ANTIMICROBIAL PRESCRIPTION PREVALENCE AND PATTERNS FOR IN-PATIENTS IN HOSPITALS, YENAGOA, BAYELSA STATE, NIGERIA

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MATRIC NUMBER 195425

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BY

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ABSTRACT

Introduction: Inappropriate and excessive prescription of antimicrobial agents promotes the development of antimicrobial resistance (AMR) which worsens patients' prognosis and threatens modern medicine. Addressing the fourth focus area of Nigeria's National Action Plan against AMR requires documenting antimicrobial prescription prevalence and patterns in hospitals.

Methods: A point prevalence survey (PPS) of antimicrobial prescribing (AMP) was conducted among in-patients' in 11 hospitals in Yenagoa, Bayelsa State. The prevalence of AMP was computed with the number of in-patients as denominator and number on antimicrobials as numerator. A key informant interview was conducted for Medical Directors in each hospital and Directors in the State Ministry of Health to identify some factors associated with the AMP prevalence and patterns. It covered three thematic areas: perception of AMP and AMR; knowledge of antimicrobial stewardship (AMS) and AMP policy; and intervention strategies. Patterns of prescribing were described based on hospital type, gender, age groups, diagnoses, indications for treatment, nature of therapy, type of antimicrobial agents, route of administration and number of agents per patient. Appropriateness of prescribing was assessed using three quality indicators; reason for prescribing was documented at start, stop/review date documented and treatment supported by microbiological testing. Prescriptions that had all three quality indicators were considered appropriate.

Results: There were 209 in-patients (public, 69 and private, 140) and 189 (public, 64 and private, 125) on antimicrobials, giving an AMP prevalence of 90.4% (public 92.8% and private 89.3%). Females were 59.7% of patients. Median age (± IQR) was 27 ± 32 years. There were therapeutic indications in 63% of prescriptions and empirical therapy in 75.7%. All 419 prescriptions were of broad spectrum antibacterials only for the 189 in-patients, and seven antimalarials prescribed 118 times for 94 of them with a mean (± SD) of 2.7 ± 1 antimicrobials per patient. The most frequently prescribed was Metronidazole (55.0% patients) followed by Ceftriaxone, Gentamicin and Ciprofloxacin (35.4%, 30.7% and 28.6% respectively). The parenteral route was utilised in 74.0% of patients. Only 4.8% of prescriptions were appropriate when assessed with three quality indicators.

Therapeutic indications, empirical therapy, oral route of administration and private hospitals all showed some association with appropriate prescriptions on bivariate analysis. However, only the oral route and private hospitals were statistically significant on logistic regression. All key informants interviewed emphasized the need for an AMP policy and expressed unanimous interest to comply with it when available.

Conclusions: There is unacceptably high prevalence of AMP with overuse of broad spectrum antibacterials and widespread inappropriate prescriptions. Improvements require policy circulation and retraining of medical doctors to reduce improve prescription practices and reduce risk of AMR.

DECLARATION

I hereby declare that this work is original. The work has neither been presented to any other faculty for the purpose of the award of a degree nor has it been submitted elsewhere for publication.

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CERTIFICATION

I certify that this work was carried out by Dr. Bio Belu Abaye in the Department of Epidemiology and Medical Statistics, Faculty of Public Health, University of Ibadan, Ibadan, Nigeria.

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DEDICATION

This dissertation is dedicated to my beloved and faithful wife, Rebecca Biobelemotein Abaye, whose intuition enabled me accept the offer of admission into the University of Ibadan, Ibadan, Nigeria and the Nigeria Field Epidemiology and Laboratory Training Programme (NFELTP) to pursue this uplifting Masters in Public Health Field Epidemiology Practice. Her courage and sacrifices deployed to raise our three children almost alone while I studied remain indelible in my heart.

I also dedicate this to all Antimicrobial Stewards in Nigeria whose eyes have been opened to the need to prescribe antimicrobials responsibly, and whose hearts are fixed on playing their part to limit the pandemic of antimicrobial resistance. Together, we can preserve our endangered profession and save our world.

