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1 **Original Article**

2 A Cross-Sectional Study Evaluating the Knowledge and Beliefs About, and the Use of Antibiotics
3 Amongst Medical Students in Malaysia

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77 [Original Article](#)

78 A Cross-Sectional Study Evaluating the Knowledge and Beliefs About, and the Use of Antibiotics
79 amongst Medical Students in Malaysia

80 **ABSTRACT**

81 **Background:** The introduction of antibiotics into modern medicine has changed clinical care by
82 saving millions of lives. However, antibiotics are not a panacea for everything and misuse of
83 antibiotics has led to their many benefits being overshadowed by the development of
84 antimicrobial resistance. **Aims of Study:** This study aimed to assess university students'
85 knowledge and beliefs about and their use of antibiotics. **Methods:** This cross-sectional study
86 was conducted among medical and non-medical students of the National Defence University of
87 Malaysia. A universal and convenience sampling method was applied for medical students and
88 non-medical students respectively. The data was collected using a validated questionnaire and
89 analyzed using IBM SPSS Statistics version 24 (IBM Corporation, Armonk, NY, USA). Frequencies
90 and percentages were used to describe the knowledge and beliefs about and use of antibiotics,
91 and the MANOVA test and Logistic Regression were used to explore the associated factors.
92 **Results:** A total of 674 students participated in this study who expressed a high level of trust in
93 their doctors. More than half of the respondents' knowledge was low (58.2%) and their health
94 beliefs were outdated (56.1%). Respondents' age, race and program were found to be
95 significantly associated with up-to-date knowledge and beliefs about antibiotic use ($p < 0.001$),
96 while multiple logistic regression found factors associated with finishing a course of antibiotics
97 were studying in a medical field (OR=3.370; $p < 0.001$), perceived personal health (OR=0.467;
98 $p = 0.009$) and ethnic origin (OR=0.455; $p = 0.045$). Using multiple logistic regression, the
99 significant factors associated with antibiotic self-prescribing were beliefs (OR=0.756; $p < 0.001$);
100 had been prescribed antibiotics during the last 12 months (OR=2.445; $p = 0.001$) and trusted the
101 doctors who did not prescribe antibiotics. **Conclusion:** This study has identified a concerning
102 low knowledge about antibiotics amongst some Malaysian university students, which is
103 reflected in use of unprescribed antibiotics and a lack of adherence to treatment. University
104 students will often be the future leaders of a country and will therefore act as role models in
105 their communities. This study has identified a need for widespread educational interventions

106 for students regarding antibiotic usage and resistance issues so that their future behaviors do
107 not undermine healthcare initiatives.

108 1. **INTRODUCTION**

109 Over the last three to four decades, tremendous changes have taken place in both the concepts
110 and the understanding of pharmaceutical treatment strategies [1-2]. Current medical students
111 will become doctors who will be prescribing independently throughout their careers, which are,
112 on average, 40 years [3-7]. Learning, attaining and updating prescribing knowledge and skills is
113 therefore an essential tool for every student and practicing doctor [8-11] however multiple
114 studies report that many medical students do not adequately learn prescribing skills to
115 effectively prescribe drugs during their undergraduate programs [12-15]. The World Health
116 Organization (WHO) also reports that the prescribing of at least 50% of medicines is
117 inappropriate [16], with a large proportion of these being antimicrobials or antibiotics [17, 18].
118 Overuse and misuse of antimicrobials is currently a global public health problem, particularly
119 because this encourages antimicrobial resistance (AMR) [19-21].

120 The current study was therefore carried out to appraise the usage pattern, knowledge and
121 beliefs about antimicrobial use among medical and non-medical students of the Universiti
122 Pertahanan Nasional Malaysia [(UPNM) National Defence University of Malaysia]. Specifically,
123 this study intended to seek the respondents' opinions on their trust in their doctors' behaviors
124 and communication skills (as a proxy for exploring adherence to treatment with antibiotics)
125 while prescribing antimicrobials; the factors associated with knowledge and beliefs about
126 antibiotic use; finishing a course of prescribed antibiotics, and antibiotic self-prescribing.

127 2. **MATERIALS and METHODS**

128 2.1 **Study Design**: This was a snapshot cross-sectional study using a survey questionnaire as the
129 method of data collection, with one data collection point.

130 2.2 **Study Population**: The study population comprised medical and non-medical students of
131 the UPNM, Malaysia, Kem Perdana Sungai Besi, Kuala Lumpur, Malaysia, from all years of study.

132 The non-medical students were drawn from the faculties of Defence Studies and Management
133 (FDSM), Engineering (FE), Defence Sciences and Technology (FDST), and Language Center (LC).

134 **2.3 Study Period:** The data were collected from 1st January to 30th April 2018.

135 **2.3 Sampling Method and Sample Size:** This research was conducted among the students of
136 the 2017-2018 academic year. This is a military university where most students are cadet
137 officers, although there are some territorial students and civil students. The students are
138 extensively occupied with the military training programme, which is mandatory for all courses.
139 This made access to the students difficult. For the medical students, a universal sampling
140 method was adopted as the total population size was small (N=230), as only 50 students are
141 admitted into the Medical Faculty of this university each year. Due to the difficulty in accessing
142 the non-medical students, a convenience sampling method was applied for these cohorts. Any
143 undergraduate students, both male and female, were eligible to participate in this study.

144 **2.4 Sample Size Calculation:** The Raosoft Sample Size Calculator [22] was utilized to calculate
145 the sample size for non-medical students given that universal sampling was adopted for
146 medical students. The calculated sample size was 316, added to by 32 of a 10% non-response,
147 giving the sample size of 348. An error margin of 5%, a confidence level of 95%, response
148 distribution of 50%, and a total population size of 1746 was used in the calculation [22].

