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Addressing antimicrobial resistance in Nigerian hospitals: Exploring physicians prescribing behaviour, knowledge and perception of antimicrobial resistance and stewardship programs

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ABSTRACT

Introduction: We assessed the knowledge of, attitude towards antimicrobial resistance (AMR) and practice of antimicrobial stewardship (AMS) among physicians in Nigeria to provide future guidance to the Nigerian National Action Plan for AMR. Methods: A descriptive cross-sectional questionnaire-based study explored the physicians' self-reported practice of antibiotic prescribing, knowledge, attitude and practice of AMR and components of ASPs. Results: The majority (217; 67.2%) of respondents prescribed antibiotics daily in their clinical practice AMR was recognized as a global and local problem by 308 (95.4%) and 262 (81.1%) respondents respectively. Only 91 (28.2%) of respondents have ever heard of antibiotic stewardship. The median AMR knowledge score was 40 (19-45)out of 45while that for ASP was 46.0(32-57) out of 60. There was significant statistical difference between the ASP median scores among the medical specialties category (P value <0.0001) More respondents had good knowledge of AMR than ASPs (82.7% versus 36.5%; p <0.0001). Conclusion: Respondents in this study were more knowledgeable about AMR than AMS and its core components.

Keywords: Antibiotic stewardship, rational use of antimicrobials, inappropriate use of antimicrobials, antibiotic prescription, tertiary healthcare facilities, Nigeria

1. Introduction

The inappropriate use of antibiotics is a major driver of antimicrobial resistance (AMR) and is a considerable public health concern across many continents and countries including sub-Saharan Africa [1-5]. As a result, the Global Action Plan on Antimicrobial Resistance was adopted in May 2015 by the World Health Assembly and endorsed by Heads of States of many countries, including Nigeria, at the United Nations General Assembly in New York in September 2016[6] to try and reduce AMR rates. This is because AMR increases health care costs and the economic burden on individuals, families, healthcare systems and society since antimicrobial resistant infections are more difficult to treat with a tendency for longer hospital stays and increased mortality[7-9]. In recent years, the role of AMR caused by methicillin-resistant Staphylococcus aureus (MRSA), Vancomycin-Resistance Enterococci (VRE) and extended-spectrum beta-lactamases (ESBL) in

increasing patients' morbidity and mortality is a matter of public health concern [10-13] . Across countries, inappropriate prescribing and dispensing of antibiotics across all healthcare sectors continues to be reported, particularly in low-middle income countries (LMICs) [14-20] , which alongside the widespread use of antibiotics in animal farming and poor disposal techniques, have further contributed to the development of AMR[21]. The link between quantity of antibiotics consumed and AMR has been reported in studies conducted in several countries[22,23].

Antimicrobial stewardship programmes (ASPs) are part of successful interventions used in combating AMR across sectors and countries [24-27]. The implementation of ASPs involves actions that promote the responsible use of antibiotics within and outside healthcare facilities [28,29]. The core elements of hospital ASPs include having committed leadership that will be responsible for program outcomes and working to improve antibiotic use [30]. Other critical elements of ASPs in hospitals include implementation of recommended actions, monitoring of antibiotic prescribing against agreed guidance and against current resistance patterns, regular reporting of information to all key stakeholders as well as educating prescribers about resistance and optimal prescribing [28]. Some of the well reported benefits of ASPs include improved quality of patient care, improved patient safety, optimized treatment of infections, reduced spread of AMR, reduced utilization of antibiotics, reduced adverse events from antibiotics and reduced healthcare costs [25,26,29,31].

The United States Center for Disease Control and Prevention (CDC) has recommended that all acute care hospitals should implement ASPs in recognition of their considerable benefits [32] . However, it is recognized that ASPs are more challenging to introduce in low- and middle-income countries due to issues of available resources and manpower [33]. Core healthcare professionals, particularly physicians, are central to the successful implementation of ASPs because of their front

role in the medicine use process as prescribers of antimicrobials and decision-making in the management of patients.

A number of studies have reported the inappropriate use of antibiotics among hospitals and other sectors in Nigeria [34-36]. This is not surprising within hospitals in Nigeria as currently there are relatively few healthcare facilities in Nigeria with established ASPs because of poor implementation of national policies regarding their establishment and functioning as well as concerns with available resources[37]. We also see concerns with ASPs in hospitals in other sub-Saharan African countries including their knowledge regarding ASPs although there are ongoing programmes to address this [38,39]. There are also concerns in Nigeria that pharmaceutical companies are a considerable source of information regarding medicines in hospitals with concerns compounded by the limited extent and activities of Drug and Therapeutic Committees even among tertiary hospitals in Nigeria [40,41]. This situation will also exacerbate inappropriate prescribing of antibiotics in hospitals in Nigeria unless addressed. Clearly, to address potential bottlenecks with implementing ASPs in Nigeria, there is an urgent need to assess baseline knowledge regarding AMR and antimicrobial stewardship (AMS) among physicians starting in leading hospitals in Nigeria. This information will assist policy makers and other public heath stakeholders, especially in hospitals, with designing interventions to successful implement ASPs and reduce AMR.

Consequently, the objective of this study is to assess knowledge of AMR, attitude and practice of AMS among physicians practicing at tertiary health institutions in Nigeria as the first step to addressing practice gaps. Whether the physician's knowledge, attitudes, and practice were influenced by contextual factors or perhaps a pre-existing behavioral tendency also warrants investigation to plan future interventions to improve prescribing practice.

