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An Analysis of Determinants in Antimicrobial Use by Physicians in Ogun State, South West Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Authors EOS and VUN designed the study, wrote the protocol and wrote the first draft of the manuscript. Authors CJE, AD and BA managed the literature searches, analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: The increasing rates of antimicrobial resistance on the part of pathogens are gradually becoming a pandemic, this has to be curbed to reduce mortality.
Background: The vast majority of antimicrobials currently in use are prescribed by Physicians. The Physicians act as a gateway in the control and use of life saving medications such as antimicrobials, attention must be paid towards antimicrobial stewardship and rational antimicrobial use.
Methods: This was a cross sectional survey of clinicians at 3 tertiary hospitals in Nigeria. A self-administered structured Questionnaire containing 25 questions was given to the respondents to complete to assess the level of knowledge of physicians in antimicrobial use.
Results: The following were found to be statistically significant – Physicians in the Public hospitals were more likely to collect specimens for microbiology analysis before commencing antibiotics

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– p = 0.02, Odds Ratio (O.R) = 2.61, Risk Ratio (R.R) = 1.47, 95% Confidence Interval (CI) = 1.16 – 5.80, Chi Square (χ^2) = 1.47, a slightly higher likelihood of Physicians in the Private Tertiary Hospital having a Clinical Microbiologist in their hospital – p = 0. 00, O.R = 0.08, R.R = 0.25, CI = 0.05 – 0.99, χ^2 = 4.55.

Discussion: Targeting rational interventions via educating physicians on antimicrobial use has had an established positive impact in curbing antimicrobial resistance in hospitals.

Conclusion: Training programs on antimicrobial use need to be strengthened.

Keywords: Physicians; antimicrobial resistance; antimicrobial stewardship; infection control.

1. INTRODUCTION

Globally, there is an increase in the rates of antimicrobial resistance on the part of pathogens and this therapeutic challenge is made worse by the fact that the arsenal of antimicrobials that are being used to combat infections are gradually declining in overall potency. This portends danger for the combat of infectious diseases which are a huge public health challenge in developing countries such as Nigeria. The safe, appropriate and judicious use of antimicrobial agents is therefore an important component of patient safety in hospitals and healthcare settings and it must be ensured as much as possible at all times [1].

It is imperative that health care institutions optimise antimicrobial use by doctors on hospital patients in order to improve patient outcomes, reduce adverse drug reactions to the barest minimum, drive down antimicrobial resistance rates and ensure cost-effective therapy. It is essential that this is achieved because the pace at which novel antimicrobial compounds are being developed by pharmaceutical companies has showed remarkably over the last twenty years [2].

It is not expected that this trend will alter in the foreseeable future, because of reduced returns on novel antimicrobial compounds for such companies. This implies that the antimicrobials we have in our employ at the moment are put strictly into judicious use [3].

In addition, it is also becoming more technically challenging for pharmaceutical companies to develop new antimicrobial agents. There are also diminished incentives for them to produce new antimicrobials in the light of rapid development of resistance and increased profitability from the production and marketing of therapeutic agents used in the management of non-communicable diseases such as hypertension and diabetes mellitus [4].

A randomised controlled trial revealed that 20 to 50% of antimicrobials prescribed in advanced health care systems are either unnecessary or inappropriate and such systems have weak or ineffectual antibiotic policies in place [5].

It is estimated by the Centre for Disease Control Atlanta (CDC) that up to two million people are infected with antibiotic resistant organisms with attendant 23,000 mortalities annually despite the establishment of antibiotic policies and infection control programs in the facilities where these data were obtained [6].

According to the international federation of infection control, an antibiotic policy will improve patient care, promote best practice, make better use of drugs, refund the emergence of resistant strains and improve the education of junior doctors. It will also eliminate the use of unnecessary or ineffective antibiotics and restrict the use of “powerful” ones. The core component of an antibiotic policy include: An available list of local antibiotics with their dosages and routes of administration, local guidelines for therapy and prophylaxis of infectious diseases and drug toxicities of the different agents [7].

Studies conducted in some countries have revealed that approximately 50% of antimicrobial regiments used to combat infectious diseases are inappropriate. Resistance to antimicrobial agents is a global problem; with its effect being felt across the globe, however its impact is felt much more in developing economies such as Nigeria whose health care systems are not fully developed [8,9].

