Physicians' knowledge, perceptions, and attitudes toward antimicrobial prescribing in Riyadh, Saudi Arabia

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ABSTRACT

الأهداف: تقييم معرفة، وإدراك، ومواقف الأطباء السعوديين الممارسين تجاه وصف المضادات الميكروبية في الرياض، المملكة العربية السعودية.

الطريقة: اعتمدت هذه الدراسة المقطعية على إعداد وتوزيع أوراق الاستبيان التي قمنا بتوزيعها على الأطباء الممارسين في الرياض، المملكة العربية السعودية. وامتدت مدة الدراسة من يونيو إلى أغسطس 2013م. ولقد قمنا بتحليل نتائج الدراسة من خلال استخدام المحلل الإحصائي ستاتا 12.

النتائج: لقد قمنا بنجاح بجمع 212 (84.8%) إجابة كاملة على الاستبيان الذي قمنا بإرساله. وأدرك غالبية المشاركين في الدراسة بأن مقاومة المضادات الميكروبية تعد من المشاكل المهمة في حياتهم اليومية (119, 56.1%)، وكذلك من المشاكل المهمة على الصعيد الوطني (148, 69.8%). وقد اعتقد المشاركين في الدراسة بأن العلاج التجريبي العشوائي الغير مناسب (101, 47.6%)، والاستخدام المفرط للمضادات الحيوية في الخدمات الصحية (66, 31.1%) من العوامل الأساسية المؤدية لزيادة مقاومة المضادات الميكروبية. وقد فضل المشاركين علاج العدوى وليس المستعمرة الجرثومية (98, 46.2%)، بالإضافة إلى تثقيف الأطباء (74, 34.9%) وذلك كأفضل الوسائل للحد من المقاومة البكتيرية للمضادات الحيوية. وأبدى العديد من المشاركين (95, 44.8%) عدم ثقتهم بخصوص معرفتهم بمتطلبات وصف المضادات الحيوية، فيما كان لدى ثلثي المشاركين (135, 63.7%) توجيهات محلية لوصف المضادات الحيوية حيث أعرب 90 مشاركاً (66.7%) عن فائدتها. وقد أعرب غالبية المشاركين في الدراسة (160, 75.5%) عن الفائدة العظيمة التي يقدمها فريق مكافحة العدوى المحلي.

الخاتمة: أظهرت هذه الدراسة بأن هناك احتياجات كبيرة لم تُلبى في تدريب وتعليم الأطباء في مجال وصف المضادات الميكروبية. ولذلك فنحن بحاجة إلى مراجعة التوجيهات المحلية الخاصة بوصف المضادات الميكروبية وذلك من أجل ضمان انها ذات صلة وفائدة أكبر للأطباء الممارسين.

Objectives: To assess knowledge, perceptions, and attitudes toward antimicrobial prescribing among physicians practicing in Riyadh, Saudi Arabia.

Methods: A questionnaire was developed and distributed to physicians working in hospitals in Riyadh, Saudi Arabia between June and August 2013. The results were analyzed using Stata 12 software.

Results: Two hundred and twelve (84.8%) full responses were returned. Most respondents perceived antimicrobial resistance as a significant problem in their daily practice (119, 56.1%) and at a national level (148, 69.8%). Inappropriate empirical therapy (101, 47.6%) and excessive use of antimicrobials in healthcare settings (66, 31.1%) were believed to be the main contributors to increasing bacterial resistance. Respondents favor treating infection rather than colonization (98, 46.2%), and physician education (74, 34.9%) as the most effective interventions to reduce antimicrobial resistance. Many respondents (95, 44.8%) do not feel confident in their knowledge of antimicrobial prescribing. Two-thirds of the respondents (135, 63.7%) have local antimicrobial guidelines, of which 90 (66.7%) felt were useful. Most respondents (160, 75.5%) considered their local infectious diseases service to be very helpful.

Conclusion: There are considerable unmet training and education need for physicians in the area of antimicrobial prescribing. Local antimicrobial guidelines need revision to ensure they are more relevant and helpful for medical practitioners.