2. Methods

2.1 Study design and setting

This was a descriptive cross-sectional survey using a self-administered questionnaire. The study was conducted in six tertiary healthcare facilities located in four out of the six geopolitical regions of Nigeria between April 1 and June 30, 2019. These facilities are: Ekiti State University Teaching Hospital, Ado-Ekiti, Federal Teaching Hospital, Ido-Ekiti and Federal Medical Centre, Owo, all located in the South-Western geo-political zone; the University of Ilorin Teaching Hospital, Ilorin (which is in the North-Central zone), Ahmadu Bello University Teaching Hospital, Zaria, (in the North-Western zone) and Imo State University Teaching Hospital, Orlu, located in the South-Eastern zone of the country. These hospitals are also involved in training of undergraduate students of medicine and allied health sciences, as well as postgraduate medical training and research. These hospitals offer in- patient and out-patient services in emergency and general medicine, family medicine, intensive care medicine, internal medicine, paediatrics, obstetrics and gynaecology, general and specialist surgery, as well as laboratory services. Consequently, if there are concerns with knowledge and attitudes towards ASPs and subsequent monitoring of drug utilization patterns in these hospitals, these concerns are likely to be magnified in primary and secondary care facilities [37,40].

2.2 Study population and sampling

All consenting physicians at the selected health care facilities were possible candidates for inclusion in the study. The study population included medical and surgical interns, medical officers at the general and emergency clinics, as well as resident doctors (postgraduate students) in the various sub-specialties of medicine and surgery, as well as specialist doctors or consultants.

The sample size was calculated using the online statistical software Raosoft® (http://www.raosoft.com/samplesize.html) using the following assumptions: 5% margin of error, confidence level of 95% and response rate of 50%. The sample size of three hundred and six (306) was computed from a population of 1500 physicians in the selected hospitals. A total of 400 questionnaires were produced and sent to the participating healthcare facilities.

2.3 Study instrument

The questionnaire, which was in English, was adapted from similar studies with context-specific contents added [42-44] . The questionnaire included sections on the general characteristics of the respondents (age, sex, and duration of practice) as well as practice of antibiotic prescribing. The questionnaire had 9 and 12 statements about respondents' knowledge of AMR and ASP respectively using a 5-point Likert scale responses including "strongly agree", "agree", "neutral", "disagree" and "strongly disagree" [45-47]. To objectively assess the knowledge about AMR and ASPs, a composite score was calculated for each response as follows: strongly agree (5 points), agree (4 points), neutral (3 points), disagree (2 points)" and strongly disagree (1 point). Knowledge scores was subsequently classified as good (36-45 points), average (27-35 points) and poor (<27 points). For the assessment of ASPs, we classified the combined scores as follows: good (48-60 points), average (36-47 points) and poor (<36 points). The conversion of Likert-scale responses to composite scores for objectivity has been used previously in similar studies [48,49]. The questionnaire was reviewed for face and content validity by experts in the field of clinical pharmacology and therapeutics, paediatrics and infectious diseases. The questionnaire,was pre-tested among fifteen physicians working in another tertiary healthcare facility that was not part of the study and necessary adjustments made before being sent out to respondents Questions reflecting respondents' attitude and practice either had a straightforward Yes/No option or required

specific responses by participants. Cronbach's alpha coefficient (0.96) was used to measure the internal consistency of the questionnaire. The ATC classification was used when discussing potential classes of antibiotics prescribed [50].

2.4 Study procedure

Questionnaires were sent to the focal persons (investigators) in the selected institutions who subsequently administered these to consenting participants during departmental academic programmes through the chief residents to ensure maximum participation.

2.5 Data analysis

Data analysis was performed with IBM SPSS version 25 (Armonk, NY: IBM Corp). Categorical variables (sex, cadre of physicians, and knowledge class) were summarized using frequencies and percentages. Normality of data was determined using Kolmogorov-Smirnov test with the continuous variables variables (age, duration of practice, knowledge score for AMR and ASP) having non-normal distribution. Hence these variables were summarized using the median (range) and appropriate non-parametric statistical test (Kruskal-Wallis test) was applied in comparing the median AMR and ASP scores for different categories (cadre of physicians, duration of practice, medical specialty) of respondents.,. The association between categorical variables (duration of practice, cadre of physicians, knowledge of AMR and ASPs) was assessed using Mann Whitney U Test. A p-value less than 0.05 was accepted as statistically significant association.

2.6 Ethical consideration

Ethical approval (EKSUTH/A67/2018/06/003) was obtained from the Research Ethics Committee of Ekiti State University Teaching Hospital, Ado-Ekiti, Nigeria before commencement of the study.

3. Results

3.1 Socio-demographics details

A total of 326 were returned out of 400 questionnaires indicating a response rate of 81.5%. Three questionnaires were incomplete; consequently only 323 were analyzed and had their findings reported. The mean age and duration of practice of respondents was 33.0 (range: 20-55) years and 6.0 (range: 1-29) years respectively. The socio-demographic details including sex, duration of practice, cadre of physicians and specialty, commonly self-prescribed antibiotics and periodicity of review of prescribed antibiotics are shown in Table 1.