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List of Acronyms

Acronym	Meaning
AGPMPN	Association of General Private Medical Practitioners of Nigeria
AMP	Antimicrobial Prescription
AMR	Antimicrobial Resistance
AMS	Antimicrobial Stewardship
ASP	Antimicrobial Stewardship Programmes
BYSG	Bayelsa State Government
CME	Continuing Medical Education
FMOH	Federal Ministry of Health
HF	Healthcare Facility
KII	Key Informant Interview
NAFDAC	National Agency for Food and Drug Administration and Control
NAP	National Action Plan
NCDC	Nigeria Centre for Disease Control
NFELTP	Nigeria Field Epidemiology and Laboratory Training Programme
NMA	Nigerian Medical Association
PI	Principal Investigator
PPS	Point Prevalence Survey
SHMB	State Hospitals Management Board
SMOH	State Ministry of Health
WHO	World Health Organisation

CHAPTER ONE

INTRODUCTION

1.1 Background

Prescription of antimicrobial agents is a frequent healthcare practice and the mainstay for treatment of communicable diseases in Nigeria. This is more so given the high burden of these diseases in the country (NCDC, 2017). With the emergence and spread of antimicrobial resistance (AMR), the world has awakened to the need for collective, concerted and scientifically sound approaches to fight AMR. There is global consensus that AMR threatens human health and that optimal and rational use antimicrobials must be part of a global action against AMR (WHO, 2015). Research has and still needs to be targeted at many facets of this global action plan, which includes monitoring prescribing prevalence and patterns, to ensure appropriate use of antimicrobials.

Antimicrobial resistance is not really new but is now more widespread, recognized and reported. Misuse and overuse of antimicrobial agents drives the increasing rate of antimicrobial resistance (Llor et al., 2014), (Mendelson, 2015). More and more resistant strains of bacteria are emerging making more antimicrobial agents 'useless or endangered'. So attention must be on how we use available antimicrobial agents. To ensure judicious and optimal deployment of such a resource we must assess, now and periodically, how we are doing. The findings must be communicated to prescribers, producers and even protagonists who drive the huge practice of antimicrobial use.

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A point prevalence survey (PPS) is a simple and quick method of assessing antimicrobial prescribing (AMP) prevalence and pattern at a particular point in time. It determines prevalence of prescribing by measuring the number of in-patients on antimicrobials among other in-patients on treatment. It further provides data on patterns of prescribing. With 35% in Europe and 56% in China, point prevalence surveys have shown a wide variation in the prevalence of antimicrobial prescribing in different parts of the world. (Lee et al., 2015), (Magerman, 2015). In Nigeria, a prevalence of 55.9% and 69.7% was observed in Owerri and four tertiary hospitals, respectively (Nsofor, 2016) (Oduyebo et al., 2017). Both studies showed similar patterns of prescribing. This PPS provides similar data on how prescribers (medical doctors) deploy these 'rare weapons' in healthcare facilities located in Yenagoa metropolis, Bayelsa State, with a view to identifying possible ways of improving prescribing.

1.2 Scope of this Study

This study was conducted on only in-patients in the sampled facilities in Yenagoa metropolis, Bayelsa State. Only antibacterials were studied, so, except otherwise stated, antibacterials will be used interchangeably with antimicrobials in this study. Antimalarials were examined in the context of inclusion among medications prescribed for these in-patients. No other antimicrobial (antifungals, antihelminthics and antivirals) prescription was studied.

In addition to the point prevalence survey, a key informant interview (KII) was conducted among lead physicians in the selected hospitals as well as Directors in the State Ministry of Health. This was to generate additional data on associated factors.

1.3 Problem Statement

Little is documented about antimicrobial prescribing prevalence and patterns for in-patients in Bayelsa State. Two studies in Nigeria indicated a high antimicrobial prescription prevalence (AMP): 55.9% in Owerri and 69.7% in four tertiary hospitals (Nsofor et al., 2016) (Oduyebo et al., 2017) Antimicrobial resistance (AMR) is a rapidly spreading threat and an inevitable consequence of antimicrobial use. Prescribing practices of physicians has been described as a modifiable determinant of AMR. Such a determinant is being periodically assessed in advanced countries, modified through stewardship programmes and encouraging results have been noted (Harbath et al., 2005). Sadly, such assessments and interventions are not in place in Bayelsa State.

A retrospective study in Lagos indicated that over 50% of prescribed antimicrobials were inappropriate (Sunday et al., 2015) but in Bayelsa State this is not documented. Meanwhile excessive and inappropriate prescribing of antimicrobials remains a key driver of the global burden of antimicrobial resistance (AMR) (Cusini et al., 2010). (Huttner et al., 2013).

