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Original article

Perceptions regarding antimicrobial use and resistance among adult hospital patients in Saudi Arabian Ministry of Health (MOH) hospitals

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ABSTRACT

Background: Education, a key strategy within antimicrobial stewardship programmes (ASPs), has been mainly directed towards healthcare professionals and prescribers more than hospitalised patients.
Aim: To examine patients' knowledge and perceptions of antibiotic use and resistance, while evaluating the institutional role of patient education on antibiotic use in two Saudi Arabian hospitals, one with an implemented ASP and one without an ASP.
Method: A cross-sectional self-administered survey was developed and piloted. A total of 400 surveys were distributed, 200 within the hospital with an ASP and another 200 within the hospital without an ASP. Data were coded and analysed. Ethical approval was obtained before the start of the study.
Findings: 176 patients responded to the survey with 150 surveys completed and analysed. 78% of patients agreed that they should only take an antibiotic when prescribed by the doctor, however they still tended to keep left over antibiotics for future use. 84% of patients were unaware 'antibiotic resistance', with 48% believing that antibiotics help them get better quicker when they had a 'cold'. Information on antibiotic use and resistance were provided to patients in the hospital with an ASP in contrast to the hospital without an ASP.
Conclusion: Overall there are poor perceptions regarding antibiotic use and resistance among hospital patients in Saudi Arabia. Patients in the hospital with ASP demonstrated greater knowledge during their hospitalisation. ASPs should not only focus on educating healthcare professionals but should involve the patients and seize the opportunity to educate them while hospitalised.

1. Introduction:

Education, a key strategy within antimicrobial stewardship programmes (ASPs), has been a key component of the ASP strategy for healthcare professionals (Barlam et al., 2016; Dellit et al., 2007; Public Health England, 2015). Published studies have assessed the knowledge and perceptions of healthcare providers related to the implementation and uptake of ASPs in different settings and in most of these studies education is a recurrent theme echoed by all healthcare providers (Jenkins et al., 2015; Perozziello et al., 2018; Waters, 2015). It is well known that patients' and public misuse of antibiotics is also a major driving force in development of antimicrobial resistance (AMR) (Earnshaw et al., 2009). This has led to several educational campaigns, such as Antibiotic Awareness Week (World Health Organisation, 2015a), as well as other educational strategies within the community to raise public awareness of AMR (Ahmed et al., 2020; Huttner et al., 2010; Price et al., 2018; Richmond et al., 2019).

Studies assessing knowledge, behaviour and attitude towards antibiotic use among the public has identified the different ways

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people misuse antibiotics, including data from the Middle East. These included using antibiotics for treatment of common cold and cough, using antibiotics without a prescription, keeping antibiotics at home for emergency use, use of left-over antibiotics without physicians' consultation, and use of antibiotics based on a relative's advice (Alghadeer et al., 2018; Alhomoud et al., 2018; Benmerzouga et al., 2019; Gualano et al., 2015; Shehadeh et al., 2012).

While most of the effort has been targeting educating the public within community settings, it seems that little opportunity is up taken to educate hospitalised patients regarding the appropriate use of antibiotics and the growing resistance problem. The aim of this study was to examine inpatients' knowledge and perceptions of antibiotic use and resistance, while evaluating the institutional role of patient education on antibiotic use in two Saudi Arabian hospitals, one with an implemented ASP and one without an ASP.