2. RATIONALE FOR THE STUDY

Antimicrobial resistance is on the rise particularly in developing countries such as Nigeria. In addition, it is essential that the level of knowledge of physicians regarding antimicrobial agents be assessed with a view towards improving inappropriate prescription practices.

Despite the widespread abuse of antimicrobial agents which is fuelling this epidemic of resistance a substantial percentage of antimicrobials are prescribed by Physicians. This study will help us to develop interventions to retard the increasing rates of antimicrobial resistance and also help to combat the rising cases of medico-legal litigation which is becoming rife in clinical practice.

It is important that local studies be conducted in Nigeria in order to ascertain the antimicrobial prescription patterns and practices among Nigerian doctors with the view to improve such practices for the purpose of patient safety and also to include patient outcomes. Several decisions on management of infectious diseases in our local environment are largely based on guesswork. Most clinicians do not understand the roles of clinical microbiologists and infectious disease physicians in helping them manage their patients and also in improving patient outcomes.

There has been no such study conducted in Ogun State and as such the data obtained will serve as baseline information for future studies. The findings from the study will in addition help us to direct our interventions at the right category of health care workers.

2.1 Aims

The aim of the study is to better understand the level of knowledge of Physicians in Ogun State concerning rational antimicrobial use.

2.2 Objectives

Primary Objective: this is to assess the level of knowledge of Physicians towards rational antimicrobial use.

3. METHODOLOGY

The survey was targeted at clinicians in three tertiary hospitals in Nigeria. Babcock University Teaching Hospital, Olabisi Onabanjo University Teaching Hospital and Federal Medical Centre Abeokuta. The Survey was conducted over a two week period in the three centres.

These 3 Hospitals were selected because of their geographical proximity to each other in the State of Ogun and serve the population. These three hospitals serve as referral centres for the bulk of patients in the state with a vast number of specialties and sub specialties.

BUTH (Babcock University Teaching Hospital) has 120 doctors, OOUTH (Olabisi Onabanjo University Teaching Hospital) 131 and FMC (Federal Medical Centre) Abeokuta 150.

A total of 130 doctors were targeted from different sub specialties. The categories of doctors to be recruited include: House officers, Registrars, Senior Registrars Consultants and Medical Officers. The sub specialties include: Internal Medicine, Surgery, Obstetrics & Gynecology, Paediatrics, Family Medicine, Pathology, Dentist, Radiology and Anaesthesia.

All respondents recruited into the study were informed of study details gave informed consent and assured of the confidentiality of their responses.

3.1 Survey Instruments

A self-administered structured Questionnaire containing 25 questions was given to the respondents to complete. This 25 item questionnaires assessed the level of knowledge of physicians in the following areas: attitude towards antimicrobial prescription, perception of the magnitude of antimicrobial resistance, knowledge of the causes of resistance, knowledge of antimicrobial stewardship and antibiotic policy.

In addition, physician demographics were collected for analysis, cross referencing and cross tabulation.

3.2 Data Analysis

Data were analysed using EPI INFO Version 3.5.1. The following were determined: Odds ratio, risk ratio, with the p value set at < 0.05. The chi square will be used in the calculation of categorical variables.

4. RESULTS

There were a total of 122 respondents in the study with a female to male ratio of 2:1. Majority of Physicians sampled (n = 82) were less than forty years while the rest (n = 32) were above that age. The vast majority of respondents 60.8%, (n = 73), had been in medical practice for less than 10 years. The results also reveal that most respondents worked in a Teaching Hospital n = 82 (71%) with antimicrobial used frequently-at least on a weekly basis 71%, (n = 82). There was a low rate of regular use of MIMS/BNF 24.2%, (n = 29) and in addition 78.3%, (n = 94)

regularly had adverse drug reactions as a key issue before prescribing antimicrobials. With respect to influence by sales representatives, 21.7%, (26) said their prescriptions of antimicrobials were in some way affected by marketers. Results also show that 49.6%, (59) of respondents had attended a seminar on antimicrobial use in the last 12 months and 27.7% (n =33) had knowledge of the local susceptibility patterns in their hospitals.