3.2 Knowledge of AMR

Antimicrobial resistance (AMR) was recognized as a global and local problem by 311 (96.6%) and 264 (83.0%) of the respondents respectively. The median AMR knowledge score was 40.0 (range: 19-45) with 267 (82.7%), 47 (14.6%) and 9 (2.7%) respondents having good, average and poor knowledge respectively. Details of AMR knowledge score are shown in Table 2. The difference between the median score for the various categories under physician cadre, medical specialty and duration of practice was not statistically significant.

3.3 Self-reported prescribing of antibiotics and related practices

Table 3 reports on the availability of antibiotic policy, treatment guidelines, infection control committees and the sending of samples to the laboratory before commencing treatment with antibiotics within the hospitals. Two hundred and fifty-one (77%) respondents had clinical microbiologists in their facilities. Despite this, only 181 (55.5%) of respondents routinely sent samples to the laboratory before commencing antibiotic treatment. Very few respondents interacted frequently with pharmacists (66, 20.2%) and clinical microbiologists (33; 10.1%) when prescribing antibiotics. Fluoroquinolones (J01MA) were the most frequently prescribed antimicrobials by respondents followed by third generation cephalosporins (J01DD); (239; 74%) and (233; 72.1%) respectively. Figure 1 shows the frequency distribution of the classes of frequently prescribed antibiotics by respondents. Factors influencing the choice of prescribed antibiotics are shown in Figure 2.

The potential causes or drivers of AMR identified by respondents are shown in Figure 3. The association between physician cadre, sex, practice duration, and AMR knowledge groups was not statistically significant (p values of .840, .122 and .251 respectively). Using the appropriate analysis, we did not find any significant statistical difference between the mean AMR knowledge score, sex, cadre and duration of practice of respondents (p values of .639, .243 and .847 respectively).

3.4 Knowledge and attitude towards ASP

Only 92 (28.2) % of respondents have ever heard of ASPs while 54 (16.6%) had attended educational programmes on AMS. Table 4 shows the attitude and perception of respondents to components of ASPs. The median ASP knowledge score was 46.0 (range: 32-57)with 118 (36.5%),

186 (57.6%) and 19 (5.9%) having good, average and poor knowledge respectively. A comparison with the proportion of respondents with good AMR knowledge clearly showed that more respondents had good knowledge of AMR than ASPs (82.7% versus 36.5%; p <.0001). However, there was no statistically significant association between physician cadre, practice duration, and ASP knowledge (p value of .360, and .365 respectively). Comparison of median ASP knowledge scores among different categories (sex, physician cadre and practice duration) did not yield any statistically significance (P values of .173, .488 and 0.346 respectively). There was significant statistical difference between the ASP median scores among the medical specialties category (P value <0.0001). Further post hoc analysis showed significant differences between the median ASP score for physicians working in Internal Medicine and those in Surgery and Obstetrics and Gynaecology. Table 2 shows the details of comparison of the mean AMR and ASP scores.

4. Discussion

This study assessed the prescribing practices, knowledge and attitude of Nigerian physicians in leading tertiary hospitals in Nigeria concerning AMR and ASPs. Overall, their knowledge regarding AMR was good with 82.7% of respondents being categorized as having good knowledge. However, their knowledge about ASPs and their core components was less impressive with only 36.5% having good knowledge. This is similar to the findings in a recent study in Zambia where there were concerns with knowledge of AMS among physicians and pharmacists in leading teaching hospitals [38]. There have also been concerns with the implementation of ASPs across LMICs [33,51].

The frequency of self-reported prescribing of antibiotics among physicians was high in our study with 67.2% and 26.3% of respondents doing this on a daily and weekly basis, respectively. A

recent study on the determinants of antibiotic prescribing among physicians in a Nigerian tertiary hospital also reported that 97% of them prescribing antibiotics frequently [41]This is similar to the findings from two recent point prevalence studies in Nigeria[52,53] with reported rates of 69.7% and 78.2% respectively. Reports from other studies showed high rates of antimicrobial prescribing among hospitals across sub-Saharan Africa, which ranged from 50% of inpatients among the African countries taking part in the Global Point Prevalence Study (PPS) up to 80% among hospitals in Botswana, Ghana and Kenya [54-59]. Similarly, 66% of respondents in a study conducted in Pakistan prescribed one or more antibiotics daily [44]. Some of the reasons for frequent and sometimes unnecessary prescribing of antibiotics include the severity of disease condition, the fear of losing patients to competing hospitals, concerns with the cleanliness of operating theatres and wards, lack of facility guidelines and pressure from pharmaceutical sales representatives [41,60-62]. Since most patients with infections are treated empirically, there is a need to review the prescribed antibiotics using clinical or microbiology indicators. Encouragingly, respondents in this study reported a review of prescribed antibiotics was undertaken at 48 hours (124; 41.2%) and 72 hours (117; 38.9%). In another Nigerian study, a stop/review documentation was found in only 21.3% of cases indicating that majority of patients were treated empirically throughout the course of therapy [63]. These results are similar to those from a study conducted among acute care physicians in the USA where 99% reviewed prescribed antibiotics within 48-72 hours [64] and higher than a recent study in Ghana where stop/ review dates recorded in patients' notes varied between 13% to 74% of patients depending on the wards and hospital [58]. The introduction of treatment guidelines and antibiotic use policies are some of the interventions employed to promote rational antibiotic prescribing in hospitals worldwide [57,65,66]. However, these measures were not in place in our study with only 102 (31.6%) and 121 (37.5%) respondents

aware of existing antibiotic policies and treatment guidelines for infectious diseases in their hospital facilities, respectively. This lack of institutional policies has also been reported in another study conducted in Lagos, Nigeria [41]. In contrast, 107 and 216 out of 253 hospitals sampled in a UK study had a policy for antibiotic prescribing and guidelines on antibiotic use respectively [67].

