was used to gather public responses. A four-part questionnaire was adapted and modified from previous studies [12, 17–19]. Part I recorded a total of 9 demographic characteristics and Part II documented respondents’ recent antibiotics consumption (defined as antibiotic use within the past four weeks). Part III was made up of 12 knowledge statements covering five aspects including: identification of antibiotics, action of antibiotics, good bacteria, adverse effects of antibiotics and administration of antibiotics. Participants were asked to respond with either “Yes”, “No” or “Not Sure”. Part IV contained eight attitude statements and respondents were required to answer according to a 5-point Likert scale (1=strongly disagree; 2=disagree; 3=not sure; 4=agree and 5=strongly agree). Part IV was adopted wholly from a previous study [12]. The questionnaire was originally developed in English, which was then translated into Malay language (the national language of Malaysia). Face and content validation of the questionnaire was undertaken by a panel of senior hospital pharmacists. Feedback was gathered to improve the questionnaire presentation, clarity and congruency of meaning. Modifications were made and the questionnaire was pilot-tested among 30 respondents. Pilot testing was carried out based on the feedback from the first round and reliability testing was also conducted. Cronbach’s alpha for Part III and Part IV of the questionnaire were 0.68 and 0.74 respectively.

Study Design and Administration of Questionnaire

The study was conducted over 6 weeks in February and March 2010 using the validated questionnaire. Respondents were attendees of the outpatient pharmacy department of Putrajaya Hospital. Sample size was determined using the Raosoft sample size calculator [20] for the population of 116,000 people attending Putrajaya Hospital annually. A sample size of 383 was required to provide a confidence level of 95%.

Along with a confidentiality statement and paragraph explaining the objectives of the study, 520 self-administered questionnaires were distributed to account for potential non-response. A convenience sampling method was adopted. The inclusion criteria were: (1) Adults aged 18 years and over; (2) able to read and understand Malay or English and (3) aware of the term ‘Antibiotics’. Verbal consent was obtained from all study participants before administering the questionnaire. No personal identifiers were included in the form.

Statistical Analysis

Only fully completed questionnaires were included in the analysis. Numerical data were expressed as mean ± standard deviation. Respondents’ age was categorised into four groups “18–30”, “31-45”, “46-60” and “61 and above”. “Appropriate responses”, defined as correct answers for Part III and positive attitude for Part IV were given 1 score as opposed to 0 score for “inappropriate responses”, defined as either incorrect answers, negative attitude or “Not Sure”.

All data were analysed using SPSS® version 20.0. Demographic characteristics, recent use of antibiotics, knowledge and attitude scores were summarised using descriptive statistics. The difference between mean scores was examined by using t-test or ANOVA where appropriate. Demographic characteristics which contributed significantly to knowledge and attitude were identified using a general linear model (GLM). The adjusted odds ratios (AORs) of obtaining an inappropriate response for each knowledge and attitude statement were determined using multiple logistic regressions. Pearson’s correlation was used to examine the relationship between antibiotic knowledge and attitude. Correlation between related statements was performed using Chi-square test. In all statistical analyses, a p-value of < 0.05 was considered to be statistically significant.

Results

Out of 520 questionnaires distributed, 508 questionnaires were returned (97.7% response), of which 107 questionnaires were incomplete. The final sample included 401 questionnaires.
Respondents’ demographic characteristics are summarised in Table 1. The mean age of the respondents was 41.1 ± 13.8 years old, with most falling within the 31-45 age group. Most respondents were Malay (77.1%), female (63.8%), had undertaken tertiary education (62.1%) and were wage-earners (64.6%). A minority of respondents worked in health-related occupation (11.0%), as did their family members (23.9%).

Only characteristics with significant difference (p < 0.05) in mean scores were included in the general linear model (Table 1). After adjustment, highest education level (p<0.001) and healthcare-related occupation (p=0.001) were found to contribute significantly to the mean knowledge score whereas gender (p=0.010), race (p=0.005), highest education level (p<0.001), employment status (p=0.016) and healthcare-related occupation (p=0.005) were found to contribute significantly to mean attitude score.