The data also show that 83.2% (n = 99) had a Clinical Microbiologist in their practice but only 51% (n =51) consulted them routinely in the management of Infectious Diseases. While collecting samples 44.1% (n = 52) would take samples before instituting antibiotics and 87.6% (n = 99) regularly changed antibiotics on the basis of a new susceptibility report. With regards to the use of Quinolones in children, 35.2% (n = 38) were favourably disposed towards its use in that age group. Concerning external pressure to prescribe antimicrobials 20.7% (n = 24) admitted to having prescribed one based on a request from a patient or care giver Table 1.

Table 1. Summary statistics of respondents

Variable		Frequency (N)	Percentage
Age	< 40	82	68.3
	> 40	38	31.7
Gender	Male	81	66.9
	Female	40	33.1
Length of Practice	< 10 years	73	60.8
	> 10 years	47	39.2
Institution	Medical Centre	34	29.0
	Tertiary Hospital	82	71.0
Rate of antibiotic use	Weekly	82	71.0
	Monthly	34	29.0
Consult MIMS/BNF	Irregularly	91	75.8
	Regularly	29	24.2
Consider adverse reactions in prescribing	Irregularly	26	21.7
	Regularly	94	78.3
Influenced by sales representatives	No	94	78.3
	Yes	26	21.7
Attended seminar on use	No	60	50.4
	Yes	59	49.6
Aware of resistance trends in local hospital	No	86	72.3
	Yes	33	27.7
Status	Consultant	20	16.7
	Resident	100	83.3
Practice	BUTH	46	38.7
	FMC	38	31.9
	OOUTH	35	29.4
Microbiologist available in hospital	No	20	16.8
	Yes	99	83.2
Consult Microbiologist in Infections management	No	49	49
	Yes	51	51
Take samples before giving antibiotics	No	66	55.9
	Yes	52	44.1
Change antibiotics with new m/c/s results	No	14	12.4
	Yes	99	87.6
Confidently use Quinolones in children	No	70	64.8
	Yes	38	35.2
Pressured to prescribe antibiotics	No	92	79.3
	Yes	24	20.7
Antibiotic policy in hospital	No	72	76.3
	Yes	42	23.7

BNF – British National Formulary, BUTH – Babcock University Teaching Hospital, FMC – Federal Medical Centre, OOUTH – Olabisi Onabanjo University Teaching Hospital

The following were found to be statistically significant – Physicians in the Public hospitals were more likely to collect specimens for microbiology analysis before commencing antibiotics – p = 0.02, O.R = 2.61, R.R = 1.47, CI = 1.16 – 5.80, χ^{2} = 1.47. There was also a slightly higher likelihood of Physicians in the Private Tertiary Hospital having a Clinical Microbiologist in their hospital – p = 0. 00, O.R = 0.08, R.R = 0.25, CI = 0.05 – 0.99, χ^2 = 4.55. Paradoxically Physicians in the Public sector were more likely to consult a Clinical Microbiologist in the management of Infectious Diseases – p = 0.08, O.R = 0.48, R.R = 0.69, CI = 0.21 – 1.09, χ^2 = 3.00. It was discovered that Physicians in the Public Hospitals were more likely to follow antibiotic policies p = 0.01, O.R = 5.1, R.R = 1.93, CI = 1.34–19.47, χ^2 = 6.04. Finally Physicians in the Private Sector were more likely to attend seminars on antimicrobial use when compared to their counterparts in the public sector p = 0.02, O.R = 0.40, R.R = 0.62, CI = 0.18–0.87, χ^2 = 5.46 Table 2.

The favoured antibiotics for the management of Sepsis, Community Acquired Pneumonia and Uncomplicated Urinary Tract Infections were Ceftriaxone, Co-Amoxiclav and Ciprofloxacin respectively. However some Physicians responded that they would treat Urinary Tract Infections with Doxycycline and Sepsis with Azithromycin and Co-Amoxiclav Fig. 1.

Regarding the perception of the burden of antimicrobial resistance about 50% of respondents said they agree that the rates are on the rise while 25% said that they strongly agreed Fig. 2.

5. DISCUSSION

The injudicious use of antimicrobial agents is ultimately leading to the emergence of multi-resistant organisms which in turn is responsible for increased morbidity, prolonged hospital stay and mortality for our patients. The reversal of this trend is a must if we are to win the silently raging war between microbes and humanity. It has also been established that infections caused by resistant bacteria result in delayed response to therapeutic agents, therapeutic failure and mortality [10,11].