2. Methods

2.1. Questionnaire design

A cross-sectional self-administered survey was used to meet the study's aim. The questionnaire statements were adapted from previously validated tools (André et al., 2010; Awad and Aboud, 2015; Oh et al., 2011) following a literature review. The survey included two main sections; The first section included background information including hospital name, gender, age and level of education. While the second section included Likert-type statements on knowledge and perceptions regarding antibiotic use and AMR to address: access to antibiotics (three items), effect of antibiotics (six items), antibiotic resistance (six items), doctor's habits and patient/doctor relationship (six items) and patients' use of antibiotics during hospital stay (five items). The Likert-like scale used included 3 possible responses for participants: Agree, Do not know, or Disagree. The survey was developed in English and then translated into Arabic through a forward and backward translation process. The survey was then translated from English to Arabic. Two independent researchers, who are bilingual (Arabic/English) speakers, then translated back the survey to English (IB and NS). The survey was piloted with 52 patients representing two hospitals, one with ASP and one without ASP. Appropriate changes were made in accordance with participants' feedback regarding the questionnaire's content and layout; they gave us feedback about the clarity of the questions, how easy it was complete the questionnaire and whether all terms used were understandable and interpreted correctly.

2.2. Validity and reliability of the survey

Face and content validity were reviewed by the study's researchers as well as two ASP pharmacists and an infectious disease consultant working in Saudi Arabia. During the pilot study, a T-test was conducted to allow the determination and comparison of the mean scores and confirm that the survey could successfully differentiate participants' positive and negative perspectives (Moore et al., 2012; Watkins et al., 2007). By conducting a visual inspection of the total low and high survey scores reported by the study participants, a cut-off score was determined. A high score indicated that the patients had a positive perception towards antibiotic use and resistance. A correlation test was also conducted to show whether there is a significant correlation between the subscales of the survey in relation to each other and the overall score of the survey. The correlation test revealed that the sub-scales from (1)–(5) had a significant and strong correlation between the dimensions of the survey with each other and with the overall score of the survey between $r \geq 0.28$ and $r = 0.89$.

The reliability of the survey was ensured by 1) the split half method, which divided the total items (26 items) into two groups. The analysis showed that there were good correlations between the groups ($r = 0.80$, $p < 0.001$, N: 52. 2) Test-re-test of the questionnaire; The survey was conducted again after 7 days among the same pilot group (52 participants) who completed the survey the first time. The Pearson correlation test indicated that the correlation between the first and second survey performance was significant ($r = 0.79$, $p < 0.01$, $N = 52$). 3) Cronbach's Alpha method was used to calculate the reliability coefficients of all items in the survey and showed that the coefficient was sufficient at a level of 0.86 and thus the instrument provided an acceptable degree of reliability (Altawil, 2016; Moore et al., 2012; Watkins et al., 2007).

2.3. Sampling, setting and sample size

Participants were recruited using a purposive/convenience sampling method. The survey was distributed in two Ministry of Health (MOH) hospitals Saudi Arabia; one hospital without an established ASP in Albaha region and another with an established ASP in Makkah. The hospital with a formal ASP, has a full ASP team including and ASP pharmacists who make rounds to in-patients and educate and provide them with information on antibiotic use. The other hospital does not have a formal ASP, but has an antibiotic pharmacist, who only provides information to prescribers from the pharmacy without any direct contact with patients. All patients being treated with antibiotics in medical departments were targeted except for psychiatric patients, patients in the intensive care unit and patients less than 21 years. Any patient meeting this inclusion and exclusion criteria was approached by the antibiotic pharmacist at each hospital.

It was decided to distribute 200 questionnaires at each site initially and to continue data collection for a period of 4 months and increase the number of questionnaires if all 400 questionnaires were completed within the time frame. The antibiotic pharmacist at each hospital also distributed a copy of the invitation letters and participant information sheets to the patients. The pharmacists also explained to the participating patients the importance of the study and how their participation would help healthcare professionals understand the gaps within the patients' knowledge to be able to address these gaps by providing better education and counselling. Patients were also offered to be informed of the results of the study once it is completed. Participants were asked to sign a consent form before the completion of the paper-based survey. Patients were giving the chance to go through the survey with the pharmacist and ask for clarifications if needed. Some patients chose to complete the questionnaire in the presence of the pharmacist while others requested to complete it later and for the pharmacists to collect it later. The data was collected between February 2017 and May 2017.