149 **2.5 Techniques of Data Collection:** Following ethics approval and with permission from the
150 faculty administration, students were invited to a meeting where the project was explained,
151 consent was obtained, and the survey questionnaires given out and completed. Data were
152 collected using a validated instrument regarding antibiotic use [23]. Permission was obtained
153 from the corresponding and principal author of the original questionnaire. The self-
154 administered questionnaire comprised four sections:

- 155 • **Section A** - Socio-demographic data, including age, gender, ethnicity/race, place and
156 year of birth and programme and type of admission.
- 157 • **Section B** - Pattern of Antibiotic Use.
- 158 • **Section C** - Knowledge about Antibiotics.

- 159 • **Section D** – Beliefs about the use of Antibiotics.
- 160 • **Section E** - Doctors' behaviours and the Patient/Doctor Relationship.

161 Prior to undertaking the full survey, the questionnaire was pre-tested and validated in the local
162 context, with 20 (10 medical and 10 non-medical) students who did not participate in the
163 principal study. The sections of this questionnaire demonstrated acceptable Cronbach alpha
164 results, with values between 0.672-0.882, which indicated that the instrument possessed good
165 internal consistency and reliability. Evidence of convergent validity was shown by the significant
166 correlations between the items of each section and the total mean in each part ($r=0.332-0.718$;
167 $p=0.05$) [24, 25].

168 **2.6 Data Analysis:** The data collected were analyzed using IBM SPSS Statistics version 24 (IBM
169 Corporation, Armonk, NY, USA). Descriptive statistics were used to describe the sample using
170 frequency and percentage for categorical variables and mean with standard deviation for age as
171 this was normally distributed. In the section on knowledge, attitude and perception of doctors'
172 behaviours, "strongly disagree" was combined with "disagree" and "strongly agree" was
173 combined with "agree" to simplify the results, using a scoring system where one mark was
174 given for "strongly agree" and "agree," and 0 marks for "strongly disagree" and "disagree" for
175 correct statements in the knowledge and attitude section, reversed for any inaccurate
176 statements. Neutral responses ("neither agree nor disagree") were given a mark of zero.

177 The Multivariate Analysis of Variance (MANOVA) test was used to analyse the socio-
178 demographic factors associated with knowledge and attitude regarding antibiotic usage. These
179 were defined as the total knowledge and attitude scores, taking into consideration the
180 numerical outcome variables used. The Bonferroni post-hoc test was used in a pairwise
181 comparison to identify the different pairs of significant results relating to the independent
182 variables with more than two groups. The Pearson correlation test was used to explore the
183 association between the two numerical variables for age. Linearity and normality assumption
184 was confirmed before any results were reported.

185 In exploring the associated factors for finishing prescribed antibiotics and the self-prescription
186 of antibiotics, simple logistic regression followed by multiple logistic regression was carried out
187 using the binomial outcome variables, where the “don’t know/can’t remember” answers were
188 treated as missing values. The factors considered in the analysis were age, gender,
189 race/ethnicity, programme, whether studying in medicine, perceived personal health status,
190 trusting doctors to prescribe or not prescribe antibiotics, and the total knowledge and attitude
191 scores. For variables with a p -value of less than 0.25, forward Likelihood Ratio (LR) and
192 backward LR tests were carried out to identify the variables to be tested via multiple logistic
193 regression. Before finalizing the results, each variable that had been taken out due to non-
194 significance was recalculated to ensure their non-significance before being finally rejected.
195 Model fitness was checked before the results were reported as an odds ratio (OR) with a 95%
196 confidence interval (CI). An OR of more than one means that there is a higher probability for
197 the outcome variable, while an OR of less than one means that there is less probability for the
198 outcome variable, as compared to the reference group. The significance level was taken as 0.05
199 in all the statistical tests done.

200 **2.7 Ethical Considerations:** This research study was approved by the Institutional Ethical
201 Clearance Committee, Centre for Research and Innovation Management, UPNM, Kem Sungai
202 Besi, 57000 Kuala Lumpur, Malaysia, Code of Research: UPNM/2017/SF/SKK/07, Memo No:
203 UPNM (PPPI) 16.01/02/027 (2), 12 December 2017. The study population was informed about
204 the objectives and process of the study; that the data gathered would be anonymized and used
205 for publication, and that study participation was entirely voluntary, with no penalty for non-
206 participation. Written consent was obtained before the survey questionnaires were distributed.

207 3. RESULTS

208 3.1 Socio-Demographic Characteristics

209 674 participants were recruited for this study. Their socio-demographic characteristics are
210 displayed in Table 1. There were slightly more males (51.3%) than females (48.7%), with most
211 of the participants being Malay (84.4%) and from the Medical Faculty (i.e. medical students)