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The importance of judicious clinical use of antimicrobial agents and increasing rates of antimicrobial resistance have been the subject of numerous studies in the last decade.[1-6] These studies involved either health care workers such as physicians, medical students, or pharmacists, or the general public. Several factors may contribute to inappropriate antimicrobial usage, including doctors' knowledge and experiences, uncertain diagnosis, patients' expectations, pharmaceutical marketing influences, and unregulated antibiotic dispensing.[1] Despite continuous efforts to improve antimicrobial prescribing and address issues such as self-prescribing, unnecessary use for viral infections, dosing errors, and excessive treatment durations, rates of antimicrobial resistant infections continue to rise globally.[7-10] Investigators from different parts of the world have identified knowledge gaps regarding antimicrobial prescribing and growing concern over the increasing antimicrobial resistance among healthcare workers.[6,11,12] The development and implementation of wide ranging educational programs for both physicians and the general population are among the commonly recommended strategies to help address those concerns.[13] In Saudi Arabia, accurate, denominated antimicrobial prescribing data is not available. It is however, important to note that antimicrobials are the third most commonly prescribed group of medications in the country.[14] Furthermore, antibiotics are prescribed to 44-88% of patients who present to primary healthcare centers with upper respiratory tract infections (URTI).[15] In dental practice, Al-Harthi et al[16] found that healthcare workers believed that antimicrobials are excessively used and that their participants did not find hospital guidelines as helpful as other resources. Family and caretakers beliefs, especially among parents of young children, along with peer pressure are also significant contributing drivers of antimicrobial misuse.[17] Better understanding the physicians' knowledge, perception, and attitude toward antimicrobial prescribing is essential for formulating effective antimicrobial stewardship programs. The objective of this study was to assess knowledge, perceptions, and attitudes in relation to antibiotic prescribing among physicians practicing in hospitals in Riyadh, Saudi Arabia.

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Methods. The study was conducted between June and August 2013 and involved physicians from tertiary care centers in Riyadh, designated in this report as hospitals A, B, C, D, and others (**Appendix 1**). An electronic invitation letter was sent to physicians in various clinical specialties including internal medicine, cardiology, neurology, general surgery, urology, obstetrics and gynecology, primary health care, critical care, and emergency medicine. Participants were invited to complete a self-reported questionnaire either online or on hard copy. Participation in the study was voluntary and anonymous. The questionnaire consisted of 30 items and was designed to investigate various aspects of the physicians' antimicrobial prescribing practices and the beliefs on which they are based. The questionnaire was validated using a small group from medical residents and fellows before it was distributed among the target population. We collated the participants' demographic data including age, gender, professional status, specialty, and duration of medical practice. Responses for questions related to perception and attitude were graded on a 5-point Likert scale, agreement scale ranging from '1' for do not agree to '5' for strongly agree; or helpfulness scale from '1' not available to '5' for very helpful (**Appendix 2**). Participant ages were categorized into 4 groups; less than 25 years, 25-30 years, 31-40 years, and more than 40 years. Similarly, years of experience were categorized as 2 years or less, 3-5 years, 6-10 years, and more than 10 years.

Data were entered into a Microsoft Excel 2007 spreadsheet (Microsoft Inc., Seattle, Washington, USA) and analyzed using Stata 12 (Stata Corp, College Station, TX, USA). The institution's Research Ethics Committee approved the study.

Results. Two hundred and twelve (84.8%) of the 250 distributed questionnaires were returned successfully. The number of male respondents was slightly higher than females. Forty-eight percent of respondents were 25-30 years of age. The largest proportion of responses was from Hospital A. The largest group of respondents was residents (105, 49.5%), followed by consultants (48, 22.6%), and specialists (31, 14.6%). Most of the respondents were from medical specialties (126, 59.4%). The demographic details of the respondents are summarized in **Table 1**. One hundred and eighty-three respondents (86.3%) believed that inappropriate antibiotics prescribing did put patients at risk of developing antimicrobial resistance. Just over half the respondents (107, 52.9%) did not agree that over prescription of antibiotics is better than under