Sixty six respondents (16.5%) reported taking antibiotics within the past four weeks of the survey; most of whom obtained their medicines after consultation with doctors. Three admitted to purchasing antibiotics from retail pharmacy without prior consultation. The most common reason cited for taking antibiotics was respiratory tract infections (31.4%), which was defined as either cold, cough or flu, followed by fever (29.1%), others (12.8%), pain or inflammation (10.5%), skin problems or wounds (8.1%) and urinary tract infections (8.1%). Respondents who cited “Others” specified eye infection, ear infection, tooth infection or post-operative use as their reasons for consuming antibiotics.

The knowledge score ranged from 0 to 12 points, with a mean of 6.07 ± 2.52 and a median of 6.00. Highest inappropriate response was observed for statements on role of antibiotics. The majority of respondents did not know that antibiotics would not work against viral infections (83.0%) and most coughs and colds (82.0%). On the other hand, the majority (82.5%) seemed to be aware that antibiotics may cause allergic reactions; about half of them (52.1%) did not know antibiotics could also cause side effects. Knowledge on antibiotic resistance was also low (Table 2).

The statement “It is okay to stop taking antibiotics when symptoms are improving” was strongly associated with the statements “Antibiotics are the same as medications used to relieve pain and fever such as aspirin and paracetamol” (p<0.001) and “Taking less antibiotic than prescribed is more healthy than taking the full course prescribed.” (p<0.001).

The attitude score ranged from 0 to 8 points, with a mean score of 5.59 ± 1.67 and a median of 6.00. The percentage of inappropriate responses for the eight attitude statements are summarised in Table 3.

### Table 1: Respondents’ demographic characteristics

| Characteristics | Mean Knowledge Score ± S.D | p value | Mean Attitude Score ± S.D | p value |
|-----------------|-----------------------------|---------|---------------------------|---------|
| Gender          |                             |         |                           |         |
| Female (n = 256) | 6.31 ± 2.45                 | 0.012   | 5.79 ± 1.53               | 0.002   |
| Male (n = 145)  | 5.64 ± 2.59                 |         | 5.23 ± 1.84               |         |
| Age (years old) |                             |         |                           |         |
| > 60 (n = 37)   | 6.73 ± 2.92                 | 0.329   | 6.27 ± 1.74               | 0.062   |
| 46 – 60 (n = 107)| 6.16 ± 2.37                 |         | 5.61 ± 1.62               |         |
| 31 – 45 (n = 144)| 5.96 ± 2.42                 |         | 5.49 ± 1.73               |         |
| 18 – 30 (n = 113)| 5.90 ± 2.64                 |         | 5.47 ± 1.57               |         |
| Race            |                             |         |                           |         |
| Malay (n = 309) | 6.00 ± 2.46                 | 0.353   | 5.46 ± 1.64               | 0.003   |
| Chinese (n = 46)| 6.67 ± 2.44                 |         | 6.39 ± 1.42               |         |
| Indian (n = 31) | 6.03 ± 2.83                 |         | 5.81 ± 1.92               |         |
| Others (n = 15) | 5.67 ± 3.2                  |         | 5.27 ± 1.67               |         |
| Highest Education Level |           |         |                           |         |
| College / University (n = 249) | 6.62 ± 2.41 | 0.000  | 5.86 ± 1.56               | 0.000   |
| Secondary School (n = 128) | 5.21 ± 2.35 |         | 5.10 ± 1.72               |         |
| Primary School (n = 17) | 4.53 ± 2.53 | 0.643  | 5.35 ± 1.69               | 0.031   |
| None (n = 7)    | 5.86 ± 3.98                 |         | 5.29 ± 2.63               |         |
| Employment Status |                            |         |                           |         |
| Employed for Wages (n = 259) | 6.11 ± 2.48 | 0.004  | 5.61 ± 1.66               | 0.000   |
| Self employed (n = 29) | 5.48 ± 2.69 |         | 4.79 ± 1.50               |         |
| Housewife / Househusband (n = 32) | 6.41 ± 2.30 | 0.058  | 5.88 ± 1.68               | 0.062   |
| Retired / Unemployed (n = 60) | 6.10 ± 2.73 |         | 5.85 ± 1.70               |         |
| Student (n = 21) | 5.76 ± 2.55                 |         | 5.14 ± 1.62               |         |
| Is your occupation related to health-care? |           |         |                           |         |
| Yes (n = 44)    | 7.34 ± 3.06                 | 0.004   | 6.43 ± 1.42               | 0.000   |
| No (n = 357)    | 5.91 ± 2.41                 |         | 5.48 ± 1.67               |         |
| Is your family’s occupation related to health-care? |           |         |                           |         |
| Yes (n = 96)    | 6.49 ± 2.47                 | 0.058   | 5.86 ± 1.67               | 0.062   |
| No (n = 305)    | 5.93 ± 2.53                 |         | 5.50 ± 1.66               |         |
| What is your most common location seeking health-care? |           |         |                           |         |
| Gov. Clinic / Hospital (n = 289) | 6.08 ± 2.51 | 0.268  | 5.56 ± 1.69               | 0.182   |
| Private Clinic / Hospital (n = 92) | 5.85 ± 2.64 |         | 5.51 ± 1.53               |         |
| Pharmacy (n = 20) | 6.85 ± 2.08 | 0.058   | 6.25 ± 1.89               |         |
| Others (n = 0)  | -                          |         | -                         |         |
| Do you have any chronic disease? |           |         |                           |         |
| Yes (n = 142)   | 6.16 ± 2.58                 | 0.582   | 5.73 ± 1.56               | 0.181   |
| No (n = 259)    | 6.02 ± 2.50                 |         | 5.51 ± 1.72               |         |
Table 2: Proportion of inappropriate responses for knowledge statements, compared to that for similar statements from other studies.

