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Original article

Perceptions of primary health care physicians about the prescription of antibiotics in Saudi Arabia: Based on the model of Theory of planned behaviour

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ABSTRACT

Introduction: Knowledge of different factors that influence physician decision-making in general practice for prescribing antibiotics is vital for successfully implementing antimicrobial stewardship interventions. The Theory of planned behaviour (TPB) is an established model that describes how cognitions drive human behaviour.

Objectives: The present study was performed to identify the socio-cultural and behavioural determinants that affect antibiotics prescription behaviour among primary care physicians and estimate the awareness about antibiotic resistance of public health importance.

Methodology:: The questionnaire was divided into three sections: Section-I, which contained demographic content. Section-II contained 21 question items measuring attitudes, subjective norms, perceived behavioural control, and behavioural intentions of the prescribers. Section III had 12 questions related to knowledge about antibiotic resistance. As determined by Cronbach's α for each set of measured constructs of questionnaire scale, the internal consistency was good ($\alpha \geq 0.7$). The participants' socio-cultural and behavioural determinants were graded in 3 categories depending upon the mean score, while frequencies were used to estimate antibiotic resistance awareness. The data was analyzed by calculating the one-way ANOVA and by post-hoc Tukey-Kramer HSD multiple comparison test.

Results: Four hundred thirty-four primary health care physicians responded to the questionnaire, and data was statistically investigated. Participants' knowledge of antibiotic-resistant bacteria was poor with greater behavioural intentions to prescribe antibiotics, but a positive attitude and acceptable perceived social pressure towards antibiotics.

Conclusion: Our study showed that awareness towards antibiotic-resistant bacteria among primary care physicians of Saudi Arabia stands insufficient but favourable attitude and satisfactory social pressure towards antibiotics with greater behavioural intentions to prescribe antibiotics. The continued medical education (CME) and frequent training interventions can increase these parameters of rational prescribing practice for antibiotics.

1. Background

Antibiotics are commonly used in modern medical practices and have saved millions of lives over the past century (Nikaido, 2009). However, rates of antimicrobial resistance are growing worldwide, threatening public health and increased morbidity, mortality, and healthcare costs (Howard & Scott, 2005; Kollef, 2003; W. H. Organization, 2014). World Health Organization has

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announced that antimicrobial resistance (AMR) is one of the top 10 global public health threats facing humanity that requires urgent multisectoral action to achieve the Sustainable Development Goals (SDGs). The emergence and accelerated global spread of "superbugs," which are multi- and pan-resistant bacteria causing infections that are unable to be treated successfully with existing antimicrobial medicines, has resulted in increased concerns over the usage of antibiotics (W. H. Organization, 2014). Research suggests that what underlies such high rates of antimicrobial resistance is the misuse of antibiotics in both human and veterinary practices (Albrich, Monnet, & Harbarth, 2004; Goossens, Ferech, Vander Stichele, & Elseviers, 2005; Wise et al., 1998).

Reports from Saudi Arabia have demonstrated an increasing pattern of infections with multidrug-resistant organisms, including gram-positive and gram-negative bacteria (Memish et al., 2015; Memish et al., 2012; Shibl et al., 2014). Excessive antibiotic prescribing by the prescribers has prompted calls for reform, yet the optimal methods for addressing this problem remain obscure (Goldmann et al., 1996; Murray, 1994; Schwartz, 1999; Shlaes et al., 1997). Because such reform is likely to require fundamental changes in physicians' behaviour, a better understanding of physicians' perceptions of antibiotic resistance is essential (Jarvis, 1996; Lambert et al., 1997). The prescribing decision is a complex process that involves several factors (Theodorou et al., 2009). Consequently, complex theories have been used to understand how several factors influence physician decision-making in general practice, like the knowledge-attitudes-practices (KAP) model, the Theory of planned behaviour (TPB), social cognitive theory (SCT), the operant learning theory (OLT) and the Theory of reasoned action (TRA) (Godin, Bélanger-Gravel, Eccles, & Grimshaw, 2008).

The Theory of planned behaviour (TPB) is developed to describe the determinants of individual intentions and behaviours—in this case, antibiotic prescription. An intention regarding a particular behaviour is a function of 3 determinants: 1) attitude toward the behaviour, referring to the positive or negative evaluation of performing the behaviour; 2) subjective norm, reflecting the person's perception of social pressure regarding the performance; and 3) perceived behavioural control, which refers to the person's perception of own control over the performance of the behaviour (Ajzen, 2002 (revised 2006)). The subsequent intention will then lead to the final behaviour.

Godin and colleagues inferred in a systematic review that the TPB is the most appropriate model to predict prescribing behaviour (Godin et al., 2008). Several studies applied the TPB to model the antibiotic prescribing decisions made by physicians (Légaré et al., 2013; Saliba-Gustafsson, Borg, Rosales-Klintz, Nyberg, & StålsbyLundborg, 2017; Yardley et al., 2013). But studies in Saudi Arabia are lacking. Hence this study aims to determine the perceptions of physicians for antibiotic prescribing using a TPB model in Saudi Arabia, along with to assess awareness about antibiotic-resistant bacteria of public health importance. In addition, such a model can contribute evidence to establish the design of further interventional measures.

1.1. Objectives of the Study:

Aim of the Study: The assessment of the physicians' perceptions concerning the prescription of antibiotics in different cities of Saudi Arabia based on the Theory of Planned Behaviour.