prescribing, and 178 (83.9%) did not believe that over-the-counter sale of antibiotics is appropriate (**Table 2**). Over half of the respondents (119, 56.1%) agreed that antimicrobial resistance was a problem in their daily practice, and almost two-thirds (139, 65.6%) believed it to be a significant problem in their hospitals. Only 16 (7.5%) respondents strongly agreed that they were aware of the antimicrobial resistance rates and patterns in their hospitals. Less than half (95, 44.8%) of the respondents had firm confidence in their knowledge and practice of antimicrobial prescribing. Slightly more than half of the respondents (116, 54.7%) did not agree that they receive regular infectious diseases training and education at the work place. Most respondents (142, 66.9%) found their hospital infectious disease service easily accessible and very helpful (160, 75.5%). In terms of duration of antimicrobial therapy, 107 (50.5%) stated that they usually prescribed empiric antimicrobial therapy for one week, while for approximately one third (77, 36.3%) the usual duration was 3-5 days. For most respondents (181, 85.4%), the patient's clinical condition was the most important factor to influence the decision to initiate antibiotics. The cost effectiveness of antibiotics was always considered by only a minority (10, 4.7%) of the participants, whereas 88 (41.5%) sometimes took that into consideration. Almost half (103, 48.5%) the participants believed that poor skills and knowledge were important causes of inappropriate use of antibiotics (**Table 3**). When making decisions related to antimicrobial prescribing, hospital guidelines were the most commonly used resource (83, 39.2%) followed by quick reference guides or booklets (63, 29.7%) such as the Sanford Guide to antimicrobial therapy (www.sanfordguide.com) and John Hopkins Antibiotic Guide (www.hopkinsguides.com). Only 33 respondents (15.6%) used online resources such as UpToDate (www.uptodate.com) and Medscape (www.medscape.com). Among online resources, UpToDate was most frequently used reference (126, 59.4%) (**Table 4**). When assessing the availability, accessibility, and utilization of hospital guidelines

Table 1 - Demographic details of 212 physicians who responded to a questionnaire on knowledge, perceptions, and attitudes toward antimicrobial prescribers.

Variables	Number (%)
Gender	
Male	117 (55.2)
Female	95 (44.8)
Age (years)	
25-30	101 (47.6)
31-40	59 (27.8)
>40	52 (24.6)
Hospitals	
A	131 (61.8)
B	19 (9.0)
C	18 (8.5)
D	5 (2.4)
Others	39 (18.4)
Professional status	
Consultant	48 (22.6)
Fellows	26 (12.3)
Specialists	31 (14.6)
Residents	105 (49.5)
Others	2 (1.0)
Years of experience	
<2 years	47 (22.1)
3-5 years	61 (28.8)
6-10 years	43 (20.3)
>10 years	61 (28.8)
Specialties	
Medical	126 (59.4)
Surgical	37 (17.5)
Critical care	27 (12.7)
Accident and emergency	10 (4.7)
Obstetrics and gynecology	7 (3.3)
Others	5 (2.4)

A - Prince Sultan Military Medical City, Riyadh, KSA, B - King Fahad Medical City, Riyadh, KSA, C - King Khalid University Hospital, Riyadh, KSA, D - King Faisal Specialist Hospital and Research Centre, Riyadh, KSA

Table 2 - Responses of 212 physicians to questions related to their perceptions and attitudes in relation to antimicrobial prescribing.

Questions	Do not agree	Somewhat agree	Neutral	Agree	Strongly agree
	Number (%)				
Inappropriate antibiotic prescribing puts patients at risk	6 (2.8)	7 (3.3)	16 (7.5)	66 (31.1)	117 (55.2)
It is always better to over-prescribe antibiotics than under-prescribe?	107 (50.5)	41 (19.3)	32 (15.1)	25 (11.8)	7 (3.3)
Everyone should be able to buy antibiotics without a prescription?	178 (84.0)	14 (6.6)	14 (6.6)	4 (1.9)	2 (0.9)
Antimicrobial resistance is a problem in my daily practice?	7 (3.3)	43 (20.3)	43 (20.3)	72 (34.0)	47 (22.2)
Antimicrobial resistance is a significant problem for my hospital?	16 (7.5)	25 (11.8)	32 (15.1)	86 (40.6)	53 (25.0)
Antimicrobial resistance is a significant countrywide problem?	4 (1.9)	25 (11.8)	35 (16.5)	99 (46.7)	49 (23.1)
Antimicrobial resistance is a significant worldwide problem?	5 (2.4)	22 (10.4)	23 (10.8)	110 (51.9)	52 (24.5)
I am aware of the antimicrobial resistance rates and patterns in my hospital?	42 (19.8)	52 (24.5)	47 (22.2)	55 (25.9)	16 (7.5)
I feel confident about my knowledge and practice in the area of antimicrobial prescribing?	26 (12.3)	41 (19.3)	50 (23.6)	85 (40.1)	10 (4.7)
I receive regular training and education in antimicrobial prescribing in my work place?	74 (34.9)	42 (19.8)	35 (16.5)	45 (21.2)	16 (7.5)
The infectious diseases service in my hospital is easily accessible?	18 (8.5)	21 (9.9)	31 (14.6)	90 (42.5)	52 (24.5)
The infectious diseases service in my hospital is very helpful?	11 (5.2)	20 (9.4)	21 (9.9)	92 (43.4)	68 (32.1)