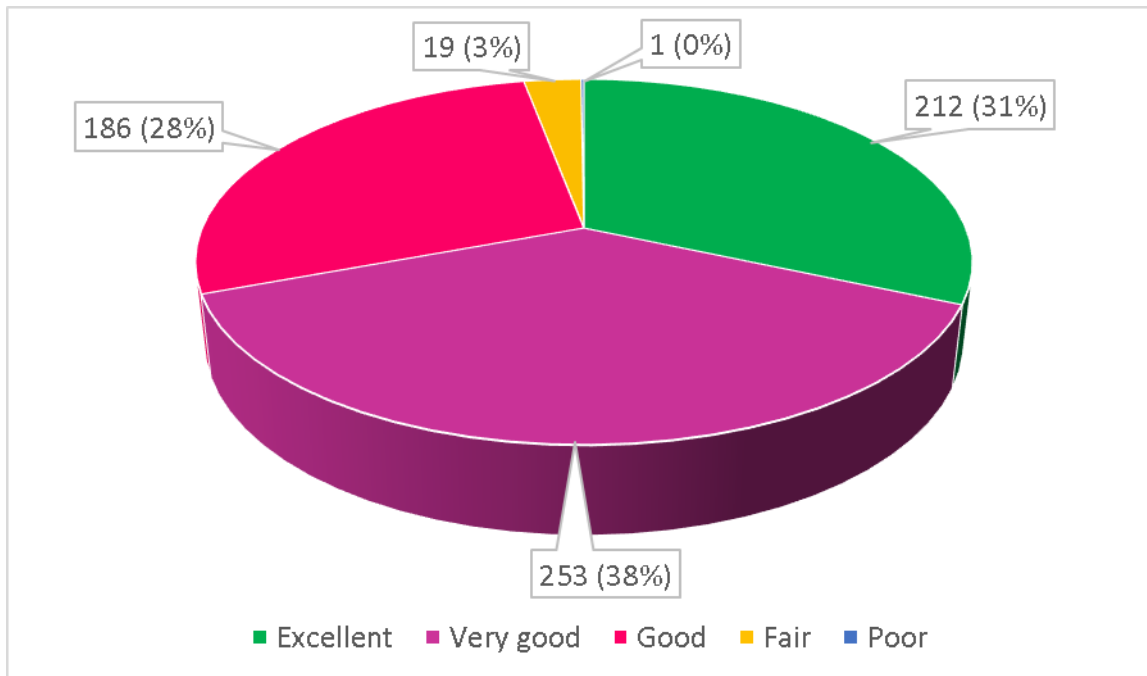
212 (32.5%). In terms of marital status, there were two missing responses, otherwise all participants
 213 were single.

214 **Table 1:** Socio-demographic characteristics of participants (n=674).

Variable	Frequency	Percentage (%)
Age (years old)	21.5 ^a	1.32 ^b
Sex		
Male	346	51.3
Female	328	48.7
Race/Ethnicity		
Malay	566	84.0
Chinese	20	3.0
Indian	73	10.8
Others	12	1.8
Faculty		
Medical	215	31.9
Engineering	81	12.0
DSM ^c	199	29.5
Science	112	16.6
Language	55	8.2

215 ^a Mean; ^b Standard deviation; ^cDefence Studies and Management

216 The survey asked respondents about their perceived health status, see Figure 1. This shows that
 217 majority of the participants perceived themselves to be in either “very good” (38%) or
 218 “excellent” (31%) health.



219

220 **Figure 1:** Perception of health status (n=671).

221 **3.2 Knowledge and Beliefs about Antibiotics**

222 Table 2 shows the comparison of the different levels of knowledge and beliefs regarding
 223 antibiotic usage between medical and non-medical faculties. The chi-square test shows
 224 significantly higher levels of knowledge and more up-to-date beliefs among medical compared
 225 to non-medical students with a p-value of < 0.001. Amongst the total of 674 students in the
 226 study, the results demonstrate that, only 22 (3.3%) had a high level of knowledge about
 227 antibiotics and that 296 (43.9%) held up-to-date beliefs regarding antibiotic usage. In Table 3,
 228 detailed responses are set out on knowledge and beliefs about antibiotics usage.

229

230 **Table 2:** Comparing levels of knowledge and beliefs regarding antibiotic usage between medical and
 231 non-medical faculties using chi-square test.

Categories	Indicated marks ^a	<u>Medical</u> No. (%) (n=215)	<u>Non-medical</u> ^b No. (%) (n=459)	<u>Total</u> No. (%) (n=674)	p-value
<u>Knowledge:</u>					
Low	0 – 6	58 (27.0)	334 (72.8)	392 (58.2)	< 0.001
Moderate	7 – 10	136 (63.3)	124 (27.0)	260 (38.6)	
High	11 – 13	21 (9.8)	1 (0.2)	22 (3.3)	
<u>Beliefs:</u>					
Negative ^c	0 – 3	59 (27.4)	319 (69.5)	378 (56.1)	< 0.001
Positive ^d	4 – 7	156 (72.6)	140 (30.5)	296 (43.9)	

232 ^a Awad AI, Aboud EA. Knowledge, Attitude and Practice towards Antibiotic Use among the Public in
 233 Kuwait. PLoS One. 2015; 10 (2): e0117910 [23].

234 ^b Combination of students from Defence Studies and Management, Engineering, Defence Sciences and
 235 Technology, and Language Center.

236 ^c Outdated health beliefs about antibiotic use

237 ^d Up to date and informed health beliefs about antibiotic use

238

239 **Table 3:** Detailed results about knowledge and beliefs about antibiotics (n=674)

Items	Frequency (%)		
	Disagree	Neutral	Agree
<u>Knowledge:</u>			
• Effective against bacteria	24 (3.6)	121 (18.0)	529 (78.5)
• Effective against viruses	199 (29.5)	188 (27.9)	287 (42.6)
• Work on most coughs and colds	109 (16.2)	228 (33.8)	337 (50.0)
• Speed up recovery from coughs and colds	102 (15.1)	240 (35.6)	332 (49.3)
• Different antibiotics cure different diseases	52 (7.7)	175 (26.0)	447 (66.3)
• Kill good normal bacteria on skin and gut	104 (15.4)	223 (33.1)	347 (51.5)
• Should not use antibiotics which gives skin reaction	58 (8.6)	158 (23.4)	458 (68.0)
• Cause imbalance in bacterial flora	69 (10.2)	304 (45.1)	301 (44.7)
• Should stop antibiotic if got side effects	52 (7.7)	149 (22.1)	473 (70.2)
• Human can be resistant to antibiotics	51 (7.6)	232 (34.4)	391 (58.0)
• Unnecessary antibiotics can increase bacteria's resistance	58 (8.6)	228 (33.8)	388 (57.6)
• Usage among animals reduce effect on humans	140 (20.8)	353 (52.4)	181 (26.9)
• Resistance to antibiotics is a worldwide problem	47 (7.0)	283 (42.0)	344 (51.0)
<u>Beliefs:</u>			
• Keep antibiotics at home in case in need later	199 (29.5)	181 (26.9)	294 (43.6)
• Get antibiotics from others without seeing a doctor	462 (68.5)	117 (17.4)	95 (14.1)
• Buy antibiotics from pharmacy without a	457 (67.8)	140 (20.8)	77 (11.4)

prescription			
• Prefer antibiotic for cough for more than a week	205 (30.4)	202 (30.0)	267 (39.6)
• Prefer antibiotic if have sore throat	266 (39.5)	247 (36.6)	161 (23.9)
• Always complete taking antibiotics even if feel better	149 (22.1)	182 (27.0)	343 (50.9)
• Stop taking antibiotics when feel better	260 (38.6)	162 (24.0)	252 (37.4)