1.2. Specific Objectives:

a. To assess the attitudes towards the prescription of antibiotics.
b. To determine the perceived social pressure towards the prescription of antibiotics.
c. To determine the perceived behavioural control measures for making a rational decision on antibiotic prescriptions
d. To study the behavioural intentions and willingness to prescribe antibiotics
e. To assess information about antibiotic resistance of public health importance

2. Materials and Methods:

Study Design: It was a cross-sectional, non-interventional, questionnaire-based study using the TPB Model questionnaire (Liu et al., 2019).

The Study Setting and Sample selection criteria: The questionnaire was earlier distributed in paper form to the physicians working in primary health care centers and university hospitals of Riyadh, Dammam, and Jeddah cities of Saudi Arabia, but due to the emergence COVID-19 pandemic situation, we transformed the in-person distribution of the questionnaire into electronic form to all the physicians working in Saudi Arabia.

Inclusion criteria: The non-probability convenience sample of physicians working in Saudi Arabia who gave their informed consent were included in the study.

Exclusion criteria: Physicians working in Saudi Arabia who were unwilling to participate in the study were excluded.

Sample size calculation: Using G * power sample size calculator, assuming the expected population standard deviation to be 3.9 with a precision of 0.6 and confidence interval of 95%, a sample size of 166 was estimated in each of the at least three bigger cities, which are Riyadh, Dammam, and Jeddah, in total forming 498. A larger sample of 645 was considered assuming a response rate of 70%. We maintained the same sample size even after electronic distribution considering its significant coverage in these major cities.

2.1. Structure of the questionnaire:

The questionnaire was developed in line with the guidelines for TPB surveys and designed after a detailed review of relevant literature (Francis J, 2004; Liu et al., 2019). The questionnaire was first piloted on 20 physicians from primary care facilities who were not involved in the main study and was tested for face and content validity. Their feedback improved the clarity of the questionnaire. The finalized questionnaire composed of 3 sections Section-I contained demographic content. Section-II contained 21 question items measuring attitudes, subjective norms, perceived behavioural control, and behavioural intentions of the prescribers. The mean score for each component of section II was calculated by taking average of points scored for each question response. The highest positive affirms score was 5, and the least score was 1 for each answer, as mentioned in the supplementary file S1. Finally, section III had 12 questions related to knowledge about antibiotic resistance (Labi et al., 2018).

2.1.1. Attitudes (4 items)

Attitudes are described as the degree to which a prescriber favors the prescription of antibiotics in outpatient encounters (Ajzen, 1991). It contained four questions related to usefulness, appropriateness, responsibility, and harmfulness of prescribing antibiotics for outpatients which covered ordinal form of both positive and negative options to elude agreement prejudice, and respondents were asked to rank it (Liu et al., 2019). A higher score of 17–20 shows a more favorable attitude toward the prescribing of antibiotics.

2.1.2. Subjective norms (6 items)

Subjective norms include the perceived social pressure to which a prescriber is subject to antibiotic prescriptions.(Ajzen, 1991) Respondents were asked in form of 6 questions to rate the degree of pressure arising from patients, colleagues, and the society (Liu et al., 2019) on a 5 point scale from always (5), often (4), sometimes (3), rarely (2), and never (1). If physician didn't know their colleagues perspective it was scored as 0. The average was taken for 6 responses for each respondent and it displays that greater average score of 21–30 indicates larger pressure.

2.1.3. Perceived behavioural control (5 items)

Perceived behavioural control estimates how easy a prescriber feels in making a rational decision on antibiotic prescriptions (Ajzen, 1991). It included five questions related to self-efficacy, pertaining to the ability of a prescriber to prescribe antibiotics rightly, and controllability, relating to the extent to which a prescriber can decide whether or not to prescribe antibiotics (Liu et al., 2019). Respondents rated on a five-point Likert scale, from stongly agree to strongly disagree or full control of prescription and easy for deciding prescription to no control and very difficult to decide, respectively. The average of 5 responses for each respondent was calculated, later interpreting into scale of lesser, acceptable or higher pressure. The higher score of 23–25 indicates higher behavioural control.

2.1.4. Behavioural intentions (BI- 6 items)

Behavioural intentions estimate the degree to which a prescriber is willing to prescribe antibiotics (Ajzen, 1991). Two subscales were used. The BI- to prescribe antibiotics, asking three questions concerning whether a prescriber wants, expects, and plans to prescribe antibiotics ranging "strongly agree" (1) to "strongly disagree" (5), with higher average of 12–15 depicting high intentions to prescribe antibiotics. While, three questions of BI- to reduce antibiotic prescriptions which rated from "strongly agree" (5) to "strongly agree" (1), with greater score of 11–15 showing satisfactory behaviour to reduce antibiotics prescription (Liu et al., 2019).

Section III: Assessment of information related to antibiotic resistance, including knowledge and management of infections by methicillin-resistant Staphylococcus aureus (MRSA), extended-spectrum beta-lactamase-producing Enterobacteriaceae (ESBL), carbapenem-resistant Enterobacteriaceae (CRE), and vancomycin-resistant enterococci (VRE) (Labi et al., 2018).

2.2. Data collection:

The study was carried between July 2020 and January 2021. Total 434 primary health care physicians working in different cities of Saudi Arabia responded to the questionnaire giving a response rate of 67.28% for the targeted sample size of 645 that was considered before the start of study.

2.3. Data analysis

The data were interpreted using the statistical software JMP®, Version 12, SAS Institute Inc., Cary, NC, 1989–2019. Descriptive statistics were conducted to estimate the awareness, knowledge, and attitude level of the participant. ANOVA test was performed to determine if there was a difference in the mean measuring attitudes, subjective norms, perceived behavioural control, and behavioural intentions of the participants according to age, gender, city, professional status, workplace, and duration of clinical practice. It was followed by a post-hoc Tukey-Kramer HSD multiple comparison test if the ANOVA test was significant for any of the above parameters. The statistical significance was determined at a p-value of 0.05 and a 95% confidence interval.