Possible associated factors or determinants of inappropriate AMP, which could be identified and modified at healthcare facility level, are also not documented. The burden of AMR or the prevalence of prescribing that drives it, cannot continue to be ignored. To combat AMR we must assess and measure all possible drivers such as prescribing prevalence, patterns and appropriateness. These assessments will help develop suitable stewardship programmes to preserve the efficacy of these drugs for many more years (Aidan Hollis et al. 2013; Morel et al. 2017) and sustain the relevance of modern healthcare systems, especially in Bayelsa State.

1.4 Justification for this Study

This study documents the point prevalence and patterns of antimicrobial prescribing in Yenagoa, Bayelsa State as at May 2018. It therefore, fills an information gap in Nigeria. The Nigeria Centre for Disease Control (NCDC), through its AMR Technical Working Group, called for research works from all over Nigeria that are related to the five focus areas of the National Action Plan (NAP) against Antimicrobial Resistance (AMR). This survey attempts to meet research needs related to the fourth focus area of the NAP, which has to do with antimicrobial stewardship.

The point prevalence survey (PPS) methodology adapted here is simple, quick and affordable. Assessment of AMP is objectively done, reproducible and can be a local template for repeated or serial point prevalence surveys to monitor trends for in-patients in these hospitals. It could also guide or trigger more strategic research on AMP.

Targets for hospital-based interventions shall also be identified. It provides some relevant information to guide interventions for continued improvements and control of AMR. The findings will offer a data base for immediate clinicians' engagement in addressing their contribution to development and spread of resistant pathogens, on one hand, and possible control of AMR, on the other.

1.5 Research Questions

1. What is the prevalence of antimicrobial prescribing in Yenagoa hospitals?
2. What are the common antimicrobials prescribed for in-patients?
3. What are the common reasons for prescribing antimicrobials?
4. What proportion of prescribed antimicrobials is supported by microbiological testing or data?
5. What proportion of antimicrobial prescribing complies with written policies or guidelines?
6. What proportion of antimicrobial prescriptions is considered inappropriate or unnecessary?
7. What are the factors associated with antimicrobial prescribing?
8. What areas for intervention can be identified to ensure rational use of antimicrobials?

1.6 Objectives

1.6.1 General Objective

To determine the point prevalence, and describe patterns, of antimicrobial prescription for in-patients in public and private hospitals, Yenagoa, Bayelsa State, Nigeria.

1.6.2 Specific Objectives

1. To determine the point prevalence of antimicrobial prescription for in-patients in hospitals, Yenagoa, Bayelsa State, Nigeria, May 2018.
2. To describe patterns of antimicrobial prescription for in-patients in hospitals, Yenagoa, Bayelsa State, Nigeria, May 2018.
3. To determine the proportion of antimicrobials prescribed appropriately for in-patients in hospitals, Yenagoa, Bayelsa State.
4. To identify factors associated with inappropriate antimicrobial prescription in these hospitals.

CHAPTER TWO

LITERATURE REVIEW

2.1 History of Antimicrobial Prescribing and Resistance

The practice of prescribing antimicrobial agents dates back to the 1940s after penicillin, discovered in 1928 by Sir Alexander Fleming in London, was commercially available and widely put to use by clinicians (Aldridge et al., 1999). Within a decade of its discovery, penicillin became an effective weapon frequently put to use in the battle field of infectious diseases to save lives. The use of penicillin and many other antimicrobials introduced down the years, however, was not without adverse consequence. The most unwelcomed consequence was the development of resistance to penicillin by bacteria it once readily killed. Fleming and his contemporaries recognized this over those years of penicillin's earliest use, leading him to make this sad observation and caution the world on how to use it. In his famous Nobel Prize acceptance speech, an author recalls, Fleming admonished us saying, "It is not difficult to make microbes resistant to penicillin in the laboratory by exposing them to concentrations not sufficient to kill them … there is the danger that the ignorant man may easily under-dose himself and, by exposing his microbes to non-lethal quantities of the drug, make them resistant". Furthermore, Fleming said, "The thoughtless person playing with penicillin treatment is morally responsible for the death of the man who succumbs to infection with the penicillin-resistant organism" (Mendelson, 2015). So true this is today! So relevant his admonition in this generation and clime! For upon us has befallen the worst fears of Fleming and his contemporaries: the development and spread of AMR. Indeed, our quest to subdue these pathogens should be balanced with understanding how best to use these antimicrobials. We must deploy them with caution, reason and good understanding of the balance between need and benefit on one hand as well as immediate and long-term adverse effects on the other. Fleming recognized, way back then, that the way penicillin is used would greatly influence the development of bacterial resistance to it.