Just over half of respondents in our study routinely sent samples to the laboratory before commencing treatment with antibiotics. This is not surprising as earlier hospital-based studies from Ghana, Ethiopia, and South Africa, showed low number of samples being sent to the microbiology laboratory before commencement of treatment [68-70]. This is not helped in Ghana by issues of out-of-pocket co-payments [58].

The lack of institutional polices, lack of sensitivity testing and influence from pharmaceutical companies may help explain the high use of fluoroquinolones and third -generation cephalosporins in our study, which is a concern although equally high rates are seen across countries [57]. Overall in the Global PPS among 53 hospitals across a number of continents, penicillins (J01C), third-generation cephalosporins (J01DD) and fluoroquinolones (J01MA) were the most frequently prescribed antibiotics [71]. Our findings are similar to reports from PPS conducted in Nigeria [53] [63]. Third-generation cephalosporins, ceftriaxone and amoxicillin-clavulanic acid (a penicillin) were among the three most prescribed antibiotics in drug utilization studies conducted in tertiary healthcare facilities in India and Ghana [72], whilst there was limited prescribing of fluoroquinolones in another study conducted in Ghana as well as across Botswana [54,58]. The choice of antibiotics among respondents in our study was influenced by the likely causative organisms, results of culture/sensitivity and cost. The socio-economic status of patients and patients' demands were factors influencing the choice of antibiotics among physicians in Lahore,

Pakistan, exacerbated by concerns regarding knowledge and introduction of ASPs in Pakistan [51]. There is a need to conserve a number of these antibiotics under the WHO AWaRe list of antimicrobials [73,74], and we will be looking at this more closely in the future in Nigeria.

Of concern, given limited knowledge regarding ASPs and high empiric prescribing, was that the respondents in this study were of the opinion that AMR was less of a problem locally (in respondents' healthcare institutions) than globally (81.2%) vs. 95.4%). A study conducted among physicians in the Caribbean reported similar findings with 82% and 53% of respondents agreeing that AMR was a problem globally and locally respectively [48]. This contrasts with only 8.9% of respondents feeling that AMR was a local problem in a study conducted among physicians working in a tertiary healthcare facility in Ghana [42]. Contributory factors towards the development of AMR identified in our study are in keeping with those reported by others and included inappropriate prescribing and use of antibiotics, poor infection control measures, poor knowledge of local antimicrobial resistance patterns, severity of illness, patient pressure and influence of pharmaceutical sales representatives [43,75,76].

Of additional concern is that less than a quarter of study respondents in our study had prior knowledge of the term "antimicrobial stewardship" though a larger proportion were able to answer questions associated with AMS. Significant deficits were also seen in their knowledge of ASP components including the prompt change of intravenous to oral antibiotics and the role of ASPs in reducing *Clostridium difficile* infections. Arguably, the ability of respondents to answer some of the stewardship-related questions may be due to residual knowledge from their medical training or acquired experience. The relatively poor knowledge of physicians regarding AMS and ASPs have also been reported in studies conducted among physicians in Saudi Arabia, India and Pakistan [51,77]. It was interesting to note that physicians working in Internal medicine had significantly

higher scores about ASP than colleagues in surgical disciplines (Obstetrics and Gynaecology and Surgery). We hope to explore potential causes of this difference in the near future. There were also concerns about delays in changing from intravenous to oral antibiotics in a study conducted in Jimma, Ethiopia, where only 20.9% of those qualified for the switch had this performed on time[78]. There were also concerns with the lack of intravenous to oral switching among hospitals in South Africa. This is a concern as lack of appropriate switching increases costs, but timely conversion from intravenous to oral routes reduces undue prolong utilization of scarce and limited healthcare resources [79-81].

The onset of *Clostridium difficile* infections during hospital inpatient admission remains one of the indicators for assessing the success of ASPs [82,83]. Whilst there is paucity of data regarding the prevalence of *Clostridium difficile* infections among hospitalized Nigerian patients, results of studies conducted in other LMICs including South Africa, Kenya, and Brazil shows that this is becoming a serious problem [83-85]. Consequently, there is a need for educational programmes to improve on the knowledge of healthcare workers in Nigeria regarding local and national microbial flora and AMR patterns. Provision of adequate diagnostic facilities in microbiology laboratories would also give much needed support. The Nigeria National Action Plan has rightly identified the lack of ASPs in both private and public health facilities across Nigeria and has prioritized establishment and monitoring of AMS [86]. Consequently, there is an appreciable educational need to improve on the knowledge and activities of physicians in Nigeria especially regarding ASPs. This is especially important as a recent study among Nigerian medical and pharmacy students reported poor knowledge of AMR and ASP [87]. This need for capacity building in the area of AMR and ASP is emphasized further in a study among community pharmacists in Nigeria [88]. Encouragingly, the importance of clinical microbiologists and pharmacists in the structure

of ASPs was recognized by respondents in this study, and we will be looking to build on this. Stakeholders in the healthcare sectors in Nigeria also need to improve on this inter-professional relationship in the future, building on initiatives in other countries [89,90], and we will be monitoring this in the future.