Validity of the questionnaire: The main study participant's responses (n = 434) were then statistically tested for validity and reliability of the questionnaire, with the determination of Cronbach's alpha of each set of measured constructs. It was found to be reliable with a high internal consistency that was reflected by the high Cronbach's alpha (0.73–0.88) as shown in Table 1.

3. Results:

The participants' responses were graded in 3 categories, depending upon the mean score calculated for each parameter as in Table 2. The maximum average score for attitude was 20. Its lower score displays unsatisfactory level of attitude towards antibiotics prescription, while high score shows higher favourable attitude. The subjective norms that show perceived social pressure had maximum average score of 30, with the score range of 13–20 considered as acceptable pressure while 21–30 as higher social pressure towards antibiotics prescription. The perceived behaviour control scale had maximum mean score of 25 with the score range of 0–12 as lesser controllability, while 23–25 as higher control towards prescribing antibiotics. Two subscales of the BI- to prescribe antibiotics and BI- to reduce antibiotic prescriptions, had

Table 1
Cronbach's α of each set of measured constructs.

Measured constructs	Number of questions	Mean	SD	Std Err Mean	Cronbach's α
Attitude	4	15.06	2.64	0.13	0.8237
Subjective norms	6	17.77	4.15	0.2	0.7903
Perceived Behaviour control	5	17.97	3.91	0.19	0.7334
BI- prescribe antibiotics	3	8.84	2.49	0.12	0.8313
BI- reduce antibiotics prescription	3	11.47	2.85	0.14	0.8858

Table 2
The score range of different parameters of physicians perceptions.

Parameter	Unsatisfactory	Satisfactory	Higher favourable	Max score
Attitude	0–10	11–16	17–20	20
	Lesser	**Acceptable**	**Higher**	**Max score**
Subjective norms	0–12	13–20	21–30	30
Perceived Behaviour control	0–12	13–22	23–25	25
BI- to prescribe antibiotics	0–5	6–11	12–15	15
	Poor	**Unsatisfactory**	**Satisfactory**	**Max score**
BI- reduce antibiotics prescription	0–6	7–10	11–15	15

Table 3
The demographic characteristics of study participants.

Parameter	N	%
1. Gender:	M: 254	58.52
	F: 180	41.47
2. City	Riyadh: 139	32.02
	Dammam: 48	11.05
	Jeddah:63	14.5
	Abha:38	8.75
	Others: 146	33.64
3. Professional status:	Consultant: 80	18.43
	Senior registrar: 55	12.67
	Registrar: 21	4.8
	Resident: 241	55.52
	GP: 37	8.5
4. Workplace	Primary health care center: 275	63.36
	University hospital:53	12.21
	Hospital: 85	19.58
	Polyclinics:21	4.83
5. Duration of clinical practice (years):	0–4: 248	57.14
	5–9: 97	22.35
	10–14: 41	9.44
	15–19: 18	4.14
	greater than20: 30	6.9
6. Do you work at the emergency service?	Yes: 155	35.71
	No: 279	64.28
7. Is there availability of a drug and therapeutics committee?	Yes: 207	47.7
	No: 65	14.97
	Don't know: 162	37.32
8. Is there availability of local antibiotics guidelines?	Yes: 212	48.84
	No: 100	23.04
	Don't know: 122	28.11

maximum score of 15, which represented either higher point of 12–15 presented their high intentions to prescribe antibiotics, and range of 11–15 exhibited satisfactory behaviour to reduce antibiotics prescription respectively.

Table 3 details the different characteristics of study participants. Nearly 59% of them were male, while 41 % were female. Most of the respondents belonged to the 24–35 years age group (79%) and worked in primary health care centers (63.36%). In addition, 57% of them had<4 years of clinical practice, 22.35 % engaged in clinical practice for 5–9 years, and 20.48% had more than 10 years of clinical practice. Only a small proportion of the respondents held a consultant (18.43 %) and senior resident (12.67%) professional status, while 55.52 % were residents and 64.28 % of participants did not work at the emergency. Nearly 38% were not aware of the availability of their workplace drug and therapeutic committee, and 28.11 % were unaware of local antibiotics guidelines.

Fig. 1 shows descriptive statistics indicating the level of attitude by mean attitudes scores which are satisfactory in 70.04% of participants, poor in 3.6% of participants, and higher favorable attitude in 26.26%. Fig. 2 represents perceived social pressure and perceived behavioural control towards prescribing antibiotic scores among study participants graded in 3 categories as lesser, acceptable, and higher. Moreover, they were acceptable in 75.57% and 78.8% of participants, respectively, while higher social pressure and behaviour control were seen in 13.36% and 13.8%, respectively. Fig. 3 depicts that behavioural intentions to prescribe antibiotics were 78.8% acceptable, and higher in 13.82 %. On the other hand, the behavioural intentions to reduce antibiotics prescriptions was sat-