| No. | Statement                                                                 | Current Study (%) | Oh et al (%) | McNulty et al (%) | Chen et al (%) |
|-----|---------------------------------------------------------------------------|-------------------|--------------|------------------|---------------|
|     |                                                                           | N=401             | 408          | 7120             | 1024          |
| 1   | Antibiotics are medicines that can kill bacteria.                         | 21.7              | 23.3         | 20.0*            | -             |
| 2   | Antibiotics can be used to treat viral infections.                        | 83.0              | 86.6         | ± 53.0*          | -             |
| 3   | Antibiotics work on most colds & coughs.                                  | 82.0              | -            | 38.0             | -             |
| 4   | Antibiotics can kill bacteria that normally live on the skin and gut      | 60.3              | -            | 43.0*            | -             |
|     | (digestion tract).                                                        |                   |              |                  |               |
| 5   | Bacteria that normally live on the skin and in the gut are good for your  | 73.1              | -            | ± 42.0           | -             |
|     | health.                                                                  |                   |              |                  |               |
| 6   | Antibiotics are the same as medications used to relieve pain              | 33.4              | -            | -                | -             |
|     | and fever such as aspirin and paracetamol (Panadol).                      |                   |              |                  |               |
| 7   | Penicillin is an antibiotic.                                              | 61.8              | 54.9         | -                | -             |
| 8   | Antibiotics may cause allergic reactions.                                 | 17.5              | 46.0         | -                | -             |
| 9   | Antibiotics do not cause side effects.                                    | 52.1              | 54.4         | -                | -             |
| 10  | Overuse of antibiotics can cause the antibiotics to lose effectiveness   | 32.2              | 40.9*        | -                | -             |
|     | in long term.                                                             |                   |              |                  |               |
| 11  | It is okay to stop taking an antibiotic when symptoms are improving.     | 41.9              | 28.9*        | -                | 49.9*         |
| 12  | Taking less antibiotic than prescribed is more healthy than taking the    | 33.2              | -            | -                | 92.6*         |
|     | full course prescribed.                                                    |                   |              |                  |               |

* Statements were not exactly the same as that in this study.