Study Limitations

We acknowledge the possibility of some selection bias and that associated with self-reporting studies among our respondents. Respondents in this study were physicians working in public - owned tertiary health care facilities located in three regions in Nigeria; because of this, our findings may well differ from potential findings in other care settings in Nigeria including primary and secondary level care facilities as well as private and faith-based health facilities. Though the questionnaire was developed using templates from similar studies, it has not been validated in the country. The relatively high measure of internal consistency (Cronbachs' alpha) gives the instrument some sort of validity. Also, , we believe the ecological validity of this study since attitudes and activities in tertiary facilities are very important for the future because this is where the physicians for tomorrow in Nigeria are trained. Consequently, it is imperative to address any concerns in these facilities first before wider programmes.

5. Conclusion

The knowledge of Nigerian physicians in this study regarding AMR was encouraging. However, the same cannot be said about their knowledge regarding AMS and ASPs especially their core components. There is an urgent need to address AMS and ASP knowledge gaps through continuing medical education programs for Nigerian physicians. The implementation of the ASP aspect of the

Nigerian National Action Plan for AMR if AMR rates are to reduce in Nigeria. These will be followed up in the future.

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Table 1: Socio-demographic and self-reported antibiotic prescribing details

Variable	**Frequency (%)**
Sex	
Male	242 (74.9)
Female	81 (25.1)
Cadre of Physician	
House Officer	84 (26.0)
Medical Officer	21 (6.5)
Junior Resident	140 (43.3)
Senior Resident	54 (16.7)
Consultant	24 (7.4)
Medical Specialty	
Internal Medicine	83 (25.9)
Surgery	78 (24.2)
Obstetrics and Gynaecology	64 (19.8)
Paediatrics	49 (15.2)
Family Medicine	15 (4.7)
Others	36 (11.2)
Duration of Practice (Post MBBS)	
1 – 5	142 (45.7)

6 – 10	112 (36.0)
> 10	57 (18.3)
Self-reported frequency of antibiotic prescription	
Daily	217 (67.2)
Weekly	85 (26.3)
Monthly	13 (4.0)
Other	8 (2.5)
Duration before review of prescribed antibiotic	
24 Hours	49 (16.2)
48 Hours	124 (41.2)
72 Hours	117 (38.9)
Other	4 (1.3)
Never	7 (2.3)

Table 2: Comparison of median AMR and ASP knowledge scores for different categories

Physician cadre	N	AMR Median Score	95% CI	P value	ASP Median Score	95% CI	P value
Medical Intern	76	39.5 (0-45)	36.7-39.7	0.066	45.0 (3-56)	42.8-46.2	0.488
Medical Officer	21	39.0 (29-44)	35.8-39.7		46.0 (33-57)	43.8-49.2	
Registrar	137	39.5 (0-45)	37.3-39.4		46.0 (34-57)	45.1-47.2	
Senior Registrar	53	41.0 (21-45)	39.2-41.4		46.0 (10-57)	44.0-48.8	
Consultant	24	39.5 (34-45)	38.5-40.9		46.0 (36-56)	43.9-49.1	
Specialization							
Internal Medicine	83	40.0 (0-45)	38.1-40.8	0.218	48.0 (0-57)	45.2-49.6	<0.0001*
Family Medicine	15	39.0 (29-44)	36.4-40.8		48.0 (36-56)	43.2-49.8	
Obstetrics and Gynaecology	64	39.0 (24-45)	37.7-39.8		45.0 (33-56)	42.9-46.0	
Surgery	78	40.0 (0-45)	36.2-39.7		43 (0-56)	41.9-45.6	
Paediatrics	49	40.0 (0-45)	37.1-40.9		46.0 (3-57)	42.9-48.5	
Others	28	39.0 (29-49)	36.2-39.6		44.0 (32-54)	41.9-46.6	
Duration of practice (years)							
1-5	142	40.0 (0-45)	37.6-40.0	0.636	45.5 (3-56)	44.1-46.9	0.346
6-10	112	39.5 (0-45)	37.4-39.6		46.0 (32-57)	45.5-47.9	
>10	57	40.0 (29-45)	38.0-40.0		45.0 (33-57)	44.1-47.3	

Table 3: Reported availability of some components of infection control

Statements	**YES (%)**
Do you have a written antibiotic policy in your department	102 (31.6%)
Do you refer to departmental antibiotic policy when prescribing antibiotics	56 (17.3%)
Do you have an infection control committee in your institution	157 (45.8)
Is there a treatment guideline for infectious diseases in your facility?	121 (37.5)
Is there a clinical microbiologist in your facility?	249 (77.1)
Do you usually send samples to the Microbiology laboratory before commencement of antibiotics	179 (55.4)

Table 4: The knowledge and attitude of respondents about core elements of antimicrobial stewardship program