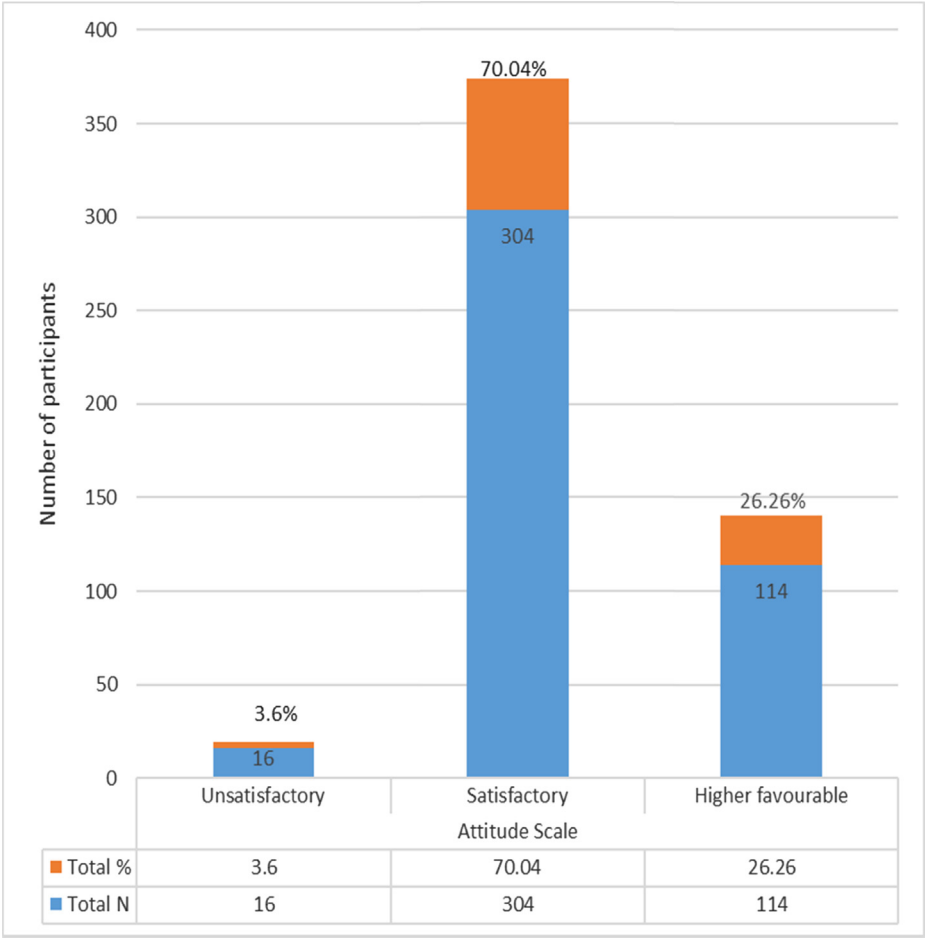


Fig. 1. Scoring scale of the attitude score towards antibiotics among study participants.

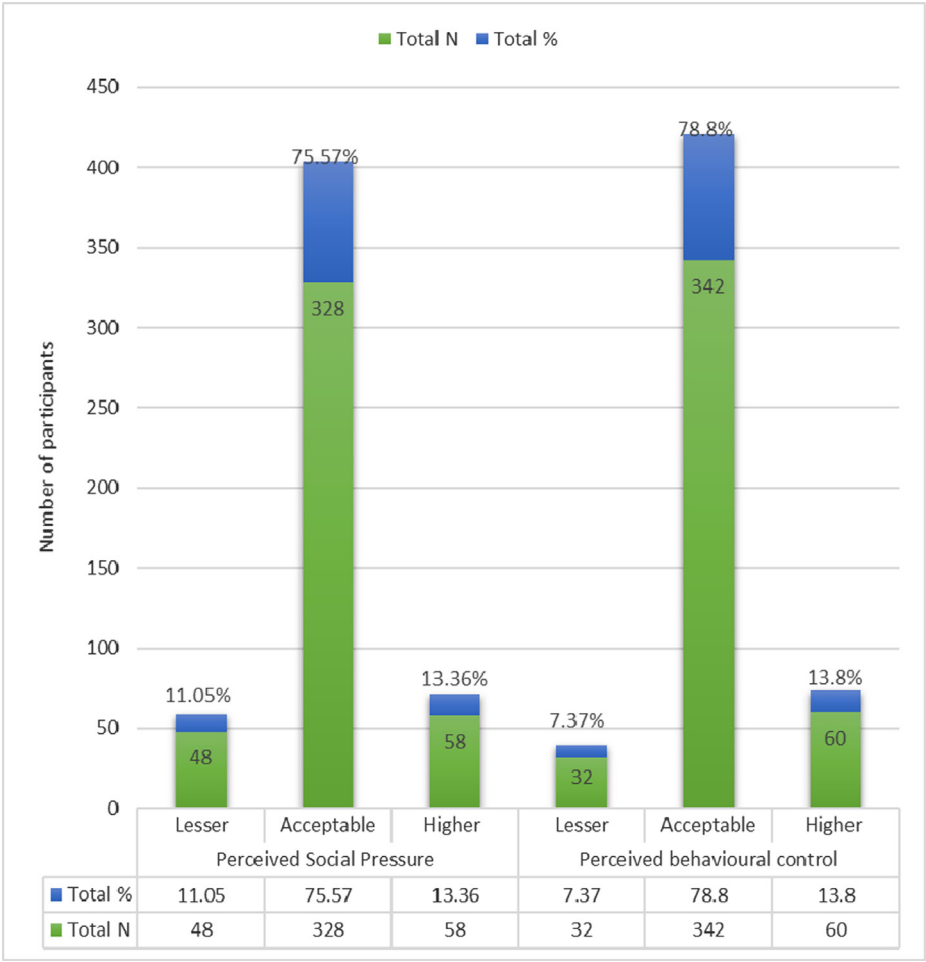


Fig. 2. Scoring scale of the perceived social pressure and perceived behavioural score towards antibiotics among study participants.

isfactory in 61.05% only but unsatisfactory in 35.71% and poor in 3.9%.

Tables 4 and 5 represent ANOVA test of significance of Attitude, Subjective norms, Perceived behaviour control score, and Behavioural Intentions for comparison among the different groups. Figs. 4-5 represents knowledge of antibiotic-resistant bacteria of public health interest about MRSA, CRE, ESBL, and VRE.