240 3.3 Doctor's Behaviors and the Patient/Doctor Relationship

241 Table 4 illustrates the respondents' perception of their doctor's behaviors and the
 242 patient/doctor relationship. Most respondents demonstrated trust in their doctor's judgment
 243 about prescribing antibiotics.

244 **Table 4:** Respondents' perception of their doctor's behaviors and the patient/doctor
 245 relationship (n=674)

Items	Frequency (%)		
	Disagree	Neutral	Agree
• Doctors consider carefully the need of antibiotics	74 (11.0)	196 (29.1)	404 (59.9)
• Doctors prescribe antibiotics because patient expects it	153 (22.7)	229 (34.0)	292 (43.3)
• Trust doctor's decision on antibiotics' prescription	28 (4.2)	125 (18.5)	521 (77.3)
• Doctors explain the use of antibiotics	91 (13.5)	199 (29.5)	384 (57.0)
• Pharmacists explain the use of antibiotics	57 (8.5)	158 (23.4)	459 (68.1)
• Trust doctors if they did not prescribe an antibiotic	51 (7.6)	149 (22.1)	474 (70.3)

246

247 3.4 Patterns of Antibiotic Use

248 Not all respondents answered all questions in this survey section. From the 662 respondents to
 249 the questions asking whether they had been prescribed antibiotics within the last 12 months,
 250 402 (60.7%) and 7 (1.0%) responded that they had been prescribed antibiotics (inside and
 251 outside Malaysia), respectively. Among those who had been prescribed antibiotics, 68 (16.6%)
 252 said they had only been prescribed antibiotics either once, 128 (31.3%) 2-5 times, 33 (8.1%) 6-
 253 10 times and 51 (12.5%) were prescribed antibiotics more than 10 times. 118 (28.9%) could not
 254 remember. On asking whether they finished the last prescribed course of antibiotics, from the
 255 422 respondents who answered, 183 (43.4%) replied that they did, 154 (36.5%) did not, and

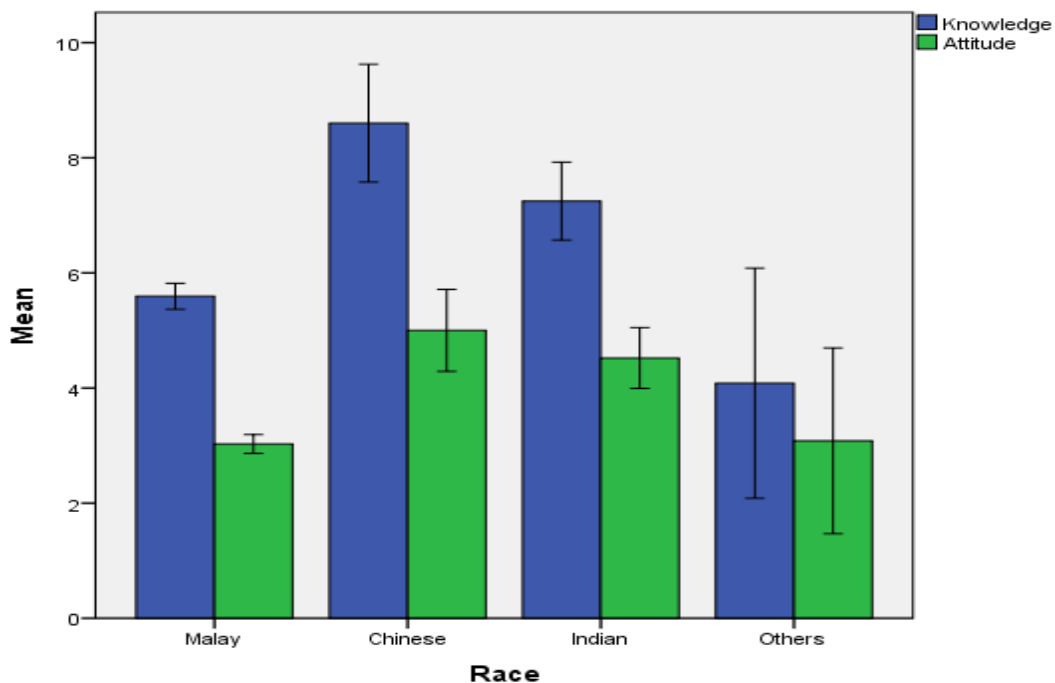
256 another 85 (20.1%) did not remember. When asked why they did not finish the course, the
257 majority 425 (63.1%) gave no response to the question; 68 (10.1%) said they forgot to take
258 them, 121 (18.0%) said they already felt better, 46 (6.8%) said it was because of the side effects
259 or that antibiotics made them feel unwell, and 8 (1.2%) replied that they kept the antibiotics in
260 case of future need. The students were then asked if they had used antibiotics without
261 prescription within the last 12 months, to which 95 (14.1%) replied that they had, while the rest
262 said “no.” Among those who said “yes”, 26 (27.4%) reported that they had used antibiotics
263 without prescription once; 24 (25.3%) 2-5 times; 8 (8.4%) 6 or more times. 34 (35.8%) could not
264 remember and three (3.2%) did not respond. Among those who said “no” to the use of
265 unprescribed antibiotics, 15 (16%) stated that they could not remember how many times they
266 use antibiotics without prescription during the last 12 months.