The World Health Organisation (WHO) defines antimicrobial resistance (AMR) as the ability of a micro-organism (e.g. bacterium, virus, and some parasites) to stop an antimicrobial agent (antibacterial, antifungal, antiviral and antimalarial) from working against it. This makes standard treatments ineffective with persistence of infections and risk of spread of resistant pathogens (WHO, 2017). The impact of AMR includes treatment failures, higher treatment costs, prolonged hospitalization, disability and death. Antimicrobial resistance (AMR) is now recognized as a great threat to human health not just in healthcare settings but also in communities and nations (Roca et al., 2015; Versporten et al., 2016). Reiterating this, authors have cited the highlights made by the WHO and the US Centers for Disease Control and Prevention (CDC), describing AMR as "one of the three greatest threats to human health". To further emphasize this, the theme of the 2011 World Health Day was "antimicrobial resistance: no action today and no cure tomorrow" (Kullar et al., 2017). Seven years after such an apt theme, concerted action is still being sought and galvanized globally, especially in less advanced countries like Nigeria.

Although AMR is not new, it is now more widespread and better recognized as an inevitable consequence of antimicrobial use. As more resistant strains of bacteria emerge, more antimicrobial agents are becoming 'endangered man-made weapons' that need to be handled with care and possibly replaced. Available evidence for the increase in spread of AMR suggests that the magnitude and effects are spreading fast and far, while the citadels and channels for new drug production have gone quiescent or even moribund in the past twenty or more years (Littmann, et al., 2015).

Like many authors, Mendelson alludes to increasing evidence that misuse and overuse of antimicrobials strongly drives this increasing rate of antimicrobial resistance. He cites evidence of the presence of resistance genes in bacteria isolated from ice samples as far back as 30,000 years ago (Mendelson, 2015). Rotam, citing earlier writers, noted that traces of tetracycline, for example, have been found in human skeletal remains from ancient Sudanese Nubia dating back to 350–550 CE. By 1948, barely three years after Fleming's caution, a London hospital reported that 38% of strains *Staphylococcus aureus* were resistant to penicillin. By around 2012, at least 90% and almost 100% of *S. aureus* strains were resistant to penicillin in the United Kingdom (UK) and United States of America (USA), respectively (Huttner et al., 2013). In America, many deaths have been attributed to resistant bacteria with just one organism, methicillin-resistant *Staphylococcus aureus* (MRSA), killing more people every year than emphysema, HIV/AIDS, Parkinson's disease and homicide put together (Llor et al, 2014). From the foregoing, it is clear that antimicrobial use has a flip side to all its obvious benefits: the development and spread of AMR. The widespread use of these medications which was once only life-saving has therefore become life-threatening. It's life-saving because many lives that could have been lost to infectious diseases have been saved by the timely and appropriate use of effective antimicrobials. It's life-threatening because the resistance so developed is now spreading much faster than our response to it so far.

2.2 Use of Point Prevalence Survey to Assess Antimicrobial Prescriptions

A point prevalence survey (PPS) is a type of cross-sectional study (prevalence survey) that measures the proportion of individuals with a health-related characteristic of interest among others at risk at a particular point in time (Porta, 2008) (Gordis, 2014). It is a simple, quick and inexpensive approach commonly used to measure the prevalence of antimicrobial prescribing among in-patients. The point prevalence of antimicrobial prescription for in-patients in Yenagoa hospitals is therefore, the proportion of in-patients on antimicrobials in those hospitals on survey day. The Global-PPS of antimicrobial consumption and resistance is a voluntary enrollment of hospitals from different countries and entry of their data onto the web-based platform for analysis and feedback (Goossens, 2018). The methodology deployed in this Yenagoa study is adapted from the Global Point Prevalence Survey.

The PPS also gives useful data for identifying patterns, measuring prescribing indicators and assessing appropriateness of prescriptions. Through repeated PPSs, trends and interventions in prescription practices can be monitored and assessed (Goossens et al., 2018).