Table 3 - Responses of 212 physicians to questions related to their antimicrobial prescribing practices.

Questions	Response number (%)
What is your usual duration of empiric antimicrobial therapy?	
2 weeks	28 (13.2)
3-5 days	77 (36.3)
One week	107 (50.5)
Which of these factors may influence your decision to start antimicrobial therapy?	
Patient's clinical condition	181 (85.4)
Positive microbiological results in symptomatic patients	28 (13.2)
Wanting to satisfy the senior treating physician	2 (0.9)
Worry of missing patients with possible infections	1 (0.5)
Do you ever try to make sure that your antibiotic prescribing is cost-effective?	
Always	10 (4.7)
Most of the time	52 (24.5)
Never	22 (10.4)
Rarely	40 (18.9)
Sometimes	88 (41.5)
Which of these do you think are important causes of inappropriate use of antibiotics?	
Poor skills and knowledge	103 (48.5)
Unrestricted availability of antimicrobials	53 (25.0)
Inadequate supervision	26 (12.3)
Lack of physician interest in the subject of antimicrobial prescribing and infection management	14 (6.6)
Lack of effective hospital policies	8 (3.8)
Overworked health care personnel	8 (3.8)
Which of the following do you think may help control antimicrobial resistance?	
Treating infection, not contamination or colonization	98 (46.2)
Physician education on appropriate antimicrobial therapy	74 (34.9)
Consulting with infectious diseases experts	13 (6.1)
Providing local antimicrobial guidelines	10 (4.7)
Knowledge of pathogens and antimicrobial susceptibility test results	4 (1.9)
Obtaining local antibiotic resistance profiles	4 (1.9)
Practicing antimicrobial restriction	3 (1.4)
Removing catheters when not essential	3 (1.4)
Targeting antimicrobial therapy to likely pathogens	3 (1.4)
Which of these do you think are important consequences of antimicrobial overuse?	
Antimicrobial resistance	195 (92.0)
Adverse drug reactions and medication errors	10 (4.7)
Quicker discharge from hospital	3 (1.4)
Better patient outcome	2 (0.9)
Waste of resources	2 (0.9)

Table 4 - Resources most commonly used by 212 physicians who responded to a questionnaire on knowledge, perceptions, and attitudes toward antimicrobial prescribers.

Most common references	Number (%)
Hospital guidelines	83 (39.2)
Quick reference guides or booklets	63 (29.7)
Infectious diseases service	14 (6.6)
Smart phone medical applications	10 (4.7)
Clinical pharmacists	5 (2.4)
Colleagues from your own team or specialty	4 (1.9)
Online resources	33 (15.6)

for diagnosis and management of infectious management, 135 (63.7%) indicated that they have local antimicrobial therapy guidelines. However, only 34 (16%) respondents considered local guidelines to be comprehensive. Moreover, only 56 (26.4%) were described as widely accessible, and 86 (40.6%) were considered helpful (**Table 5**).

Discussion. The study assessed the perception, attitudes, and knowledge of physicians in selected hospitals in Riyadh City toward antimicrobial prescription, whereas previous studies from Saudi Arabia focused mainly on prescribing and utilizing patterns, and to a lesser extent on the determinants of misuse.[14-20] Similar to physicians from other parts of the world, our participants were aware of the growing challenge of antimicrobial resistance at local and national levels.[5,21] Most, however, were unaware of the specific antimicrobial resistance rates and patterns in their own institutions. This may be the result of inadequate surveillance of the multi-drug resistant organisms or limited data sharing. Surveillance systems of antimicrobial usage and resistance should include

Table 5 - Responses of 212 physicians to questions related to availability, accessibility, and utility of local antimicrobial therapy guidelines.