267 104 respondents replied to the questions on the reasons for self-medicating antibiotics. The
268 reasons stated were for common colds (33, 31.7%); coughs (35, 33.7%); genitourinary infections
269 (6, 5.8%); sore throat (10, 1.5%); superficial wounds (10, 1.5%) and other (not stated) reasons
270 (10, 1.5%). When asked whether they had ever given an antibiotic to someone else to use that
271 had not been prescribed for them, 563 (83.5%) did not answer the question; 23 (3.4%)
272 answered “yes”, 69 (10.2%) answered “no” and 19 (2.8%) could not remember. Only 82
273 students responded to another question on self-medication with antibiotics, from these, 49
274 (59.8%) said they used antibiotics that were originally prescribed for an infection which
275 reoccurred later; 8 (9.8%) said these were originally prescribed for another type of infection; 12
276 (14.6%) used antibiotics obtained from a pharmacy abroad without prescription; 3 (3.7%) used
277 antibiotics originally prescribed for someone else; and 5 (6.1%) each used antibiotics obtained
278 from a pharmacy within Malaysia without a prescription or used antibiotics originally
279 prescribed for another family member.

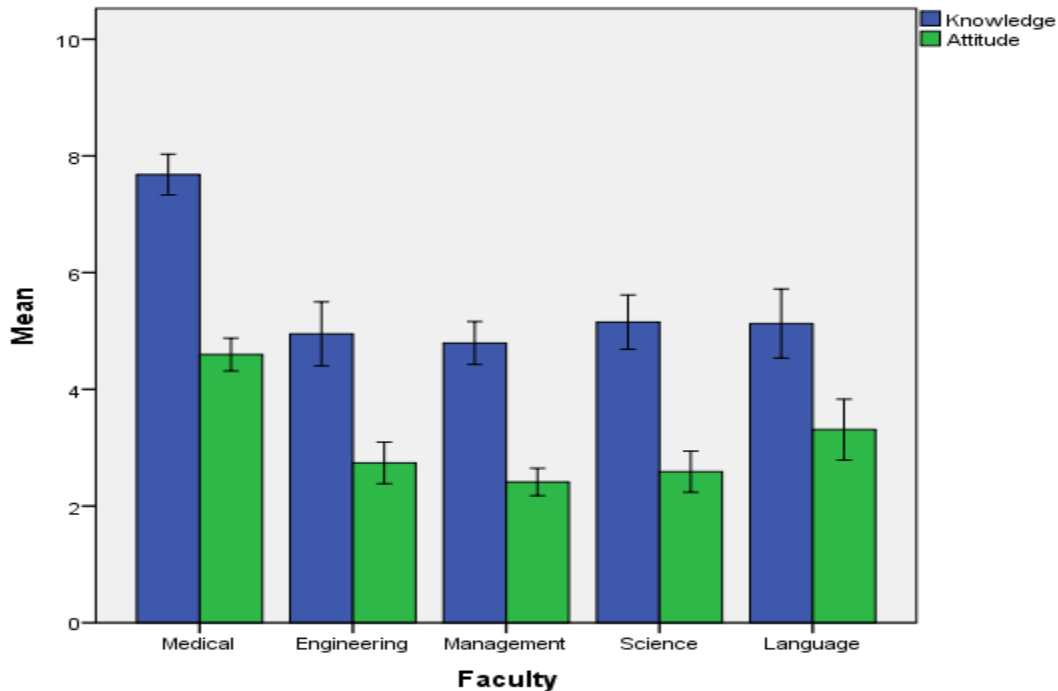
280 3.5 Knowledge and Beliefs about Antibiotics' Use

281 A Pearson correlation test used to assess the association between age with total knowledge
282 and beliefs scores found significant results for both, but with little correlation ($r=0.266$, $p<0.001$)

283 and $r=0.115$, $p=0.003$, respectively) Knowledge increased and health beliefs became more
 284 aligned with scientific evidence with increasing age. The MANOVA test showed no significant
 285 results comparing knowledge and beliefs about antibiotics use between genders and perceived
 286 health status ($p>0.05$). However, the results comparing students from different races/ethnic
 287 groups and faculties (i.e. medical vs non medical programmes) demonstrated significance at the
 288 multivariate level ($F_{(6, 1334)}=12.129$, $p<0.001$ and $F_{(8, 1314)}=29.122$, $p<0.001$; respectively) and
 289 univariate level for both knowledge and attitudes ($p<0.001$ for the comparison of knowledge
 290 and attitudes between races/ethnic groups and faculties). The comparisons of knowledge and
 291 attitudes for the different races/ethnic groups and faculties (programmes of study), including
 292 results of the Bonferroni post-hoc test are illustrated in Figures 2 and 3, respectively.



293
 294 **Figure 2:** Comparing means of total knowledge and beliefs scores between races/ethnic groups.
 295 *Bars represent 95% confidence interval of means.
 296 **Bonferroni post-hoc test of MANOVA test showed significant differences for both knowledge
 297 and beliefs between Malay with Chinese and Indian ($p<0.001$ each), but for knowledge between
 298 Chinese and others ($p<0.001$) and between Indian and others ($p=0.002$).



299

300 **Figure 3:** Comparing means of total knowledge and beliefs scores between
 301 faculties/programmes.

302 *Bars represent 95% confidence interval of means.

303 **Bonferroni post-hoc test of MANOVA test showed a significant difference for both knowledge
 304 and beliefs between Medicine and all other faculties ($p < 0.001$ each), but for beliefs only
 305 between Management and Language faculties ($p = 0.017$).