2.4. Data analysis:

Data were coded, entered manually into Microsoft Excel 2016, and uploaded to the SPSS database (Version 23; SPSS Inc., NY, USA). Descriptive analysis was conducted to answer the research questions by using frequencies, percentages, mean and standard deviation. The minimum significance level was 0.05, thereby aiding in the determination of whether the similarities or differences between variables were statistically significant. Based on the distribution and nature of the data and as the data is normally distributed (Kolmogorov-Smirnov = 0.047, p = 0.2, and Shapiro-Wilk = 0.985, p = 0.110), One-Way Anova analysis was used to explore the differences between perspectives on antibiotic use and resistance (dependent variable) with the hospital type, age

and level of education of participants (independent variables). T-test for more than 150 participants can work successfully to differentiate between the differences within sub-scales as well as the whole questionnaire as shown by Altawil et al. (2018) and so the T-test was also used to find the differences between the two groups within each sub-scale based on their mean in each group. The mean reported indicates the mean of cumulative scores for each domain. The overall score for each domains was calculated by adding-up scores gained from answering each statement in the domain; hence, a score of one was given to a negative response of a statement, a score of two was given to a neutral answer, and a score of three were given for a positive response. Coding of responses from participants (agree, don't know, or disagree) to different statement of the domains, was therefore carried out as follows: 1-If the statement referred to a correct knowledge and/or perception (such as questions E1-E3-table 1), then the favourable answer would be "Agree" and the correspondent score would be "3", whereas if participant chose the "don't know" for this statement, then the score would be "2" and a score of "1" was given if "disagree" was selected. 2-If the statement referred to incorrect knowledge and/or perception (such as questions E4-E6), then the favourable answer would be "disagree" and the correspondent score would be "3", whereas if participant chosen "don't know" for this statement, then the score would be "2" and a score of "1" was given if "agree" was selected. Surveys that had incomplete or missing responses were completely excluded from the analysis.

The study was approved by University of Hertfordshire Ethics committee (Number LMS/PGR/UH/02344) and official permissions were obtained in Saudi Arabia from the General Directorate of Health Affairs in Albaha and from the hospital in Makkah were the data was collected.

3. Results

Of the 400 distributed surveys, 176 responded to the survey (44% response rate). Twenty-six were excluded as they were incomplete. A total of 150 responses were analysed, 50.7% (76/150) responses were from the hospital without ASP and 49.3% (74/150) were from the hospital with ASP, 52.7% (79/150) of participants were male and 47.3% (71/150) were female, 44% (66/150) of participants were between the age of 21 and 30 years, and 48.7% (73/150) of participants hold bachelor degrees.

(1) Patients' perceptions regarding antimicrobial use and resistance in Saudi MOH hospitals

This part of the questionnaire aimed to explore the perceptions of patients regarding antibiotic use and resistance in Saudi MOH hospitals in relation to five dimensions: 1) Access to antibiotics; 2) Effects of antibiotics; 3) Antibiotics resistance; 4) Doctors' habits and the relationship between doctors and patients; and 5) Patients' use of antibiotics during hospital stay. A full summary of the responses is presented in Table 1.

(1) Access of patients to antibiotics:

The analysis showed a positive perception and good attitude regarding obtaining antibiotics, as 78% of patients were against giving antibiotics that were not prescribed by a doctor to any family member. However, 79% of patients preferring to keep left-over antibiotics at home for future use.

(2) Effects of antibiotics

The findings in this section showed that 52% of patients believed that antibiotics were generally effective against bacteria, however there were a lot of misconceptions related to antibiotic use including 48% of patients reporting that they believed that antibiotics could help them get better quickly when they get a cold (48%) and 55.3% of patients believed that antibiotics were intended to relieve pain and inflammation.

(3) Antibiotic resistance

The study results revealed that 40.7% of patients showed awareness about the reason for the occurrence of antibiotic resistance. However, 84% of patients did not link that antibiotic resistance could be due to not completing the full course of antibiotic and about 62% of patients did not realise that the risk and spread of antibiotic resistance was at a global level.