Nearly half of the respondents (45.6%) would stop an antibiotic course when their symptoms improved. Meanwhile, seventeen percent of respondents reported sharing their antibiotics with family members and would store antibiotics at home for emergency use. A small percentage of respondents demonstrated little caution when consuming antibiotics. In particular, seven percent did not check expiry dates and fewer again (3.5%) reported not taking antibiotics according to labelled instructions. Strong association was observed between respondents who would expect an antibiotic prescription for the common cold and those who thought antibiotics were effective in treating coughs and colds (p<0.001).

Table 3: Proportion of inappropriate responses for attitude statements, compared to that for similar statements from other studies.

| No. | Statement                                                                 | Current Study (%) | Oh et al (%) | McNulty et al (%) | Chen et al (%) | Vanden Eng et al (%) |
|-----|---------------------------------------------------------------------------|-------------------|--------------|------------------|---------------|---------------------|
|     |                                                                           | N=401             | 408          | 1204             | 1024          | 12755              |
| 1   | When I get cold, I will take antibiotics to help me get better more      | 61.8              | 46.8         | -                | 36.9*         |                     |
|     | quickly.                                                                 |                   |              |                  |               |                     |
| 2   | I expect antibiotic to be prescribed by my doctor if I suffer from        | 73.8              | 57.8         | 24.9*            | 53.6*         |                     |
|     | common cold symptoms.                                                     |                   |              |                  |               |                     |
| 3   | I normally stop taking an antibiotic when I start feeling better.        | 45.6              | 40.2         | -                | -             |                     |
| 4   | If my family member is sick I usually will give my antibiotic to them.  | 17.0              | 11.8         | 13.1*            | -             |                     |
| 5   | I normally keep antibiotic stock at home in case of emergency.           | 17.0              | 19.9         | -                | -             |                     |
| 6   | I will use leftover antibiotics for a respiratory illness (runny nose/   | 14.7              | 11.5         | -                | -             |                     |
|     | sore throat / flu).                                                        |                   |              |                  |               |                     |
| 7   | I will take antibiotic according to the instruction on the label.        | 3.5               | 6.9          | 4.5*             | -             |                     |
| 8   | I normally will look at the expiry date of antibiotic before taking it.  | 7.0               | 7.8          | -                | -             |                     |

* Statements were not exactly the same as that in this study.
Significant positive correlation was noted between respondents’ antibiotic knowledge score and their attitude score ($r = 0.462$, $p<0.001$). The AORs for knowledge and attitude statements are found in Table 4 and 5 respectively, with demographic characteristics. People in younger age groups, with secondary education or lower and male were found to have higher odds of poor knowledge on adverse reactions, administration of antibiotics, and attitude statements (Table 4). Those in the younger age groups were more likely to report taking antibiotics to recover more quickly, to expect antibiotics for common cold and to stop antibiotics when symptoms improve. Respondents with primary and / or no education were those who reported less caution in using leftover antibiotics and not using antibiotics according to instructions on the label (Table 5).

Table 4: Factors associated with inappropriate response for each knowledge statements.