306 3.6 Factors Associated with Finishing a Prescribed Course of Antibiotics

307 Simple logistic regression was performed on the results relating to these factors. Those who
 308 answered “don’t know/can’t remember” were treated as missing values. Five significant factors
 309 were identified associated with finishing the course of antibiotics prescribed, similar to the
 310 factors relating to self-prescribing antibiotics. Those who were more likely to finish their
 311 antibiotic course had higher total beliefs scores ($OR = 1.187$; $p = 0.002$) (i.e. were more informed
 312 and up-to-date); had been prescribed antibiotics during the last 12 months ($OR = 3.368$; $p = 0.034$)
 313 and were more likely to be studying medicine ($OR = 3.009$; $p < 0.001$), compared with scores from
 314 students from other faculties i.e. FE ($OR = 0.475$; $p = 0.048$), FDSM ($OR = 0.250$; $p < 0.001$), FDST
 315 ($OR = 0.424$; $p = 0.015$) and LC ($OR = 0.355$; $p = 0.017$). The other significant variable associated with
 316 finishing prescribed antibiotics using simple logistic regression arose from comparing students
 317 with perceived “very good” with those reporting “excellent” personal health ($OR = 0.434$;

318 $p=0.003$), finding that those reporting a “very good” perceived health status had a higher
319 probability of finishing their antibiotics. The final stage of multiple logistic regression revealed
320 three significant factors of finishing the prescribed antibiotics: studying medicine (OR=3.370;
321 95%CI=1.859-6.109; $p<0.001$), perceived personal health (OR=0.467; 95%CI=0.264-0.827;
322 $p=0.009$) in comparison of “very good” with “excellent” perceived health, and race/ethnicity,
323 specifically between Indian and Malay students (OR=0.455; 95%CI=0.210-0.982; $p=0.045$).

324 3.7 Factors Associated with Antibiotic Self-Prescribing

325 Simple logistic regression found five significant factors associated with a lower reported self-
326 prescribing of antibiotics. These were: total beliefs scores (OR=0.752; $p<0.001$) i.e. those with a
327 more informed health beliefs reported less antibiotic self-prescribing; respondents who
328 reported having been prescribed antibiotics during the last 12 months (OR=0.356; $p=0.008$);
329 studying medicine (OR=0.601; $p=0.049$) ; and faculty, specifically between the Medical Faculty
330 and the FDSM (OR=2.138; $p=0.008$), meaning students from the FDSM were more likely to self-
331 prescribe antibiotics than medical students; and trusting doctors when they did not prescribe
332 antibiotics (OR=0.471; $p=0.035$), i.e. students report not self-prescribing if they trust their
333 doctor’s decision. Multiple logistic regression, however, only revealed three significant variables
334 in the final stage, namely beliefs (OR=0.756; 95%CI=0.668-0.855; $p<0.001$); having been
335 prescribed antibiotics during the last 12 months (OR=2.445; 95%CI=1.425-4.196; $p=0.001$), and
336 trusting their doctors when they did not prescribe antibiotics, where “neither agree nor
337 disagree” gave the OR of 0.424 (95%CI=0.185-0.973; $p=0.043$), while “agree” gave the OR of
338 0.437 (95%CI=0.210-0.909; $p=0.027$) compared to “disagree”.

339 4. DISCUSSION

340 4.1 Response Rate and Socio-Demographic Characteristics

341 From the students who attended the information session, 97.73% of medical students and
342 100% of students from non-medical faculties responded, an average of 98.86%. The response
343 rate was high because the students who were interested in participating attended the
344 information session and the survey questionnaire was completed and submitted as part of the

345 session. The socio-demographic characteristics of this group were similar to those of earlier
346 studies among medical students in the UPM and other Malaysian universities [26-29].

347 4.2 Knowledge and Beliefs about Antibiotics

348 Research conducted in the United States of America (USA) amongst adults of all ethnic groups
349 studying knowledge and beliefs about antibiotic use reported that certain ethnic groups held
350 health beliefs that antibiotics are necessary for common infections, and they would be cured
351 more quickly than without antimicrobial drugs [30]. Very frequently, such patients obtain
352 antibiotics from their doctors through peer pressure; retain antibiotics from earlier bouts of
353 sickness; purchase them from a pharmacy or use a relative's left-over antibiotics. Multiple
354 studies report that consumers and communities need to be educated about the prudent use of
355 antibiotics, prescribing, and resistance because antibiotic or antimicrobial resistance (AMR) is a
356 high public health risk [17, 19, 30-34] and few new antimicrobials are in the pipeline for
357 widespread public use [35, 36]. Like an earlier study [23], this study found most of these
358 university students had a low level of knowledge about antibiotic usage, despite their high level
359 of education. In contrast, a Swedish study, in which most respondents had a university level or
360 upper secondary school equivalent education, found that most respondents demonstrated a
361 high level of knowledge about antibiotics [37]. However, regarding health beliefs, the current
362 study reflected findings from an earlier Malaysian study [38] and another from Europe [32], in
363 that most respondents were found to have outdated or misinformed health beliefs about
364 antibiotic usage.