(4) Doctors' habits and the relationship between doctors and patients

The findings in this section showed that 78.7–80% of patients reported trusting their doctors' prescribing decisions, however only 45.3% of patients believed that their doctors often took time to consider carefully whether antibiotics were needed or not.

(5) Patients' use of antibiotics during hospital stay

In response to this section, the majority of patients were disappointed because they were not informed that they were being treated with antibiotics and were not provided with relevant information regarding their antibiotic use.

(B) Difference of patients' perceptions regarding antimicrobial use and resistance in a hospital with ASP and a hospital without ASP

The findings revealed significant differences between patients' perceptions regarding antibiotic use and resistance in the hospital with ASP (M: 54.30, SD: 4.30, N = 74) and in the hospital without ASP (M: 50.67, SD: 6.43, N = 76) in relation to the total of questionnaire scores (t = (4.05), p = 0.000). Patients registered in the hospital where ASP took place showed more positive perceptions and knowledge towards antibiotic use and resistance than patients who were registered in hospital where ASP was not implemented.

Table 2 shows that only two sub-scales had significant differences in the perceptions of patients registered in a hospital with ASP and patients registered in a hospital without ASP. The findings revealed significant differences between patients' perceptions in the sub-scale 'Access to antibiotics' in the hospital with ASP (M: 6.89, SD: 1.32, N = 74) and those who registered in the hospital without ASP (M: 6.17, SD: 1.84, N = 76) in relation to the total of sub-scale scores (t = (2.74), p > 0.01). Furthermore, the findings showed significant differences between patients' perceptions in the sub-scale 'Patients' use of antibiotics during hospital stay' in the hospital with ASP (M: 9.77, SD: 2.48, N = 74) and in the hospital without ASP (M: 8.38, SD: 2.40, N = 76) in relation to the total of sub-scale scores (t = (3.485), p > 0.01) indicating that patients in the hospital with ASP were told about the issue of antibiotic resistance and were also informed about how to use the antibiotics by their doctor and pharmacist; by contrast, patients in the hospital without ASP were much less informed.

(1) Gender influence:

The findings indicate that female patients showed more significant awareness and positive perceptions towards antibiotic use and resistance than male patients (t = 11.14p = 0.000).

Table 1
Participants' responses for the survey.