There are factors responsible for this trend in our local environment and these include the excessive use of antimicrobial agents without clinical justification or backing for their application which in turn leads to an increased selection

Table 2. Statistical determinants of compliance with antimicrobial stewardship

Variable			p value	Odds ratio	Risk ratio	95% confidence interval	χ^2
	Consider adverse reactions						
Years of practice	Irregularly	Regularly	0.06	0.42	0.82	0.16-1.08	3.41
< 10 years	51	22					
> 10 years	39	7					
	Take samples before drugs						
Setting	No	Yes	0.02	2.61	1.47	1.16-5.86	1.47
Private	29	12					
Public	37	40					
	Microbiologist available						
	No	Yes					
Private	1	40	0.00	0.08	0.25	0.05-0.99	4.55
Public	19	58					
	Consult Microbiologist						
	No	Yes	0.08	0.48	0.69	0.21-1.09	3.0
Private	16	25					
Public	33	25					
	Follow antibiotic policy						
	No	Yes	0.01	5.1	1.93	1.34-19.47	6.04
Private	17	5					
Public	8	12					
	Seminar on antibiotic use						
	No	Yes	0.02	0.40	0.62	0.18-0.87	5.46
Private	15	26					
Public	45	31					

χ^2 – Chi square

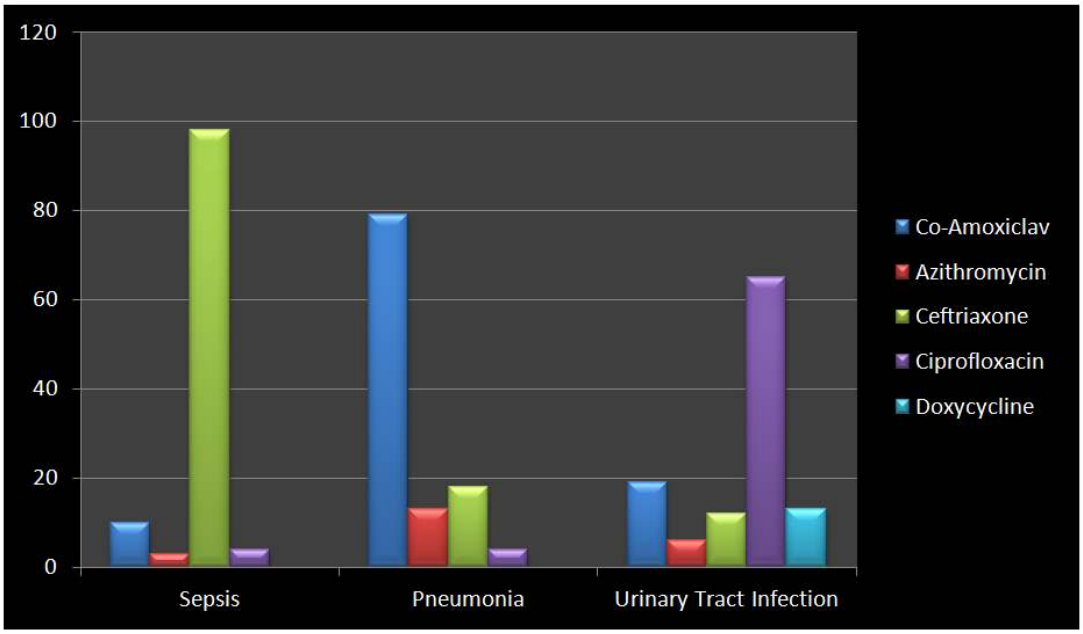

Fig. 1. Antimicrobial use in sepsis, pneumonia and urinary tract infections

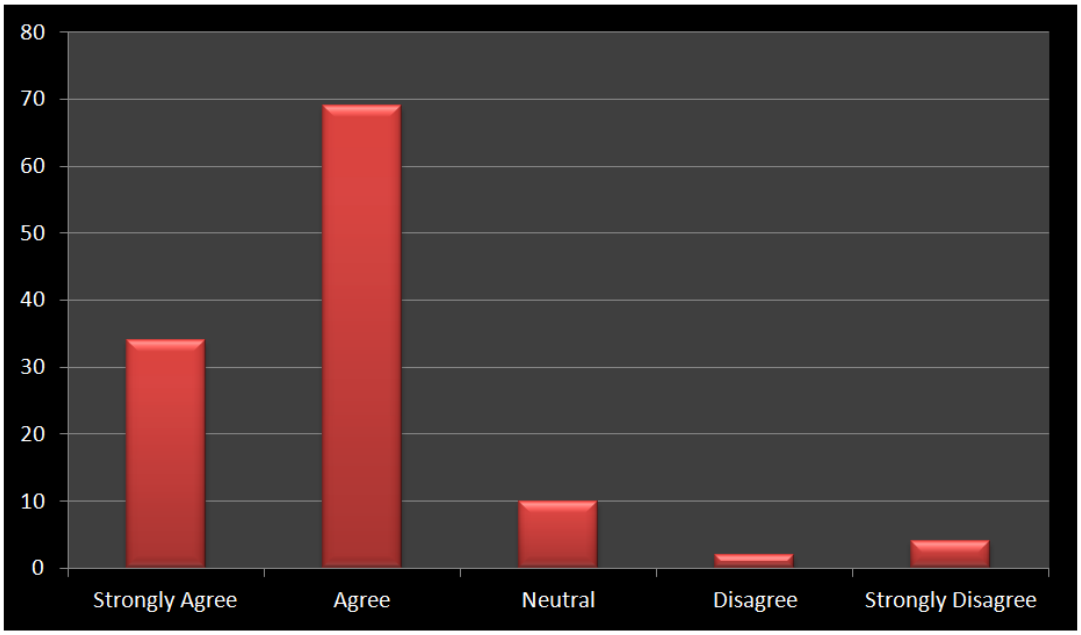

Fig. 2. Responses to the rise in antimicrobial resistance rates

pressure for multi resistant pathogens. This is evident in some of the choices of our Clinicians in the management of infections such as sepsis [12].

Another reason driving this resistance rate is insufficient knowledge on the part of prescribing Physicians on different antimicrobial agents. The low rates of attendance of conferences on antimicrobial use attest to this. Obsolete knowledge plays an important role in promoting resistance as some prescriptions are based on out-dated knowledge and also on guesswork. Several physicians are not aware of current

guidelines on the empiric management of infectious diseases such as Community acquired pneumonia, sepsis, urinary tract infections and meningitis.

It has also been shown that where infection control policies are absent or weakly implemented the spread of multi-resistant pathogens is favoured; some hospitals in our study did not have established infection control committees and policies in place. There were also no enforced antibiotic policies or guidelines in use by clinicians in several of these hospitals.