Statements	**Strongly Agree N (%)**	**Agree N (%)**	**(Don't know) N (%)**	**Disagree N (%)**	**Strongly Disagree N (%)**
Antimicrobial stewardship program will help to reduce adverse events associated with antibiotic use	107(33.1)	133(41.2)	69(21.2)		1 (0.3)
Antimicrobial stewardship program will help improve the quality of patient care	113(35.0)	141(43.7)	55(17.0)	0	0
Antimicrobial stewardship will help improve patient safety through increased infection cure rates	106(32.8)	146(45.2)	53(16.4)	2(0.6)	0
Antimicrobial stewardship will help achieve increased frequency of correct prescribing for therapy and prophylaxis	109(33.7)	136(42.1)	62(19.2)	1(0.3)	0
Antimicrobial stewardship will help reduce antibiotic resistance	104(32.2)	151(46.7)	52(16.1)	1(0.3)	0
Antimicrobial stewardship will help reduce hospital rate of *Clostridium difficile* infection	77(23.8)	122(37.8)	100(31.0)	7(2.2)	0
Leadership commitment and accountability part of the core elements of hospital antimicrobial stewardship program	83(25.7)	137(42.4)	84(26.0)	0	0
Prompt change of intravenous antibiotics to oral is one of the precepts of antimicrobial stewardship	53(16.4)	109(33.7)	137(42.4)	9(2.8)	0
Detection and prevention of antibiotic related drug-drug interaction is an item in antimicrobial stewardship	72(22.3)	140(43.3)	89(27.6)	2(0.6)	0
Microbiologists are important in antimicrobial stewardship program	106(32.8)	148(45.8)	52(16.1)	0	0
Pharmacists can play a prominent role in antimicrobial stewardship program	103(31.9)	157(48.6)	47(14.6)	1(0.3)	0
Antimicrobial stewardship program should be practiced in all hospitals	124(38.4)	139(43.0)	45(13.9)	1(0.3)	0

Figure 1: Factors influencing antibiotic prescription

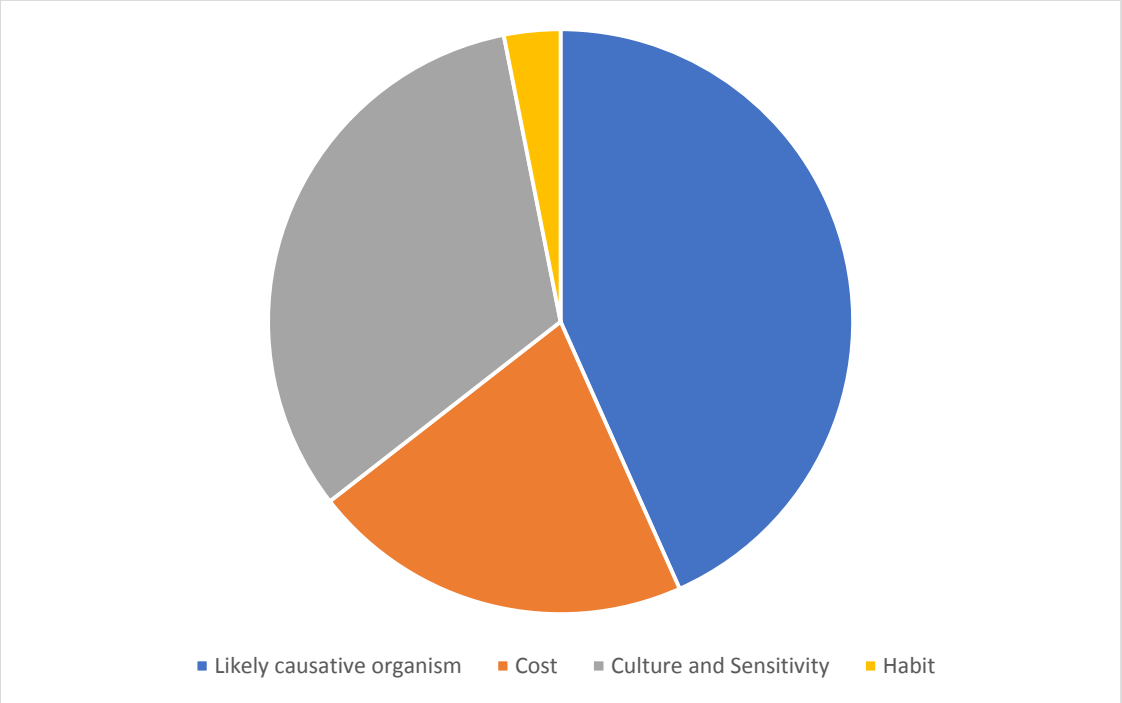
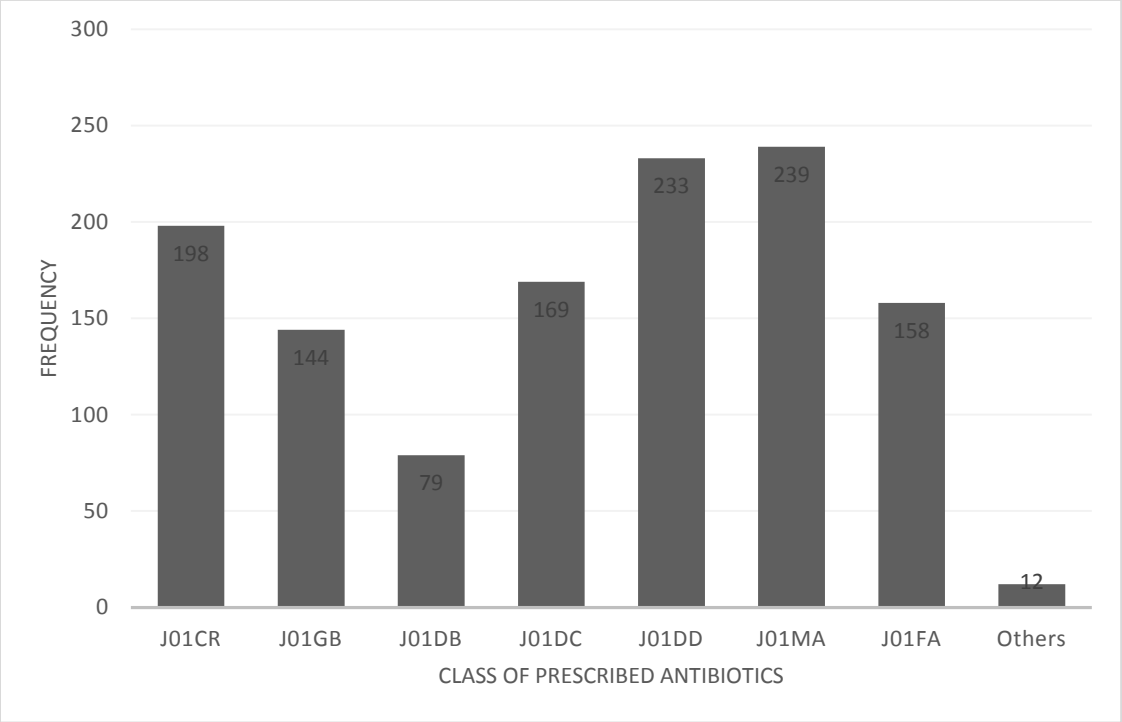