Statement	Relative Frequency Distribution			Mean	Standard Deviation
	Agree %	Do not Know %	Disagree %		
Access of patients to antibiotics (N = 150)					
B1- Left-over antibiotics are good to keep at home in case they might be needed later.	**79.3**	8	12.7	1.33	0.69
B2- If a family member is sick, I will give him/her my antibiotic.	20.7	1.3	**78**	2.57	0.814
B3- It is good to be able to get antibiotics from relatives, friends or pharmacy without having to see a doctor.	17.3	3.3	**79.3**	2.62	0.766
Effects of antibiotics (N = 150)					
C1- When I get a cold, I will take antibiotics to help me get better quickly.	**48**	6	46	1.98	0.973
C2- If I feel better after a few days, I will stop taking my antibiotics before completing the course of treatment.	**63.3**	2.7	34	1.71	0.945
C3- Antibiotics are indicated to relieve pain/inflammation.	**55.3**	20	24.7	1.69	0.843
C4- Antibiotics are used to stop fever.	**47.3**	19.3	33.3	1.86	0.890
C5- Antibiotics are effective against bacteria.	**52**	41.3	6.7	2.45	0.619
C6- Antibiotics are effective against viruses.	**51.3**	40.0	8.7	1.57	0.649
Antibiotic resistance (N = 150)					
D1- Antibiotic resistance can be due to using antibiotics when they are not necessary.	**40.7**	32.7	26.7	2.14	0.811
D2- Antibiotic resistance can be due to not completing the full course of antibiotic.	5.3	10.7	**84**	1.21	0.53
D3- Antibiotic resistance can be due to using antibiotics without physician prescription (self-medication).	**48.7**	20.7	30.7	2.18	0.875
D4- Antibiotic resistance can be due to using the same antibiotic with a different brand.	24	**44.7**	**31.3**	1.93	0.743
D5- Antibiotic resistance is a problem in Saudi today.	9.3	18	**72.7**	1.37	0.65
D6- Antibiotic resistance is a problem in the rest of the world today.	**38**	**52**	10	2.28	0.636
Doctors' habits and the relationship between doctors and patients (N = 150)					
E1- I trust the doctor's decision if she or he decides not to prescribe antibiotics.	**78.7**	7.3	14	2.65	0.715
E2- I trust the doctor's decision if she or he decides to prescribe antibiotics.	**80**	6.7	13.3	2.67	0.702
E3- Doctors often take time to consider carefully whether antibiotics are needed or not.	**45.3**	17.3	37.3	2.08	0.909
E4- Doctors often prescribe antibiotics because the patients expect it.	**38**	25.3	36.7	1.99	0.867
E5- A doctor who does not prescribe antibiotics when the patient thinks s/he should is a bad doctor.	14	4.7	**81.3**	2.67	0.709
E6- I consult another physician to prescribe antibiotics if my physician refuses to do so.	26	4	**70**	2.44	0.878
Patients' use of antibiotics during hospital stay (N = 150)					
F1- My doctor/pharmacist told me that I am being treated with antibiotics.	12.7	4	**83.3**	1.29	0.68
F2- I was told about how to take the antibiotic.	**65.3**	8	26.7	2.39	0.881
F3- This hospital is strict when it comes to prescribing antibiotics.	**34.7**	34	31.3	2.03	0.814
F4- This hospital provides information on antibiotic resistance.	22.7	14.7	**62.7**	1.60	0.835
F5- My hospital stay improved my awareness of antibiotic resistance.	32	11.3	**56.7**	1.75	0.912

Table 2
T-test on the difference between the patients' perceptions in hospital with ASP and hospital without ASP (N = 150).

Patients' perceptions	Hospital Type	Mean*	SD	T	P
Access to antibiotics	With ASP	6.89	1.32	2.74	**0.007**
	Without ASP	6.17	1.84		
Effects of antibiotics	With ASP	11.55	2.31	1.560	0.121
	Without ASP	10.99	2.14		
Antibiotics resistance	With ASP	11.24	1.72	0.866	0.388
	Without ASP	10.97	2.07		
Doctors' habits	With ASP	14.84	2.08	1.795	0.075
	Without ASP	14.16	2.53		
Patients' use of antibiotics during hospital stay	With ASP	9.77	2.48	3.485	**0.001**
	Without ASP	8.38	2.40		
Total	With ASP	54.30	4.30	4.049	**0.000**
	Without ASP	50.67	6.43		

* The mean indicates the mean of the cumulative scores for each domain. The overall score for each domains was calculated by adding-up scores gained from answering each statement in the domain; hence, a score of one was given to a negative response of a statement, a score of two was given to a neutral answer, and a score of three were given for a positive response depending on the statement.

(2) **Age influence:**

In addition, One-Way ANOVA analysis was used to explore the impact of age group on patients' perceptions regarding antibiotic use and resistance in Saudi MOH hospitals. The findings did not show any significant differences between different age groups.

(3) **Educational influence:**

Patients with a higher level of education, such master's degree or a Bachelor's Degree showed higher positive awareness and perceptions towards using the antibiotics than the patients with a lower educational level, such as secondary School ($F = (4,145) = 3.33$, $p < 0.05$, $n = 150$).