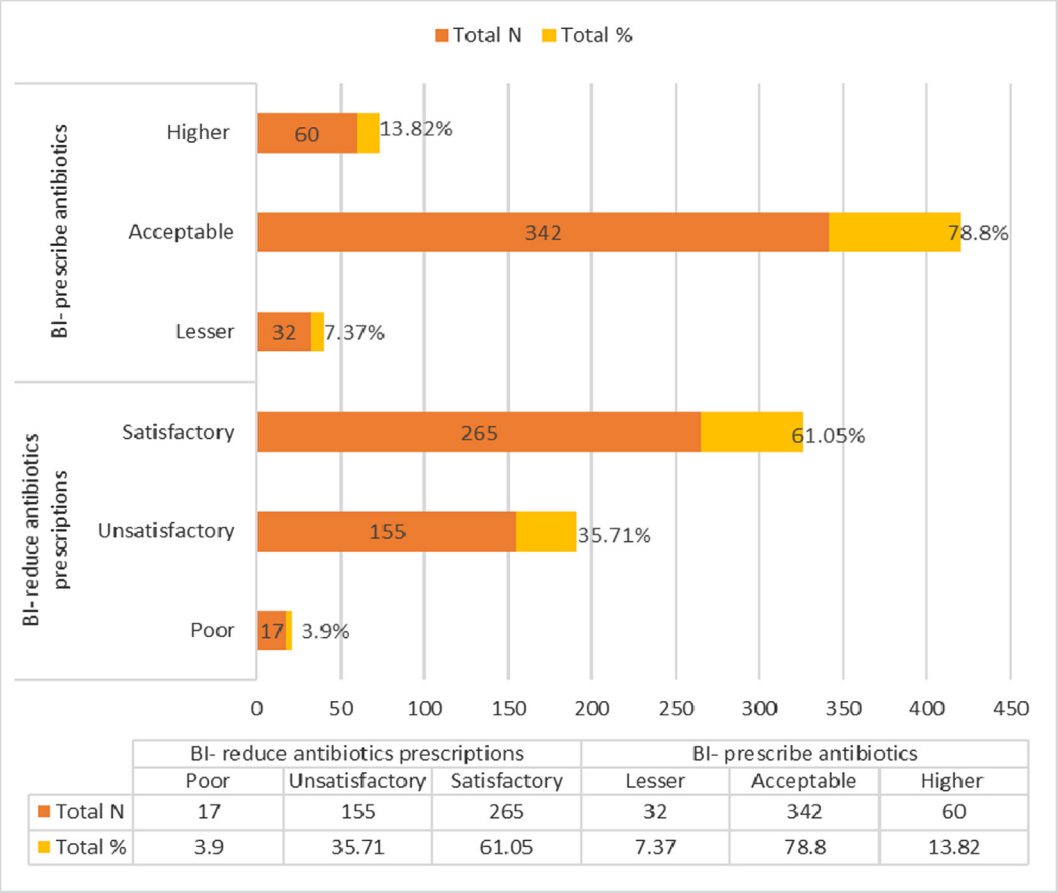
4. Discussion:

International guidelines on antimicrobial stewardship (AMS) strive to intensify the rational use of antimicrobial agents (Goff et al., 2017; Morley & Wacogne, 2017). Antibiotics prescription is a substantial challenge in daily clinical practice, which typically involves decision making under uncertainty and balancing the potential benefits and drawbacks (Simpkin & Schwartzstein, 2016; Teixeira Rodrigues, Roque, Falcão, Figueiras, & Herdeiro, 2013). Under such uncertainty, data on the perceptions of health practitioners towards antibiotic prescriptions and resistance in such a complex decisional context could present baseline information, such as critical target areas for urgent interventions, including the formation of antibiotic usage policies, as well as establishing up and promoting the use of antibiotic stewardship programs. These determinants have been researched in a short number of preceding studies. A detailed assessment into behavioural and social sciences about antimicrobial prescription behaviour (APB) in Saudi Arabia is lacking. Therefore, this study aimed to assess the perceived determinants of antibiotics prescribing behaviour among physicians in Saudi Arabia.

We regarded the Theory of planned behaviour (TPB) to be the most suitable model to better understand the cognitive determinants of APB (Ajzen, 1991). This Theory is social-cognitive in nature, positing that the judgments people make on whether or not to perform a certain behaviour are determined and explained by them specific ideas (cognitions) people have about the target behaviour.

The effect and achievement of any antibiotic use policies depend highly on their current status about APB and awareness of antibiotic-resistant bacteria of public health importance (G. W. H. Organization). Thus, in this study, we measured attitudes, perceived social pressure, perceived behavioural control, and behavioural intentions of the prescribers, along with knowledge about some important antibiotic-resistant bacteria amongst physicians of Saudi Arabia.

The mean attitude score of the study respondents was 15.06, while the mean score of the participants from Riyadh, Dammam, Jeddah, and Abha were 15.49, 15.47, 14.95, and 14.1, respectively. Therefore, better attitude towards antibiotics was seen in physicians practicing in Riyadh, which was statistically significant (Post-hoc Tukey-Kramer HSD test, $p = 0.0325$, <0.05). It was statistically insignificant while comparing gender, age groups, clinical



	BI- reduce antibiotics prescriptions			BI- prescribe antibiotics		
	Poor	Unsatisfactory	Satisfactory	Lesser	Acceptable	Higher
Total N	17	155	265	32	342	60
Total %	3.9	35.71	61.05	7.37	78.8	13.82

Fig. 3. Scoring scale of the behavioural intentions score towards antibiotics among study participants.