Figure 2: Prescribed antibiotics according to class (ATC)



NB: J01CR- penicillins: J01GB –aminoglycosides: J01DB - First generation cephalosporins : J01DC – 2nd generation cephalosporins ; J01DD – 3rg generation cephalosporins : J01MA – Fluoroquinolones : J01FA – Macrolides ; Others include J01DH – Carbipenems ; J01FF- Lincosamides

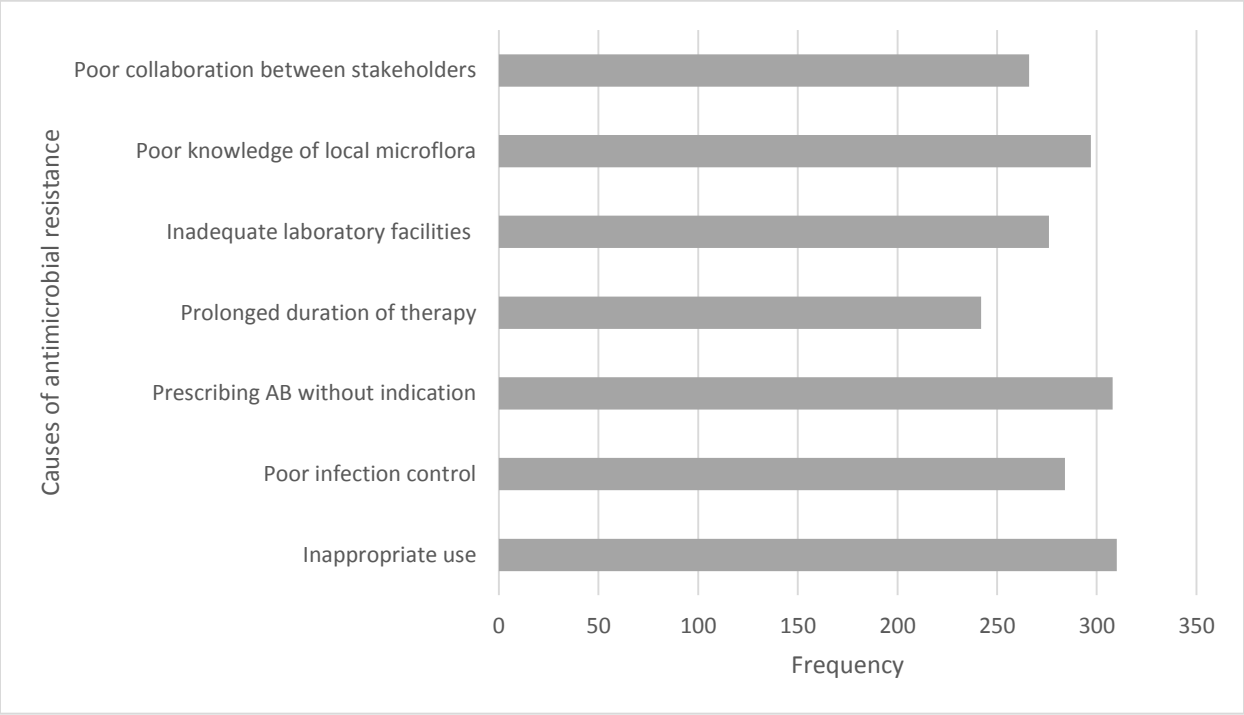


Figure 3: Causes and drivers of antimicrobial resistance identified by respondents

AN ASSESSMENT OF THE KNOWLEDGE AND PERCEPTION OF PHYSICIANS ON ANTIMICROBIAL RESISTANCE AND STEWARDSHIP

Dear respondent,

Thank you for participating in this survey. This survey is purely for academic purpose and your participation is voluntary. We would be grateful if you could respond to the questions to the best of your ability. You are free to respond to only questions you can answer. No personal details will appear in any reports generated from this study.