Research has revealed that there is a strong link between persistent antibiotic use and antimicrobial resistance. Targeting rational interventions via educating physicians on antimicrobial use has had an established positive impact in curbing antimicrobial resistance in hospitals. The accurate identification and analysis of the prevalent attitudes and knowledge linked to inappropriate antimicrobial prescribing will enable rational long term interventions to be formulated with the ultimate aim of targeting these inadequacies [13].

Previous studies by authors such as Cabana et al have shown that unless Physicians are not carried along sufficiently intervention programmes on altering prescription patterns will be largely ineffectual, because physicians still form a large and veritable pool for the administration of antimicrobials despite the availability of such drugs over the counter in sub Saharan Africa. Such evidence has led to the development of rational recommendations targeted at improving antimicrobial stewardship in certain countries by peer review bodies. Guidelines like this are geared towards improving the organisation of health care systems and changing physicians prescribing behaviour [14,15].

It is disheartening to note that there has been a marked decline in the discovery of new antimicrobial to combat infectious diseases. Since 2003 there has been a noted 80% decline in submitting to the FDA (Federal Drug Agency) for new molecular entities. It is indeed evident that antimicrobial agents are not as profitable as some other therapeutic agents especially those used for the management of non-communicable diseases [16].

The World Health Organisation (WHO) defines the rational of medicines thus: Rational use of medicines requires that patients receive medications appropriate to their clinical needs, in doses that meet their own individual requirements for an adequate period of time, and at the lowest cost to them and their community. WHO estimates that 50% of drugs are prescribed, dispensed or sold inappropriately to patients in the community. This highlights the patients' danger inherent in inappropriate prescription practices. In light of the dangers of antimicrobial use has been promoted on a means of curbing this trend [17].