Table 4
ANOVA test of significance of Attitude, Subjective norms, and Perceived behaviour control score for comparison among the different groups.

	Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Attitude score	**Q1: Age:**	3	22.2998	7.43326	1.0598	0.3659
	Error	430	3015.8938	7.01371		
	C. Total	433	3038.1935			
	Q2: Gender:	1	14.1530	14.1530	2.0218	0.1558
	Error	432	3024.0406	7.0001		
	C. Total	433	3038.1935			
	Q3: City:	4	79.0232	19.7558	2.8641	0.0231*
	Error	429	2959.1703	6.8978		
	C. Total	433	3038.1935			
	Q4: Workplace:	4	66.2661	16.5665	2.3914	0.0501
	Error	429	2971.9275	6.9276		
	C. Total	433	3038.1935			
	Q5: Professional status	4	16.1299	4.03247	0.5724	0.6828
	Error	429	3022.0637	7.04444		
	C. Total	433	3038.1935			
	Q6: Duration of clinical practice:	4	24.0043	6.00108	0.8541	0.4916
	Error	429	3014.1892	7.02608		
	C. Total	433	3038.1935			
Subjective norms score	**Q1: Age:**	3	33.3010	11.1003	0.6431	0.5876
	Error	430	7422.0192	17.2605		
	C. Total	433	7455.3203			
	Q2: Gender:	1	1.3149	1.3149	0.0762	0.7826
	Error	432	7454.0053	17.2546		
	C. Total	433	7455.3203			
	Q3: City:	4	165.0344	41.2586	2.4279	0.057
	Error	429	7290.2858	16.9937		
	C. Total	433	7455.3203			
	Q4: Workplace:	4	123.8262	30.9566	1.8114	0.1256
	Error	429	7331.4940	17.0897		
	C. Total	433	7455.3203			

(*continued on next page*)

Table 4 (*continued*)

	Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
	Q5: Professional status:	4	161.9672	40.4918	2.3818	0.0509
	Error	429	7293.3531	17.0008		
	C. Total	433	7455.3203			
	Q6: Duration of clinical practice (years):	4	128.4078	32.1020	1.8796	0.1130
	Error	429	7326.9124	17.0790		
	C. Total	433	7455.3203			
Perceived behaviour control score	**Q1: Age:**	3	387.9171	129.306	8.8978	<0.0001*
	Error	430	6248.8963	14.532		
	C. Total	433	6636.8134			
	Q2: Gender:	1	16.1657	16.1657	1.0548	0.3050
	Error	432	6620.6476	15.3256		
	C. Total	433	6636.8134			
	Q3: City:	4	81.2835	20.3209	1.3298	0.2580
	Error	429	6555.5299	15.2810		
	C. Total	433	6636.8134			
	Q4: Workplace:	4	116.6480	29.1620	1.9187	0.1063
	Error	429	6520.1654	15.1985		
	C. Total	433	6636.8134			
	Q5: Professional status:	4	381.9044	95.4761	6.5483	<0.0001*
	Error	429	6254.9090	14.5802		
	C. Total	433	6636.8134			
	Q6: Duration of clinical practice:	**4**	424.6173	106.154	7.3308	<0.0001*
	Error	429	6212.1960	14.481		
	C. Total	433	6636.8134			

The * indicates the statistical significance.

Table 5
ANOVA test of significance for Behavioural Intentions comparison among the different groups.

	Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
BI- prescribe antibiotics	**Q1: Age:**	3	11.58482	3.86161	5.7855	0.0007*
	Error	430	287.00913	0.66746		
	C. Total	433	298.59396			
	Q2: Gender:	1	1.27712	1.27712	1.8556	0.1738
	Error	432	297.31684	0.68823		
	C. Total	433	298.59396			
	Q3: City:	4	2.96267	0.740668	1.0748	0.3685
	Error	429	295.63129	0.689117		
	C. Total	433	298.59396			
	Q4: Workplace:	4	3.37990	0.844974	1.2279	0.2982
	Error	429	295.21406	0.688145		
	C. Total	433	298.59396			
	Q5: Professional status:	4	5.70319	1.42580	2.0884	0.0814
	Error	429	292.89077	0.68273		
	C. Total	433	298.59396			
	Q6: Duration of clinical practice	4	6.98399	1.74600	2.5686	0.0376*
	Error	429	291.60996	0.67974		
	C. Total	433	298.59396			
BI- reduce antibiotics	**Q1: Age:**	3	9.41839	3.13946	3.5469	0.0146*
	Error	430	380.60618	0.88513		
	C. Total	433	390.02458			
	Q2: Gender:	1	1.65083	1.65083	1.8363	0.1761
	Error	432	388.37375	0.89901		
	C. Total	433	390.02458			
	Q3: City:	4	4.29797	1.07449	1.1950	0.3123
	Error	429	385.72660	0.89913		
	C. Total	433	390.02458			
	Q4: Workplace:	4	8.57624	2.14406	2.4113	0.0485*
	Error	429	381.44834	0.88916		
	C. Total	433	390.02458			
	Q5: Professional status:	4	2.43374	0.608435	0.6734	0.6107
	Error	429	387.59084	0.903475		
	C. Total	433	390.02458			
	Q6: Duration of clinical practice:	4	11.58534	2.89634	3.2833	0.0114*
	Error	429	378.43924	0.88214		
	C. Total	433	390.02458			

The * indicates the statistical significance.

years of practice, and professional status. Overall higher favorable attitude indicating more antibiotics prescribing behaviour was seen in 26.26% of study participants. Similar results were seen in other study (Labi et al., 2018).