| Statement                                                                 | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    | 12    |
|---------------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Gender                                                                    | Female | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |
|                                                                          | Male   | 1.577 | 0.936 | 1.787 | 0.867 | 0.900 | 1.319 | 1.261 | 2.381 | 1.704 | 1.712 | 2.120 | 1.820 |
| Age                                                                       | More than 60   | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |
|                                                                          | 46 – 60 | 3.247 | 1.114 | 0.889 | 1.902 | 1.726 | 0.975 | 1.308 | 0.930 | 1.141 | 1.580 | 2.328 | 1.098 |
|                                                                          | 31 – 45 | 2.489 | 1.940 | 1.662 | 1.597 | 2.881 | 1.018 | 0.941 | 2.648 | 1.207 | 2.454 | 3.020 | 2.269 |
|                                                                          | 18 – 30 | 2.837 | 2.249 | 0.804 | 1.770 | 2.475 | 1.177 | 0.974 | 5.071 | 1.774 | 4.346 | 2.976 | 2.566 |
| Race                                                                      | Malay   | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |
|                                                                          | Chinese | 0.612 | 1.327 | 0.818 | 0.482 | 0.528 | 2.107 | 5.734 | 0.263 | 0.153 | 0.990 | 0.748 | 1.624 |
|                                                                          | Indian  | 1.519 | 0.934 | 1.165 | 0.957 | 1.265 | 1.108 | 1.054 | 0.712 | 0.256 | 1.402 | 0.850 | 0.900 |
|                                                                          | Others  | 0.510 | 1.392 | 6.178 | 2.897 | 0.629 | 0.849 | 0.658 | 0.674 | 0.353 | 1.325 | 0.298 | 0.517 |
| Highest Education Level                                                   | University / College | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |
|                                                                          | Secondary | 3.076 | 1.329 | 0.837 | 4.322 | 2.107 | 1.078 | 1.832 | 2.168 | 1.726 | 2.044 | 3.405 | 3.140 |
|                                                                          | Primary  | 5.662 | 2.594 | 1.497 | 1.574 | 1.071 | 0.938 | 1.040 | 2.847 | 2.701 | 8.686 | 5.076 | 5.134 |
|                                                                          | None     | 2.255 | 2.823 | 1.567 | 2.511 | 1.252 | 1.757 | 1.037 | 6.407 | 0.537 | 2.415 | 5.991 | 4.429 |
| Employment Status                                                        | Employed for wages | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |
|                                                                          | Self-employed | 1.943 | 1.121 | 0.920 | 1.014 | 1.725 | 0.870 | 0.944 | 0.436 | 1.010 | 1.495 | 1.835 | 1.261 |
|                                                                          | Housewife / House husband | 0.630 | 1.200 | 0.385 | 0.522 | 1.214 | 0.782 | 1.417 | 0.891 | 0.381 | 0.749 | 2.454 | 0.614 |
|                                                                          | Retired / Unemployed | 0.684 | 1.277 | 0.764 | 1.729 | 2.868 | 0.519 | 1.014 | 1.899 | 1.628 | 0.934 | 0.967 | 1.427 |
|                                                                          | Student  | 1.491 | 2.130 | 0.536 | 2.469 | 0.736 | 1.785 | 1.329 | 0.840 | 0.592 | 2.151 | 1.190 | 0.536 |
|                                                                          | Is your occupation related to healthcare? | Yes | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |
|                                                                          | No       | 1.082 | 3.076 | 1.162 | 5.341 | 2.185 | 1.116 | 2.072 | 1.615 | 1.929 | 1.712 | 1.215 | 1.392 |
|                                                                          | Is your family’s occupation related to healthcare? | Yes | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |
|                                                                          | No       | 0.802 | 1.053 | 0.984 | 0.518 | 0.810 | 1.644 | 1.480 | 0.796 | 0.990 | 1.509 | 1.048 | 1.385 |
|                                                                          | What is your most common location seeking healthcare? | Government Clinic / Hospital | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |
|                                                                          | Private Clinic / Hospital | 1.139 | 1.062 | 1.553 | 0.696 | 1.178 | 1.850 | 0.979 | 0.901 | 0.660 | 0.801 | 0.816 | 1.600 |
|                                                                          | Pharmacy  | 0.519 | 1.018 | 0.963 | 0.287 | 5.233 | 1.644 | 0.361 | 0.000 | 0.616 | 0.705 | 0.681 | 0.465 |
|                                                                          | Do you have any long term diseases? | Yes | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |
|                                                                          | No       | 0.867 | 0.991 | 0.826 | 1.670 | 0.992 | 1.324 | 1.103 | 0.950 | 0.645 | 0.746 | 1.471 | 1.098 |

*Reference group of the categorical variable.
Odds ratios were adjusted for all variables. The odds ratios were obtained by stepwise multiple logistic regression analysis. Statistically significant variables are in bold.
Table 5: Factors associated with inappropriate response for each attitude statement.