Questions	Number (%)
Does your hospital provide guidelines for diagnosis and management of patient with infective problems?	
Yes, but limited	90 (42.5)
Yes, but not helpful	11 (5.2)
Yes, comprehensive	34 (16.0)
No	39 (18.4)
I do not know	38 (17.9)
How accessible are these guidelines?	
No guidelines	34 (16.0)
Limited access / access with difficulty	60 (28.3)
Widely accessible	56 (26.4)
I do not know	62 (29.2)
How helpful do you find these guidelines?	
Not available	65 (30.7)
Not helpful at all	7 (3.3)
Somewhat helpful	54 (25.5)
Helpful	66 (31.1)
Very helpful	20 (9.4)
Do you follow the recommendations of your hospital antimicrobial guidelines?	
Never	9 (4.2)
Rarely	9 (4.2)
Sometimes	52 (24.5)
Most of the time	93 (43.9)
Always	49 (23.1)

efforts to ensure timely dissemination of information to all health care workers and stakeholders.

Most (92.0%) of our participants believed that inappropriate use of antimicrobial agents may result in antimicrobial resistance, and almost half (103, 48.6%) of the respondents believed that inadequate knowledge is the most important contributor to poor antimicrobial practices. However, it is important to note that we did not attempt to assess the appropriateness of prescribing, but rather focused on the physician's views and perception to help plan appropriate interventions. Unrestricted access to antimicrobials and inadequate supervision were other important reasons for concern among our respondents. These findings highlight the urgent need for carefully planned education and training programs to address the knowledge gaps and support appropriate evidence-based antimicrobial prescribing practices.

Most of the participants stated that their empiric antimicrobial prescribing is usually limited to a period of one week or less. Only a minority used longer empiric courses. It is reassuring that the main driver for decisions to initiate antimicrobial therapy is the patient's clinical condition. Tenuous factors such as wanting to please seniors and unfounded concerns were rarely selected as drivers for such decisions. Others identified psychosocial and behavioral factors, including self-prescription, over-the-counter availability and parents' or patients' pressure as the key factors for prescribing antimicrobials.[22,23] Training and educational programs should aim to reinforce such appropriate beliefs and to emphasize areas of good practice that already exist.

Interestingly, cost effectiveness was mostly not considered while making antimicrobial prescribing decisions. It is possible that because our respondents were from public sector hospitals, where comprehensive services are provided freely to all eligible patrons, cost was not perceived as an important consideration. Similar findings were reported by other groups, who identified limited knowledge of actual drug costs among physicians.[9,24] Our results indicate a clear need for training in cost-effective prescribing to minimize a direct and indirect financial burden on the health care systems.

Although most respondents had some confidence in their knowledge and practice in relation to antimicrobial prescribing, around one third (74, 34.9%) do not receive regular training in their area. It is therefore, not clear if such high confidence is well founded. One cause for concern in our findings was the unavailability or limited utility of local antimicrobial therapy guidelines. Of even greater concern is the fact that less than 5% of respondents feel that the availability of local antimicrobial therapy guidelines is an important tool in controlling antimicrobial resistance. It appears that appropriate training and education programs need to include elements that help physicians recognize the

important contribution of evidence-based guidelines in helping guide appropriate choices and decisions to address their well-recognized concern of poor knowledge as one of the main contributors to poor antimicrobial prescribing. The overwhelming confidence in one's prescribing abilities while not recognizing the importance of locally developed guidelines suggests that some physicians may be oblivious to their own shortcomings. Similar observations were reported by Charani et al,[25] who found that some physicians based their prescribing decision on personal knowledge and experience rather than formal policy.