A key informant interview (KII) is a qualitative data collection method that is carried out with strategic people in a community who have in-depth or first-hand knowledge of the subject of interest. The response of key informants can be useful adjuncts to the quantitative data derived from the basic PPS. The KII provides background characteristics of the informants, indicating their suitability as respondents to questions on the subject. A major feature of the KII is a catalogue of their responses in thematic areas of the interview (Washinton University, 2006).

2.2.1 Measuring Antimicrobial Prescription Prevalence

This point prevalence survey (PPS) of antimicrobial prescription (AMP) is a one-day survey that utilizes two data instruments. These are a ward data form and patient's data form. The ward data form contains denominator data such as the type of ward or hospital, the total number of beds in that ward or hospital (bed capacity) and the total number of in-patients (bed occupancy) in that ward or hospital on survey day. The patient's data form contains numerator data such as the number of in-patients on antimicrobials and details of their prescriptions (Goossens et al., 2018).

The point prevalence is the number of in-patients on antimicrobials divided by the number of patients on admission, expressed as a percentage. Preliminary results of the 2015 Global-PPS of 44305 antimicrobial prescriptions from 335 hospitals in 53 countries showed a prevalence of 89.5% and 91.4% in adults and children, respectively (Versporten et al., 2015). No data from Africa was reported. In the 2016 survey in Europe, an average antimicrobial prescription (AMP) prevalence of 35% was observed among in-patients in 214 hospitals (Magerman, 2015; (Lee et al., 2015). Another in a

Canadian tertiary care hospital for adults in 2014 showed a prevalence of 31%. Results of some other surveys are summarized in Table 2.1 below.

Table 2.1: Some point prevalence surveys of antimicrobial prescribing.

Publication Date	Title of Study / Article	Prevalence of Prescribing
June 2017	A Point Prevalence Survey of Antimicrobial Prescribing in Four Nigerian Tertiary Hospitals	69.70%
March 2011	A Point Prevalence Survey of Antibiotic Use in 18 Hospitals in Egypt	59.0%
July 2014	A multicenter point-prevalence survey of antibiotic use in 13 Chinese hospitals	56.0%
August 2016	Prevalence of Antimicrobial Use in Major Hospitals in Owerri, Nigeria	55.60%
December 2014	Australia-wide point prevalence survey of the use and appropriateness of antimicrobial prescribing for children in hospital	46.0%
August 2016	Prescribing indicators at primary health care centers within the WHO African region: a systematic analysis (1995–2015)	46.8%
September 2016	Using a simple point-prevalence survey to define appropriate antibiotic prescribing in hospitalised children across the UK	40.9%
November 2015	The Worldwide Antibiotic Resistance and Prescribing in European Children (ARPEC)	36.7%

2.2.2 Measuring Antimicrobial Prescription Patterns

The patterns of antimicrobial prescriptions can be identified and described through point prevalence surveys. These patterns are seen in the distribution of prescriptions by age group, gender, and hospital type. The class of antimicrobials prescribed, their routes of administration, range of diagnoses, indications for treatment and nature of therapy are also variable patterns that can be described. These variables are captured in the data instruments adapted from the Global-PSS data tools (Goossens et al., 2018).

All age groups were affected in various studies accessed but there was gender variation in the in-patients on antimicrobials. A point prevalence survey in Egypt showed a female preponderance of 51.7% (Talaat et al., 2014) while in Canada a male preponderance of 53% and 86% in acute and long-term care, respectively was observed (Lee et al., 2015). In Nigeria a similar female preponderance of 52.1% (Nsofor et al., 2016) was observed in Owerri, while a male preponderance of 55.0% was observed in Lagos (Sunday et al., 2015).

In different parts of the world there are variations in choice of antimicrobials prescribed for therapeutic indications. Generally, the most frequently prescribed class of antimicrobials are cephalosporins, fluoroquinolones, aminoglycosides, imidazoles and penicillins. In China, it was cephalosporins (42.4%), followed by fluoroquinolones (19.9%) and penicillins (14.5%) (Xie et al., 2015). In Australia, it was cephalosporins (30.3%), followed by aminoglycosides (22.9%) and penicillins (20.3%) (Osowicki et al., 2014). In four Nigerian tertiary hospitals Oduyebo observed cephaosporins (18.8%), followed by imidazoles (metronidazole) (18.0%) and fluoroquinolones (9.9%) (Oduyebo et al., 2017). Among children, aminoglycosides and penicillins were the most frequently prescribed in all continents, ranging from 18.4% (ampicillin) in Western Europe to 36.3% (gentamicin) in Africa (Versporten et al., 2016).