| Statement | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|-----------|---|---|---|---|---|---|---|---|
| Gender    | Female<sup>a</sup> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|           | Male | 1.777 | 1.670 | 1.753 | 2.012 | 2.162 | 2.507 | 2.628 | 1.564 |
| Age       | More than 60<sup>a</sup> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|           | 46 – 60 | 2.862 | 2.152 | 2.306 | 1.355 | 0.766 | 1.243 | 6.537 | 2.684 |
|           | 31 – 45 | 4.697 | 3.571 | 3.125 | 2.523 | 1.623 | 3.185 | 5.006 | 0.702 |
|           | 18 – 30 | 5.466 | 4.484 | 3.620 | 2.779 | 1.845 | 3.164 | 1.154 | 1.083 |
| Race      | Malay<sup>a</sup> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|           | Chinese | 0.203 | 0.313 | 0.300 | 0.886 | 1.212 | 1.285 | 4.869 | 1.336 |
|           | Indian | 0.523 | 0.313 | 0.759 | 0.675 | 1.026 | 1.232 | 2.021 | 1.238 |
|           | Others | 0.942 | 0.759 | 0.617 | 1.619 | 2.760 | 1.365 | 0.000 | 2.558 |
| Highest Education Level | University / College<sup>a</sup> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|           | Secondary | 1.855 | 3.385 | 3.218 | 1.981 | 1.530 | 1.651 | 4.487 | 0.737 |
|           | Primary | 1.356 | 1.472 | 2.404 | 2.109 | 1.677 | 1.607 | 16.373 | 0.828 |
|           | None | 1.468 | 1.489 | 2.815 | 4.867 | 1.293 | 12.012 | 26.687 | 4.984 |
| Employment Status | Employed for wages<sup>a</sup> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|           | Self-employed | 3.049 | 2.698 | 1.914 | 0.866 | 1.385 | 1.880 | 3.442 | 2.371 |
|           | Housewife / House husband | 2.215 | 1.043 | 0.894 | 0.730 | 0.602 | 0.446 | 1.299 | 0.196 |
|           | Retired / Unemployed | 1.971 | 1.648 | 1.221 | 0.817 | 0.697 | 2.104 | 0.851 | 0.597 |
|           | Student | 2.480 | 2.792 | 1.611 | 1.697 | 2.343 | 0.214 | 0.000 | 3.984 |
| Is your occupation related to healthcare? | Yes<sup>a</sup> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|           | No | 1.951 | 3.014 | 1.723 | 1.273 | 1.184 | 1.553 | 1.284e8 | 1.259e8 |
| Is your family’s occupation related to healthcare? | Yes<sup>a</sup> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|           | No | 1.283 | 1.854 | 1.157 | 1.168 | 1.163 | 0.721 | 0.538 | 0.971 |
| What is your most common location seeking healthcare? | Government Clinic / Hospital<sup>a</sup> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|           | Private Clinic / Hospital | 0.741 | 0.842 | 1.126 | 1.120 | 0.739 | 0.755 | 1.231 | 2.068 |
|           | Pharmacy | 0.454 | 0.360 | 0.389 | 0.489 | 0.416 | 0.610 | 6.301 | 2.584 |
| Do you have any long term diseases? | Yes<sup>a</sup> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|           | No | 0.744 | 0.690 | 1.285 | 1.815 | 1.450 | 1.455 | 1.214 | 1.265 |

<sup>a</sup>Reference group of the categorical variable. Odds ratios were adjusted for all variables. The odds ratios were obtained by stepwise multiple logistic regression analysis. Statistically significant variables are in bold.

Discussion

**Antibiotic Use**

Only 16.5% of respondents reported using antibiotics within the past month which was lower than the 28.9% reported in the northern state of Penang [12]. However, the main indications reported in this survey and the Penang survey were similar, with respiratory tract infections and fever being the main ones. It was still possible for the public to obtain antibiotics without prescriptions even though this practice is illegal. (Table 1) Compared to 7.5% reported in Penang [12] and 9.0% reported in Hong Kong [21], the proportion of respondents who did so in this study was lower (4.5%).