4. Discussion

In this study we aimed to explore inpatients' knowledge and perceptions of antibiotic use and resistance, while evaluating the institutional role of patient education on antibiotic use in two Saudi Arabian hospitals, one with an implemented ASP and one without an ASP. Overall findings of this study showed very poor knowledge and unhealthy perceptions about antibiotic use and resistance among study participants. Almost 50% of the patients perceived antibiotics could help to get rid of common cold quickly and about 80% believed it was adequate to keep left-over antibiotics at home for future use. There were also misconceptions that antibiotics were effective in treating fever, viral infections and relieve of inflammation. Previous studies have reported similar findings such as, using antibiotics as analgesics, keeping antibiotics at home for emergency use and use of left-over antibiotics without physicians' consultation (Aljayyousi et al., 2019; Awad and Aboud, 2015; Oh et al., 2011; Shehadeh et al., 2012). A recent systematic review (Almohammed and Bird, 2019) has further confirmed the same findings within the Gulf Cooperation Council (GCC) countries.

Level of education and sex showed a significant influence regarding the perceptions and knowledge of antibiotic use and AMR. Our analysis showed that female patients were more aware and had more positive perceptions about antibiotic use and resistance by comparison to male patients which was also reported by Zanichelli et al. (2019). Patients with higher education were more knowledgeable about antibiotic use and were more aware of the problem of antibiotic resistance than patients with lower educational levels as reported in several previous studies (Anderson, 2018; Oh et al., 2011; Zanichelli et al., 2019). Aljayyousi et al. (2019) have also demonstrated that older, married and university-graduated participants were more likely to have a positive attitude towards antibiotic use than others.

Our results showed that patients in the hospital with ASP were overall more knowledgeable about antibiotic use than those in the hospital without ASP with a significant differences between patients' perceptions in the sub-scale 'Patients' use of antibiotics during hospital stay' in the hospital with ASP; indicating that information was provided to patients in the hospital with ASP in contrast to the hospital without ASP. However, the results also indicate that although patients, in the hospital with an ASP, were more likely to be informed of the specific antibiotics they are given while hospitalised, there still was a gap in knowledge regarding the effects of antibiotics and their use in general. This is shown where most respondents, from both hospitals, showed some level of misinformation regarding antibiotics' effect and use (sub-scale 'Effects of antibiotics'). It is important to acknowledge that the opportunity for education shouldn't only be specific to the patient's current condition and specific antibiotic used while hospitalised but instead an opportunity to address patients' general knowledge and misinformation about antibiotics and their resistance.

Most of campaigns and awareness campaigns have usually targeted the public and patients within the community settings with very few evidence of educating hospitalised patients (Burstein et al., 2019; Huttner et al., 2010). Gudnadottir et al. (2013) interviewed 100 inpatients and reported that 98% of patients thought that their involvement in learning about multi drug resistant organisms was very important whether through written or verbal education. While Rawson et al. (2016) had identified that patients felt disempowerment during episodes of infection in secondary care as the information is communicated in a unilateral manner with individuals 'told' that they have an infection and will receive an antibiotic (often unnamed), leading to loss of ownership, frustration, anxiety and ultimately distancing them from engaging with decision-making. This may explain why 83.3% of our patients were strongly upset with their healthcare professionals because they did not inform them that they were being treated with antibiotics, and 56.7% of patients reported that their hospital stay did not improve their awareness of antibiotic resistance. This may be considered by developing a patient-centred intervention to improve knowledge and understanding of antibiotic therapy in secondary care as described by Rawson et al. (2016).

Hospitals need to have educational programmes for inpatients as they do for its healthcare professionals. However, the idea is not just to educate patients in a single setting but instead a public health strategy should be implemented to continue this educational awareness within the community, and thus allowing the primary and secondary care sectors to complement each other with a united educational campaign. McNulty et al. (2016) conducted a study to report how much information about antibiotics do people recall after consulting in primary care and found that although 67% who had been prescribed an antibiotic recalled being given advice about their infection or antibiotics, only 8% recalled information about antibiotic resistance and those in lower social grades were less likely to recall advice. This further warrants the need for periodic education starting with patients and their families or carers in the hospital and continuing to emphasise the message within the community. One such initiative successfully launched by the Saudi MOH was the antimicrobials awareness campaigns in its hospitals and shopping malls in accordance with the World Antibiotic Awareness Week that was launched in 2016 and has continued to run annually (Saudi Ministry of Health, 2018, 2016).