Another encouraging finding in our study was that most respondents feel that their local infectious diseases services are readily accessible and very helpful. This is an ideal starting point for pro-active training activities that are likely to gain the target physician's confidence and interest. Such programs should attempt to combine knowledge enhancement with regular competency evaluation for physicians from different specialties. It is well established that successful antimicrobial stewardship programs involve elements of organized and opportunist training, engage all stakeholders and share successes across the institution. Restrictive policies have been shown to be least effective tools, whereas education and feedback are associated with long-term effectiveness.[4,5,26]

The study has some limitations; as a survey, it is possible that respondents gave socially acceptable answers. We tried to include questions that allow respondents to state their true views without any suggestion that there are right and wrong answers. We also ensured that responses did not include any identifiers to help respondents express themselves freely. Most participants were from 4 tertiary care centers in one city, and therefore the results may not be generalizable. We are however, unaware of any similar work in the region and therefore feel that the findings are of generalized interest.

In conclusion, our study identified considerable unmet training and education needs for physicians in the area of antimicrobial prescribing. Furthermore, it appears that local antimicrobial guidelines need revision to ensure they are more relevant and helpful for medical practitioners. Local infectious diseases services and antimicrobial stewardship programs should take this data into account when planning and executing their activities.

References

1. Suaifan GA, Shehadeh M, Darwish DA, Al-Ijel H, Yousef AM, Darwish RM. A cross-sectional study on knowledge, attitude and behavior related to antibiotic use and resistance among medical and non-medical university students in Jordan. ***African Journal of Pharmacy and Pharmacology*** 2012; 6: 763-770.
2. Cespedes A, Larson E. Knowledge, attitudes, and practices regarding antibiotic use among Latinos in the United States: review and recommendations. ***Am J Infect Control*** 2006; 34: 495-502.
3. Srinivasan A, Song X, Richards A, Sinkowitz-Cochran R, Cardo D, Rand C. A survey of knowledge, attitudes, and beliefs of house staff physicians from various specialties concerning antimicrobial use and resistance. ***Arch Intern Med*** 2004; 164: 1451-1456.
4. Wester CW, Durairaj L, Evans AT, Schwartz DN, Husain S, Martinez E. Antibiotic resistance: a survey of physician perceptions. ***Arch Intern Med*** 2002; 162: 2210-2216.
5. Navarro-San Francisco C, Del Toro MD, Cobo J, De Gea-García JH, Vañó-Galván S, Moreno-Ramos F, et al. Knowledge and perceptions of junior and senior Spanish resident doctors about antibiotic use and resistance: results of a multicenter survey. ***Enferm Infecc Microbiol Clin*** 2013; 31: 199-204.
6. Abbo L, Sinkowitz-Cochran R, Smith L, Ariza-Heredia E, Gómez-Marín O, Srinivasan A, et al. Faculty and resident physicians' attitudes, perceptions, and knowledge about antimicrobial use and resistance. ***Infect Control Hosp Epidemiol*** 2011; 32: 714-718.
7. Sahlan S, Wollny A, Brockmann S, Fuchs A, Altiner A. Reducing unnecessary prescriptions of antibiotics for acute cough: adaptation of a leaflet aimed at Turkish immigrants in Germany. ***BMC Fam Pract*** 2008; 9: 57.
8. Coenen S, Michiels B, Renard D, Denekens J, Van Royen P. Antibiotic prescribing for acute cough: the effect of perceived patient demand. ***Br J Gen Pract*** 2006; 56: 183-190.
9. Reichert S, Simon T, Halm EA. Physicians' attitudes about prescribing and knowledge of the costs of common medications. ***Arch Intern Med*** 2000; 160: 2799-2803.
10. Baquero F. Antibiotic resistance in Spain: what can be done? Task Force of the General Direction for Health Planning of the Spanish Ministry of Health. ***Clin Infect Dis*** 1996; 23: 819-823.
11. Guerra CM, Pereira CA, Neves Neto AR, Cardo DM, Correa L. Physicians' perceptions, beliefs, attitudes, and knowledge concerning antimicrobial resistance in a Brazilian teaching hospital. ***Infect Control Hosp Epidemiol*** 2007; 28: 1411-1414.
12. Lucet JC, Nicolas-Chanoine MH, Roy C, Riveros-Palacios O, Diamantis S, Le Grand J, et al. Antibiotic use: knowledge and perceptions in two university hospitals. ***J Antimicrob Chemother*** 2011; 66: 936-940.
13. Belongia EA, Schwartz B. Strategies for promoting judicious use of antibiotics by doctors and patients. ***BMJ*** 1998; 317: 668-671.
14. Al-Faris EA, Al Taweel A. Audit of prescribing patterns in Saudi primary health care: What lessons can be learned? ***Ann Saudi Med*** 1999; 19: 317-321.
15. Alumran A, Hurst C, Hou X-Y. Antibiotics Overuse in Children with Upper Respiratory Tract Infections in Saudi Arabia: Risk Factors and Potential Interventions. ***Clinical Medicine and Diagnostics*** 2011; 1: 8-16.