Thank you once again

SECTION A

AGE ----------

SEX----------

BASIC QUALIFICATION ----------

ADDITIONAL QUALIFICATION_____

DESIGNATION/POSITION----------

DURATION OF PRACTICE (post MBBS) ----------

DEPARTMENT ----------

SECTION B

1. How regularly do you prescribe antibiotics a) daily { }b) weekly { } c) Monthly { } d) yearly { }
2. What time do you review your antibiotics prescription after patients have commenced treatment? 24 hrs { } 48 hrs { } 72 hrs { } I don't review { } others specify ----------
3. Do you have an antibiotic policy in your hospital? Yes { } No { }
4. Do you have a written antibiotic policy in your department Yes { } No { }
   If Yes is it pasted anywhere ----------
5. Do you refer to hospital antibiotic policy when prescribing antibiotics? Yes { } No { }
6. Do you refer to departmental antibiotic policy when prescribing antibiotics? Yes { } No { }

7. Do you consult drug formulary when prescribing antibiotics? Yes { } No { }
8. Do you have treatment guidelines for infectious disease in your department? Yes{ } No { }
9. How frequently do you use treatment guidelines for infectious disease when managing your patient?
   All the time [ ] Most times [ ] Some-times [ ] Few times [ ] Never [ ]
10. How often do you send samples to the microbiology laboratory before commencement of the antibiotics?
    A) Occassionally { } B) frequently { } C) Never { }
11. How often do you interact with hospital pharmacists when prescribing antibiotics?
    A) Occassionally { } B) frequently { } C) Never { }
12. Do you have a Microbiologist in your centre? Yes { } No { }
13. How often do you interact with a Microbiologist when prescribing antibiotics?
    A) Occassionally { } B) frequently { } C) Never { } Not applicable { }
14. What antibiotics do you prescribe regularly?
    Penicillins [ ] Aminoglycosides [ ] First generation cephalosporin [ ] Second generation cephalosporin [ ] Third generation cephalosporin [ ] Quinolones [ ] Macrolides [ ] Others please state ----------
15. What informs your choice of antibiotics? Cost { } Likely organisms { }
    Microscopy, culture and sensitivity result { } Habit { } others specify
    _____
16. Do you have an infection control committee in your institution?
    Yes { } No { } I don't know { }
17. Have ever heard about antibiotic stewardship/ program?
    Yes { } No { }If yes , how state source of information) ----------
18. Have you ever read a document on antibiotic stewardship? Yes { } No { }
19. Have you ever attended any antibiotic stewardship program? Yes { } No { }
20. If Yes, how often A} once { } b) 2-4 { } c) 5-10 { } d > 10 times { }
21. Would you be interested in attending if an antibiotic stewardship program is organized in your institution? Yes { } No { }
22. Do you think you will benefit from antibiotic stewardship program if organized in your institution? Yes { } No { }

KNOWLEDGE OF THE EXTENT OF AND CAUSES OF ANTIBIOTICS RESISTANCE

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Antibiotics resistance is a global problem					
Antibiotics resistance is a problem in our institution					
Prescribing antibiotics when they are not needed will contribute to antibiotic resistance					
In appropriate use of antibiotics is a cause of antibiotics resistance					
Non compliance with infection control precautions is a risk factor for antibiotics resistance					
Poor collaboration between clinicians, pharmacists and microbiologists will contribute to antibiotics resistance					
Giving antibiotics for longer than necessary will contribute to					

antibiotics resistance					
Poor use of microbiology laboratory facilities					
Not taking into consideration the micro-organisms likely to cause the infection					

KNOWLEDGE OF THE COMPONENTS AND BENEFITS OF ANTIOBIOTIC STEWARDSHIP

	Strongly Agree	Agree	Neutral (Don't know)	Disagree	Strongly Disagree
Antibiotic stewardship/program is the systematic effort to educate and persuade prescribers of antibiotics to follow evidence based prescribing in order to stem antibiotic resistance					
The antibiotic stewardship will help to reduce adverse events associated with antibiotic use					
The antibiotic stewardship will help improve the quality of patient care					
The antibiotic stewardship will help improve patient safety through					

increased infection cure rates					
The antibiotic stewardship will help achieve increased frequency of correct prescribing for therapy and prophylaxis					
The antibiotic stewardship will help reduce antibiotic resistance					
The antibiotic stewardship will help reduce hospital rate of Clostridium difficile infection					
Leadership commitment and accountability part of the core elements of hospital antibiotic stewardship program					
Prompt change of intravenous antibiotics to oral is one of the precept of antibiotic stewardship					
Detection and prevention of antibiotic related drug-drug interaction is an item in antibiotic stewardship					
Microbiologists are important in antibiotic stewardship program					
Pharmacists can play a prominent role in antibiotic stewardship program					

Antibiotic stewardship program should be practiced in all hospitals					
Prescribers must ensure that their patient adhere to their prescriptions					

Thank you