In response to the concerning levels of AMR in the country and in the region, the GCC countries introduced the strategic plan for combating AMR in 2014 (Balkhy et al., 2016), stemming from the WHO mandate to combat AMR at all levels (World Health Organisation, 2015b). Following that, Saudi Arabia has so far been the only country within the GCC region to introduce a national ASP guideline in 2014 (Alomi, 2017; Saudi Ministry of Health, 2014). The progress of the implementation of this national ASP guideline is detailed in the recent review by (Alomi, 2017). Another recent review within the GCC by (Alghamdi et al., 2018) highlighted that ASPs do exist in some hospitals in the region, and that Saudi tertiary hospitals and the large medical cities tend to be the main adopters of ASPs. This is not surprising given that when the national strategy was first introduced in 2014, it aimed to establish ASPs in tertiary MOH hospitals within the capital Riyadh first, then expanding further to other larger MOH hospitals (medical cities) within other localities (Alomi, 2017).

Although, patients were encouraged to participate in the study and informed that the findings of this study will help to improve the antibiotic practice and patient care and safety, the response rate was only 44%. In order to reduce response bias, we aimed to obtain a similar response from the two hospitals and chose a general central hospital (without the ASP) that had inpatients requiring the use of antibiotics for different conditions. However, because the study was conducted in only two hospitals, the results may not be generalisable but they do highlight the opportunity for inpatient education about appropriate antibiotic use. The study's aim was to explore inpatients' perceptions regarding their knowledge of antibiotics and so no data was collected regarding the indication for the antibiotic used or the specific type of antibiotic prescribed. This specific data may be useful in future similar studies to help antimicrobial stewardship programmes and antibiotic pharmacists address specific knowledge gaps and tailor their education material for hospitalised patients.

In view of the threat AMR poses in Saudi Arabia, the Saudi Ministry of Education should work towards embedding antibiotic prescribing and stewardship competences into undergraduate Medical, Pharmacy, Dental, Nursing and Veterinary curriculum, as well as introduction of antibiotic resistance topics. Furthermore, in order to improve patients' perceptions and knowledge regarding

appropriate antibiotic use and risks of resistance, high authorities should address this issue and encourage hospitals to adopt ASPs and conduct public campaigns in order to increase awareness about antibiotics use and resistance, change patients' perceptions and culture regarding inappropriate antibiotic use, and control and monitor access to antibiotics in primary and secondary care, to improve antibiotic practice, reduce antibiotic resistance and improve patient care.

5. Conclusion

It is clear from the findings of this study that there are poor perceptions regarding antibiotic use and resistance among hospital patients in Saudi Arabia. Patients in the hospital with ASP showed a better understanding and knowledge towards antibiotic use and resistance than patients in the hospital without ASP. There is a need to improve inpatients' educational programmes and campaigns on appropriate antibiotic use and risks of antibiotic resistance and spread ASPs among Saudi hospitals to improve antibiotic therapy and combat resistance.

6. Authorship

SA, IB, NA and ZA were all involved in the conception and design of the study. EB and AA collected the data. Analysis and interpretation of data was conducted by SA and reviewed by IB, NS and ZA. NA drafted the article and all authors revised it critically for important intellectual content. All authors have approved the final article.

This work is included as part of the academic PhD thesis for Saleh Alghamdi. This work was only presented as a poster presentation in the 36th Annual Meeting of the European Society for Paediatric Infectious Diseases, Malmo, Sweden: 28th May— 2nd June 2018 and it is not under consideration for publication elsewhere.

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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.2020.10.011.

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