The mean perceived social pressure score of the respondents was 17.77, and 75.57% were on the acceptable scale. It was statistically insignificant while comparing between gender, age groups, city, clinical years of practice, and professional status as depicted

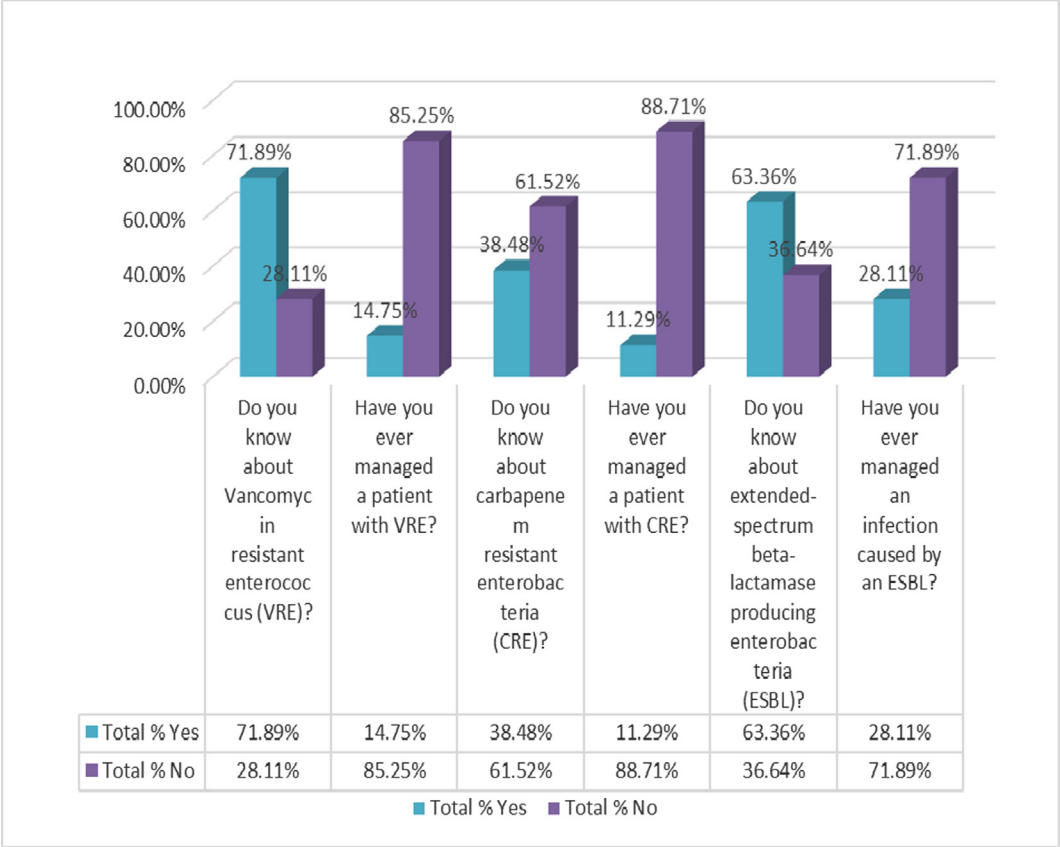


Fig. 4. Awareness about antibiotic resistant bacteria among study participants.

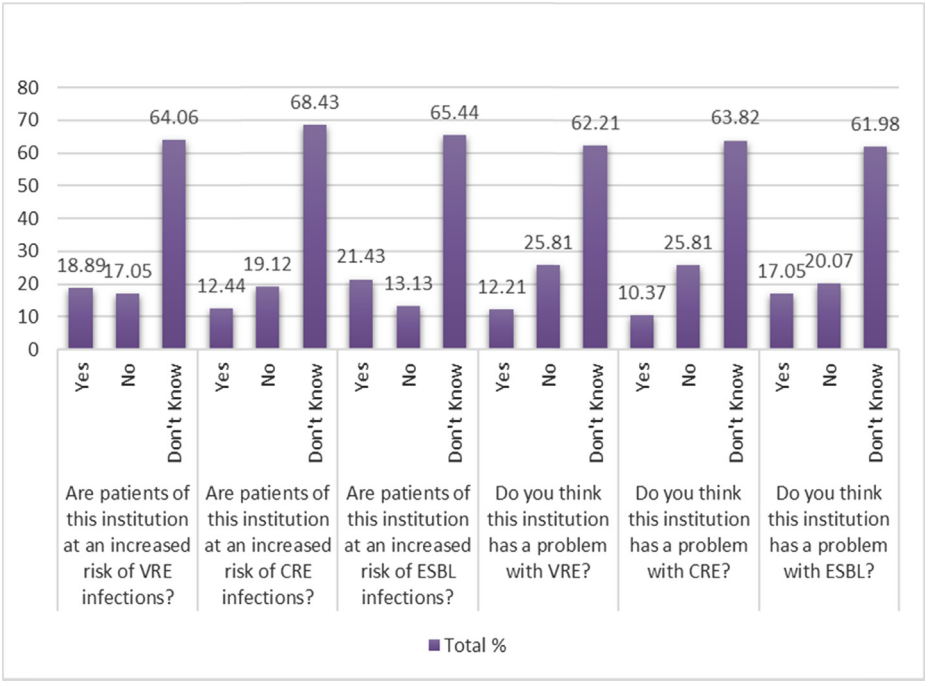


Fig. 5. Responses of the study participants about antibiotic resistant bacteria at their local institution.

in Table no. 2. However, higher social pressure was seen in 13.36% of participants. E.B. Warreman et al. reported in the systematic review about the influence of hospital routines with the perceived value of maintaining a constructive work relationship and the reluctance to intervene in a colleague's antimicrobial prescription decision (Warreman et al., 2019).