16. Al-Harthi SE, Khan LM, Abed HH, Alkreathy HM, Ali AS. Appraisal of antimicrobial prescribing practices of governmental and non-governmental dentists for hospitals in the western region of Saudi Arabia. ***Saudi Med J*** 2013; 34: 1262-1269.
17. Abobotain AH, Sheerah HA, Alotaibi FN, Joury AU, Mishiddi RM, Siddiqui AR, et al. Socio-demographic determinants of antibiotic misuse in children. A survey from the central region of Saudi Arabia. ***Saudi Med J*** 2013; 34: 832-840.
18. Al Shimemeri A, Al Ghadeer H, Memish Z. Antibiotic utilization pattern in a general medical ward of a tertiary medical center in Saudi Arabia. ***Avicenna J Med*** 2011; 1: 8-11.
19. Ahmed KZ, Al-Saadi AR. A survey of multiple prescriptions dispensed in Saudi Arabia. ***Pak J Pharm Sci*** 2005; 18: 1-2.
20. Ali M, Ahmed M. Problems of drug prescription at primary health care centres in Southern Saudi Arabia. ***Saudi Med J*** 1995; 16: 213-216.
21. Pulcini C, Naqvi A, Gardella F, Dellamonica P, Sotto A. [Bacterial resistance and antibiotic prescriptions: perceptions, attitudes and knowledge of a sample of French GPs]. ***Med Mal Infect*** 2010; 40: 703-709. French
22. Viberg N, Kalala W, Mujinja P, Tomson G, Lundborg CS. "Practical knowledge" and perceptions of antibiotics and antibiotic resistance among drugsellers in Tanzanian private drugstores. ***BMC Infect Dis*** 2010; 10: 270.
23. Al-Niemat SI, Bloukh DT, Al-Harasis MD, Al-Fanek AF, Salah RK. Drug use evaluation of antibiotics prescribed in a Jordanian hospital outpatient and emergency clinics using WHO prescribing indicators. ***Saudi Med J*** 2008; 29: 743-748.
24. Krivoy N, El-Ahal WA, Bar-Lavie Y, Haddad S. Antibiotic prescription and cost patterns in a general intensive care unit. ***Pharmacy Practice*** 2007; 5: 67-73.
25. Charani E, Castro-Sanchez E, Sevdalis N, Kyratsis Y, Drumright L, Shah N, et al. Understanding the determinants of antimicrobial prescribing within hospitals: the role of "prescribing etiquette". ***Clin Infect Dis*** 2013; 57: 188-196.
26. Tennant I, Nicholson A, Gordon-Strachan GM, Thoms C, Chin V, Didier MA. A survey of physicians' knowledge and attitudes regarding antimicrobial resistance and antibiotic prescribing practices at the University Hospital of the West Indies. ***West Indian Med J*** 2010; 59: 165-170.

Appendix 1 - List of hospitals to which the study participants were affiliated.

Hospital list
1. Prince Sultan Military Medical City, Riyadh, KSA
2. King Fahad Medical City, Riyadh, KSA
3. King Khalid University Hospital, Riyadh, KSA
4. King Faisal Specialist Hospital and Research Centre, Riyadh, KSA
5. King Abdulaziz Medical City, Riyadh, KSA
6. King Saud Medical City, Riyadh, KSA
7. Al-Habib Hospital, Riyadh, KSA
8. Al-Hammadi Hospital, Riyadh, KSA
9. Dallah Hospital, Riyadh, KSA

KSA - Kingdom of Saudi Arabia

Appendix 2 - Likert's scale for the questionnaire provided to the study participants regarding antimicrobal perscribing practices.

Agreement scale
1. Do not agree
2. Somewhat agree
3. Neutral
4. Agree
5. Strongly agree

Helpfulness scale
1. Not available
2. Not helpful at all
3. Somewhat helpful
4. Helpful
5. Very helpful