365 The low level of knowledge about antibiotics might be explained because the majority (72%) of
366 the research participants were non-medical students and, of the 32% medical students, these
367 would not be yet prescribing and therefore might not feel they need to know this information
368 yet. This cognitive dissonance may be exacerbated because in Malaysia, medical graduates do
369 not obtain their full license to practice until after another two years internship and so the
370 motivation to learn about prescribing practice may feel a long way off. In addition, a large
371 proportion of medical students had not completed their three clinical years and, although the

372 medical students had received some pharmacology and clinical pharmacology theoretical
373 classes in the pre-clinical part of the course, they had received no practical hands-on training
374 about good prescribing practice. Regarding health beliefs, there may be psychological leakage
375 from health beliefs (which may arise from one's own cultural practices) into both knowledge
376 and putting this into practice [39]. This could work in three ways. First, the students in this
377 study may well have expectations about whether they should be prescribed antibiotics which
378 could affect the prescribing practice of the doctors they saw, leading to an increase in antibiotic
379 prescribing [39]. Secondly, if the students were not prescribed antibiotics, even if their
380 knowledge gained through the courses told them that they probably did not need them, the
381 health beliefs of the students might override this, leading them to use other people's antibiotics
382 or antibiotics from a previous infection. Finally, whilst students may hear doctors saying one
383 thing about prescribing antibiotics (based on scientific evidence), their actual practice might
384 differ due to patient pressure or expectations and students will copy what they see in practice.
385 Ensuring that teaching about antibiotics includes psychological as well as pharmacological and
386 physiological principles is therefore essential.

387 Like the current study, previous studies conducted in China showed significantly higher level of
388 knowledge regarding the proper use of antibiotics, but also a higher reliance on antibiotics
389 among medical compared to non-medical students [40, 41]. Another study involving 731
390 university students in Western China also found significantly better knowledge regarding
391 antibiotics among intern students who worked in hospitals compared to other students which
392 echoes the findings of the current study as the medical students were primarily from the earlier
393 years of the course and we found that knowledge improved with age [42]. Furthermore, the
394 current findings on the lack of knowledge regarding antibiotics among non-medical students
395 was also reported by other studies carried out in Nigeria [43], Western China [42] and Jordan
396 [44]. A theoretical understanding of antibiotics is offered by most medical curricula; however,
397 this often focuses (in the early stages) on pharmacology and mechanisms of disease and
398 infection. The relatively low percentage of medical students with a good level of knowledge in
399 the current study was similar to the results of a survey carried out in 35 medical schools in 13
400 European countries [45]. This study concluded that the teaching on key principles and the

401 prudent prescribing of antibiotics should be improved, due to the existing wide variation in
402 exposure, lack of time and prioritization towards the teaching of antibiotics [45]. As reported by
403 a systematic literature review, this less than comprehensive teaching about antibiotics could
404 lead to insufficient antibiotic prescribing competencies among medical students. It should be
405 noted that the authors cautioned on the findings due to the methodological weaknesses and
406 heterogeneity of the few studies included in the review [45].

407 4.3 **Doctor's Behaviors and the Patient/Doctor Relationship**

408 “Medicine is an art whose magic and creative ability have long been recognized as residing in
409 the interpersonal aspects of the patient-physician relationship [47].” The success of healthcare,
410 treatment, and patient satisfaction largely depends on the development of a good rapport
411 between doctor and patient [48, 49]. Doctors’ interpersonal and communication skills enable
412 them to elicit the information essential to diagnose illness and conditions appropriately from
413 their patients, and provide the necessary counseling and therapeutic instructions, promote
414 lifestyle changes, and better ensure adherence to treatment [50-53]. The trust a patient has in
415 their physician is the principal component of a positive doctor-patient relationship which
416 optimizes care and success of treatment [54, 55]. Most of the current study respondents had
417 full trust in their doctors, which should have promoted adherence to treatment regarding the
418 prescribing of antibiotics or not.

419 4.4 **Pattern of Antibiotic Use**

420 The development of AMR is a global public health concern which causes tremendous human
421 misery [19, 34, 56]. Multiple studies find that the inappropriate use of antibiotics in both
422 community and hospital acquired infections (especially in respiratory and urinary tract
423 infections (UTIs)) contribute most to the evolution of AMR [57, 58]. Around 63% of the current
424 study participants reported that they had used antibiotics in the last year, similar to results
425 from a British study where 63% of the patients had used antibiotics in primary care settings in
426 the last 12 months [59]. This British study (with unadjusted regression analysis) found that
427 antibiotics were prescribed because of a UTI in the last year, which was followed by the

428 development of AMR [59]. Such high prescribing rates are echoed in many other countries,
429 including low resource settings. For example, in Nigeria, although one study found an antibiotic
430 prescribing rate of 49.5-63% [60], another study reported a prescribing rate of 63.3-86.6%, and
431 among pediatric cases, 80-86% [61].

432 AMR has become an alarming public health issue with “700,000 deaths annually (and rising)”
433 [62], especially because of the misuse or overuse of antibiotics which has led to the prevalence
434 of multidrug resistant (MDR) microbial [63]. Whilst the ideal length of antimicrobial treatment
435 for conditions such as ventilator-associated pneumonia (VAP) is not certain, limiting a course of
436 antibiotics to 7-8 days can reduce the problems of overuse in critical care, including AMR,
437 adverse effects or adverse drug reactions (ADR), ADR related impairment and increase
438 healthcare costs [63]. Another study found that short-term antimicrobial courses were as safe
439 and effective for life-threatening infections as long-term courses [64]. Until relatively recently,
440 patients were frequently advised to finish each course of antibiotic treatment, even they felt
441 better [65], however, a recent study reported that completing the full course of antibiotics is
442 ineffective if the patient feels well and should not be part of an antibiotic stewardship program
443 [66]. Among the current study respondents, a small group stated that they had taken antibiotics
444 without prescription between 2-6 times in the last year. Their reasons for self-prescribing
445 antibiotics (because of common colds, cough, genitourinary infections, sore throat, and
446 superficial wounds, etc.) were similar to those cited in other studies [23, 67-71]. Some
447 respondents reported that the antimicrobials they used were left over from those previously
448 prescribed to colleagues or family members, again in line with an earlier study [23]. The reasons
449 for self-prescribing were not explored in this study, however in Malaysia people can obtain
450 antibiotics from local pharmacies, thus avoiding the need to get a doctor’s prescription, which
451 may save individuals both money and time.