The mean perceived behavioural control (PBC) score of all the physicians was 17.97, and the majority of them were on the

acceptable scale, but nearly 13.8% had higher control over their antibiotics prescription. Similar findings were seen in the study of Liu et al (Liu et al., 2019). The mean PBC score of the participants aged between "56–65", 36–45", "24–35" and "46–55" were 20.46, 19.95, 17.56, and 17.36 respectively. Therefore, higher score was found to be in senior physicians, which was statistically significant. [F value of 8.89 (3) = (<0.0001*), p < .05](Post-hoc Tukey-Kramer HSD test, p = 0.0212*, p < .05). While the PBC mean scores of consultant, registrar, senior registrar, GP and resident were 19.36, 19.23, 19, 17.7, and 17.22, respectively. Thus, physicians with a higher professional degree had higher control towards antibiotic prescription (post-hoc test, p = 0.0002*, p < .05). Similarly, physicians with more than 9 years of clinical experience had higher control than new physicians, as represented by statistical significance, [F value of 7.33 (4) = (<0.0001*), p < .05] (post-hoc test, p = 0.0001*, p < .05). However, it is statistically insignificant while comparing between gender and city.

The mean behavioural intentions to prescribe antibiotics of all study participants was 8.84. Its score in participants aged between"56–65", "46–55" ,"36–45", and "24–35" was 6.73, 8.63, 8.23, and 9.05, respectively. Also, its score in participants with more than 20 years of clinical practice is higher (7.56) compared to experience<4 years (9.01). Therefore, higher intentions to prescribe antibiotics were found to be in junior physicians compared to senior clinically experienced physicians and is statistically significant [Table 5, post-hoc test for age, p = 0.0021*, p < .05 and post-hoc test for clinical years, p = 0.0222*, p < .05)]. The mean behavioural intentions (BI) to reduce antibiotics prescriptions was 11.47 and was found to be satisfactory in 61.05 % of respondents. Its score in participants aged "36–45" was 12.52 compared to "24–35," which was 11.26, a statistically significant difference (Post-hoc Tukey-Kramer HSD test, p = 0.0093*, p < .05). However, it is statistically insignificant while comparing gender and city. The study from Scotland by Eccles, M.P found that a high level of behavioural intentions coupled with a low level of behavioural control drives the (irrational) antibiotic prescribing for patients with upper respiratory tract infections (URTIs) (Eccles et al., 2007).

Figs. 4 and 5 shows the responses of physicians' knowledge and, if ever managed at their institution, the methicillin-resistant Staphylococcus aureus (MRSA), extended-spectrum beta-lactamase-producing Enterobacteriaceae (ESBL), carbapenem-resistant Enterobacteriaceae (CRE), and vancomycin-resistant enterococci (VRE). Most of the physicians (71.89%) knew VRE, and 63.36 % knew about ESBL, but only 38.48 % were aware of CRE. Only 28.11 % of physicians had managed ESBL during their clinical practice, followed by VRE (14.75 %) and CRE (11.29%). This awareness of public health antibiotic-resistant bacteria plays an important role in doctor's antibiotics prescription behaviour, reflecting higher intentions to prescribe antibiotics in our study participants.

As depicted in Fig. 5, more than 60% of respondents did not know the magnitude of antibiotic resistance at their institution, and therefore it was likely to be underestimated. These findings can have a potential influence on patient care and infection control activities, as physicians are less likely to pay attention while selecting antibiotics if they are unaware of antibiotic resistance status at their institution. Similar results were seen in other study (Labi et al., 2018).

Although most of the participants had a good attitude and acceptable perceived social pressure, behavioural intentions were satisfactory in less than two-third of participants, and less than one-fourth had ever managed antibiotic-resistant bacteria. Their awareness about their institutional antibiotic resistance was found to be poor. Our findings contribute a reason to enhance educational campaigns and awareness of antibiotic restriction policy in Saudi Arabia. Hospital educational programs should include concepts of antibiotic resistance development, multidrug-resistant organisms, and modalities for preventing the development and spread of antibiotic resistance, including a refresher course on antibiotics and the recent guidelines. Training medical students and physicians on giving and receiving feedback on antibiotic prescription quality at the department level and acknowledging teams for improvements in the quality of prescribing is much needed. Also, antibiotic use and resistance concepts should be incorporated into the clinical education programs at an advanced level for medical schools.

Our study has some limitations. 1) the self-reported nature of the data are inherently exposed to recall bias, selective reporting, and/or participant error. These features were mitigated by the anonymous, voluntary nature of participation and the large sample size. 2) the voluntary participation in this cross-sectional study determines that those more interested in antimicrobial stewardship issues are possibly over-represented in the sample as the majority of study participants were residents.

5. Conclusion:

Our study determined that the physicians of Saudi Arabia had good attitude towards the prescription of antibiotics, acceptable perceived social pressure, while the senior and more clinical experienced physicians with a higher professional degree had higher control towards antibiotic prescription. Also, physicians had higher behavioural intentions to prescribe antibiotics along with profound unsatisfactory knowledge and poor awareness of public health antibiotic-resistant bacteria. Therefore, training of physicians to improve their knowledge through regular conferences, workshops, and continued medical education (CME) is an hour of need. Also, experiential learning by receiving feedback on prescription quality for junior physicians voluntarily could be a great option in their uplift of professional antibiotic education.

6. Institutional review Board statement

Ethical approval was taken before the start of the study by Institutional Review Board of Princess Nourah bint Abdulrahman University with Registration number of H-01-R-059 and IRB log number, 19–0180

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jsps.2021.10.011.

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