The irrational use of antimicrobial has also been defined to include: inappropriate use, overuse and the under dosing of such agents. This trend is more common in developing countries due to lax controls on over the counter sales of antibiotics, unrestricted marketing of drugs and a higher burden of infectious diseases in the community as opposed to non-communicable diseases in the developed world [18].

This irrational use of antimicrobial on the part of physicians may be linked to inappropriate selection of agents' inappropriate duration or a combination of both. In addition once there is some form of therapeutic relief some patients discontinue their medication as is the case with anti-malarials.

A study conducted in a Turkish hospital revealed that inappropriate use of antimicrobials was found both in surgical and medical wards. In a surgical ward that was surveyed by the researchers the rates approached 43.7% while it was 44.9% in medical wards. They also discovered that several decisions were not based on laboratory guidance as only 4.7% of prescriptions were made on the result of culture results as opposed to 71.4% that were made on empiric decisions and 23.9% for prophylactic use [18].

Researchers in Sudan identified inappropriate antimicrobial prescription as being a threat to patient safety in their health care settings and these scenarios was also compounded by non-compliance with infection control precautions [19].

Antimicrobial resistance which is a direct effect of inappropriate prescriptions develops through different mechanisms, such as genetic mutations, hyper production of enzymes that

inactivate or degrade antibiotics (such as extended spectrum β lactamases) and mutations in cell membrane structure [20].

It has also been proven that the administration of antibiotics may induce the development of resistant subpopulations. This is clearly evident as areas in the hospital that have the higher antibiotic usage rates have the higher rates of resistant bacteria such as in Intensive Care Units, High Dependency Units and Transplant Centres [21].

In clinical practice, doctors have reported that patients put them under pressure in order for them to prescribe antibiotics. This persistence on the part of patients often puts physicians under duress to overprescribe antimicrobials which were hitherto unnecessary. Some physicians comply so as not to lose confidence in the eyes of their patients. Mangione-Smith et al. [22] in a survey of prescription patterns reported that 30 to 50% of paediatricians would administer antimicrobials if they perceived that the patients wanted them despite such being against their clinical judgement. Similarly Colgan and Powers discovered 33% of patients who had a viral upper respiratory tract infection were prescribed antibacterial agents based on patient's expectations despite evidence to the contrary [23].

The inability to arrive at a laboratory backed diagnosis also fuels the continual injudicious of antimicrobials in clinical practice. Distinguishing viral from bacterial infections is hardly feasible or clinical grounds alone and as such microbiological reports are invaluable. The use of antimicrobial agents as a form of therapeutic diagnosis is practiced by some physicians. Resolution of infection after administration of antibiotics is a pointer to a bacterial infection as observed by a study conducted by the Centre for Disease Control (CDC) [24].

Unfortunately the concept of antimicrobial stewardship is still alien to clinical practice in the developing world. In Nigeria the role of clinical microbiologists and infectious disease physicians is poorly understood despite the fact that clinical microbiologists and infectious disease physicians play a key role in antimicrobial stewardship programs [25].

The headship of antimicrobial stewardship programs is traditionally domiciled under clinical microbiologists, however several clinicians do not routinely consult clinical microbiologists or seek their help in the management of infectious diseases particularly pyrexia of unknown origin. The prompt involvement of clinical microbiologist will help to streamline guidance in the administration of antibiotics.

Antimicrobial Stewardship programs have been shown to be of proven benefit in curbing injudicious use of antimicrobials as institutions that employ it report marked reductions in the rates of antibiotic resistance. It consists of a multi-disciplinary approach which includes clinical microbiologists, infectious disease physicians and pharmacists. The basic operational framework of such programs relies on a heavy team approach with these category health professionals [26].

This is achieved via the implementation of a working antimicrobial stewardship program. The core component of antimicrobial stewardship include: leadership commitment, accountability, any expertise, action, teaching, reporting and education [27].

6. CONCLUSION

Training programs on antimicrobial use need to be strengthened in order for our Physicians to be abreast of current guidelines in the management of infections. In addition each hospital must implement an antimicrobial policy in order to optimize patient management.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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