452 4.5 Factors Associated with Knowledge and Beliefs about Antibiotic Use

453 A significant association exists between the respondents’ total knowledge and beliefs scores
454 with age, with increasing age correlating with an improved knowledge and more appropriate

455 and informed health beliefs about antibiotic use, this corroborates the findings of other studies
456 [72, 73]. No significant correlation was found when comparing knowledge and beliefs about
457 antibiotic use between different sexes and perceived health status. A Jordanian study also
458 reported no significant difference between sexes [74]. The current study, however found
459 significant differences among races/ethnic groups and students from different faculties,
460 consistent with the findings from another study in Malaysia [38]. Some of the explanations for
461 this could lie in cultural perceptions and health beliefs as discussed above. Finally, this study
462 found that (as anticipated) knowledge about antibiotic usage was significantly higher in the
463 medical students as compared to non-medical students, probably because it is included in the
464 medical curriculum and medical students have a keener interest in understanding about
465 infections and treatment as they are training to be doctors.

466 4.6 Factors Associated with Finishing the Course of Antibiotics Prescribed

467 Five factors were significantly associated with finishing the course of prescribed antibiotics
468 using simple logistic regression: total beliefs scores; had been prescribed antibiotics during the
469 last 12 months; studying medicine; faculty (course of study), and perceived “very good”
470 personal health. Multiple logistic regression found only three significant factors, namely:
471 studying medicine, perceived “very good” personal health, and race/ethnicity, specifically in the
472 comparison of Indian with Malay students. These results mean that those studying medicine
473 were more at odds (more likely) to finish the course of their prescribed antibiotics. Medical
474 students might know more about the risks of AMR due to not finishing their antibiotics as
475 prescribed, and therefore might be more likely to follow the doctor’s advice. On the other
476 hand, those who perceive their personal health as “very good” were less likely to finish their
477 course of prescribed antibiotics as compared to those with perceived “excellent” personal
478 health, and those of Indian ethnic origin were less likely to finish their antibiotics as compared
479 to those who identified as Malay.

480 4.7 Factors Associated with Antibiotic Self-Prescribing

481 Simple logistic regression study found five significant factors associated with self-prescribing
482 antibiotics: total belief scores; studying medicine; having been prescribed antibiotics in the last
483 12 months; faculty/program of study (specifically between the Medicine and Management
484 programs) and trusting the doctors when they did not prescribe antibiotics. Conversely,
485 multiple logistic regression only revealed three significant variables in the final stage, namely:
486 beliefs, had been prescribed antibiotics during the last 12 months, and trusting their doctors
487 when they did not prescribe antibiotics. With an OR of less than one, those with more informed
488 health beliefs were at lower odds (less likely) to self-prescribe antibiotics, and those who either
489 “trusted” or “neither trusted nor not trusted” the doctors when they did not prescribe
490 antibiotics were less likely to use antibiotics without a doctors’ or dentists’ prescription, as
491 compared to those who did not trust the doctors’ judgment. On the other hand, those who had
492 been prescribed antibiotics during the last 12 months were more than twice at odds (more
493 likely) of self-prescribing antibiotics as compared to those who were not. This might be because
494 they think they already know what kind of antibiotics they need; however, this might not be
495 correct and could lead to the development of AMR.

496 5. **Limitations of the Study**

497 This was a cross-sectional study conducted only in one university in Malaysia. Further studies
498 would need to track cohorts, possibly include random sampling and inclusion of other
499 universities, stage of education or countries to explore more deeply into people’s health beliefs
500 and knowledge and whether the findings from this study are generalizable or whether the
501 findings are more culturally specific.

502 6. **CONCLUSIONS**

503 This was a cross-sectional study conducted amongst UPNM students about their antibiotic
504 knowledge, beliefs and usage. Slightly more male students responded than females and most of
505 the respondents were Malay. The knowledge of over half of the respondents about antibiotic
506 usage was low and their health beliefs were outdated. This is a key finding from the study. Over
507 60% of the study population had taken antibiotics between 2-10 times in the last year, and self-
508 medication was quite common for a sore throat, common cold, cough or superficial infection.

509 Age, race and course of study were found to be significantly associated with knowledge and
510 beliefs regarding antibiotic use, with medical students (as anticipated) being more
511 knowledgeable and up-to-date than non-medical students. The factors associated with finishing
512 a course of antibiotics were studying medicine, good perceived personal health status, and
513 race/ethnicity. The significant factors associated with antibiotic self-prescribing were outmoded
514 health beliefs, having been prescribed antibiotics during the last 12 months, and not trusting
515 their doctors when they did not prescribe antibiotics. Finally, this study reveals the importance
516 of providing educational interventions which includes education on the psychological aspects of
517 prescribing antibiotics, health beliefs and patient expectations, and an antibiotic stewardship
518 program to combat the inappropriate use of antibiotics and to help prevent AMR.

519 **Key Issues**

- 520 • This study explored medical and other students' knowledge and beliefs about, and
521 their use of, antibiotics from a Malaysian University
- 522 • The study found that, whilst medical students' knowledge and beliefs about the use
523 of antibiotics was higher than those of other students, over half of students had
524 outdated beliefs and poor knowledge
- 525 • Over 60% of the study population had taken antibiotics between 2-10 times in the
526 last year, and over 25% of students had self-medicated over the last year for a sore
527 throat, common cold, cough or superficial infection
- 528 • The study concluded that educational and community interventions on how
529 antibiotics should be used are needed to help raise awareness of antibiotic
530 resistance and change the practice of these future leaders and role models
- 531 • Such training should include the psychological aspects of antibiotics prescribing
532 around patient expectations and health beliefs

533 **Author Contributions**

534 The authors contributed equally.

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539 **Conflict of Interest**

540 The authors declare no conflicts of interest.

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