**The Knowledge and Attitude Gaps**

The results suggest that misunderstandings about antibiotic use were prevalent, which may cause unnecessary risk of antibiotic-resistant infection. Confusion about the role of antibiotics in treating infections was the most critical, with more than 80% of respondents failing to identify that antibiotics do not eradicate viral infections. This is consistent with the study in Penang (86.6%) [12]. In contrast, the proportion was reported to be 53.0% in a UK study [17]. Thirty eight percent of respondents from the UK study [17] thought antibiotics would be effective for treating most coughs and colds, compared to 83.0% in this study. The significant correlations between knowledge statements 6, 11 and 12 indicate that the knowledge gap might not be totally random. Respondents might have mistaken antibiotics as equivalent to painkillers or antipyretics, leading them to assume that stopping antibiotics is okay, as they would do with painkillers and antipyretics with symptom improvement.
The prevalence of inappropriate attitudes was higher compared to previous work [12,17,18]. In particular, more respondents from this survey reported that they would take antibiotics to help them recover faster, would expect antibiotics to be prescribed by a doctor for the common cold, would stop antibiotics when they start to feel better, would share antibiotics with sick family members and would use left-over antibiotics for treating future respiratory illnesses (Table 3).

Factors that were expected to have huge impact on knowledge and attitude, such as higher education level, race and increased age showed only a maximum of 2.1 score difference. Education level has been reported as a factor significantly associated with both knowledge [12,21] and attitude [21] on antibiotics. A local study found ethnicity to contribute significantly to knowledge on antibiotics [12].

Respondents’ knowledge of appropriate antibiotic use was found to correlate positively with attitude. Strong association was also observed between several knowledge and attitude statements. This was consistent with a study in Korea, where adequate knowledge of antibiotics was shown to be a predictor for appropriate attitudes toward antibiotics and their use where participants with adequate knowledge were 1.52 times more likely to demonstrate appropriate attitude [22].

**The ‘High Risk’ Group**

This survey identified demographic groups who were prone to misconceptions and efforts to reach these groups of people should be a part of future educational campaigns. For instance, respondents without tertiary education may benefit from education about antibiotics only being effective for bacterial infections and not viruses.

**Targeted Antibiotic Campaign and Counselling**

An antibiotic campaign was launched in 1999 in the UK targeting young women and mothers who had higher consultation rates than other patients [23]. Its success in raising awareness on antibiotic resistance and reducing expectations for antibiotics had led the campaign being repeated in 2002. In Malaysia, it would be worth considering such a campaign at least at a local level. The Know Your Medicine Campaign [24] launched jointly by the Ministry of Health and Consumers Association of Malaysia in 2007 was a positive start and demonstrated willingness on the part of policy-makers but also providers at grassroots levels to promote prudent medicine usage among the public.

Previous work has reported members of the public not identifying with bacterial resistance as a personal threat and feel they have no role in managing the risk associated with it [25]. Hence, a targeted antibiotic campaign should aim to make members of the public, particularly those from the ‘high risk’ groups identified in this study feel that they have an influence in overcoming antibiotic resistance. Successful implementation of a nationwide campaign could potentially lead to sustained reduction of antibiotic utilization and lower bacterial resistance [26,27]. On another level, healthcare professionals also have the responsibility of providing proper counselling to these “high risk” patients. Effective doctor-patient communication and patient empowerment have been shown to reduce antibiotic prescribing for coughs and colds in the primary care setting [28]. Besides the knowledge, instilling the right attitude should also be a priority as simply increasing public knowledge on antibiotics has been shown to cause higher incidences of self-medication [17].

**Limitations**

There are several limitations in this study. Similar to all self-administered public surveys, the accuracy of the results was heavily dependent on the honesty and understanding of the respondents. Selection bias might occur due to convenience sampling. As the study was conducted in a local hospital setting, the findings may not be generalised to the whole country or other sectors of health care. The survey methodology omitted respondents who could not understand English or Malay language and those who had no awareness of the term “antibiotic”.

**Conclusion**

The study identified important knowledge and attitude gaps as well as people ‘at risk’. Future antibiotic awareness campaigns and patient counselling should promote specific messages to public members from the ‘high risk’ groups, to fill up the knowledge and attitude gaps as an effort against antibiotic resistance.

**Authors’ Contributions**

KK Lim had the original idea for the study. Both KK Lim and CC Teh designed the questionnaire and carried out the data collection. KK Lim carried out the data analysis and wrote the first draft of the paper. All authors contributed to the revision of the paper and approved the final version.

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**Conflict of Interest**

None.

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