Most indications among in-patients on antimicrobials were therapeutic rather than prophylactic. The parenteral route of administration was also most frequently used for initial doses of antimicrobials in all countries, hospitals, wards and age groups: 78.8% in European children (Versporten et al., 2016) and 74.8% in Nigeria. In Nigerian surveys, broad spectrum antimicrobials were generally used (Oduyebo et al., 2017), (Nsofor et al., 2016).

2.2.3 Assessing Appropriateness of Antimicrobial Prescriptions

The extent of appropriate or inappropriate AMP is not well known in the UK (Smith et al., 2018). This is more so in Africa where little or no surveillance data on AMP and AMR exists. A standardized algorithm, initially reported by Gyssens, used a combination of criteria to define appropriateness of antimicrobial prescription (AMP). These include appropriate decision, indication (evidence of infection), choice (based on spectrum of activity, safety profile and effectiveness for infection), route of administration, dosage and duration of therapy. Cusini's assessment of appropriateness of AMP in a Swiss tertiary care hospital using this algorithm found that 37.0% of therapeutic AMP were inappropriate (Cusini et al., 2010). Willemsen's scored modification of this algorithm reported 37.4% inappropriate AMP. In that stud, he demonstrated the usefulness of a PPS in assessing appropriateness and determinants of inappropriate AMP (Willemsen et al., 2007). Some other assessors used compliance with existing policy or guidelines, targeted treatment and de-escalation within 72 hours as appropriate (Paruk et al., 2012).

Using factors in the Gyssens algorithm, Sunday found 54.0% AMP in a tertiary healthcare cantre in Lagos were inappropriate (Sunday et al., 2015). Others have used a combination of variables assessed in a PPS as quality indicators to assess appropriateness. These indicators include documentation at start of treatment of the following: reason for prescription; stop or review date; support of microbiological testing or data; and compliance with existing AMP policy (Oduyebo et al., 2017). Excluding policy compliance, the other three quality indicators are readily accessed n a PPS and were used in this Yenagoa survey.

Nathwani and Sneddon, quote a '30% Rule' on antimicrobial prescribing in the United Kingdom by Hoffman et al. This rule stated that the point prevalence of AMP for in-patients was approximately 30%. Up to 30% of these AMPs as well as those specifically for surgical prophylaxis were inappropriate. Furthermore, approximately 30% of hospital pharmacy costs are due to antimicrobial use and 10-30% of these can be saved by antimicrobial stewardship programmes (Nathwani et al., 2013). Such a pattern is not clearly established and may be an interesting find in Bayelsa State or Nigeria.

2.3 Surveillance of Antimicrobial Prescribing and Resistance

Data needs to be generated and information shared routinely on the actual prevalence and pattern of antimicrobial prescribing, on one hand, and resistance on the other. Significant gaps exist in surveillance of antimicrobial prescribing practice in Africa as surveillance systems are not in place. The availability of standardized study methodologies, overall co-ordination and data sharing vary in all WHO regions. However, available data shows high rates of both antimicrobial prescription (AMP) and antimicrobial resistance (AMR) in community and healthcare settings (WHO, 2014). Despite the paucity of data, Africa has reported obvious cases of bacterial resistance to commonly used antimicrobial agents (GLASS, 2017). With enrollment of nine African nations in the Global Antimicrobial Resistance Surveillance System (GLASS), including Nigeria by the end of 2016, reporting of needed data is expected to keep improving.

CHAPTER THREE

METHODS

3.1 Study Area

This study was carried out in Yenagoa Local Government Area (LGA) and part of Ogbia LGA which makes up the Yenagoa metropolis, in Bayelsa State, south-south Nigeria. Bayelsa State is in the centre of Niger Delta. Like most parts of the state, the terrain in Yenagoa is low flat tropical rain forests and marshlands having small lakes, ponds and large rivers. The social environment in Yenagoa ranges from rural and sub-urban in most parts, to urban in the city centre. Bacterial infections are a common reason for hospital presentation. So a high prevalence of antimicrobial prescribing is expected. The population growth, un-matched with socio-economic and infrastructural growth, may also predispose to both high infection rates and antimicrobial use. Residents of Yenagoa are mostly traders and civil servants. There are also farmers and fishermen.

There are eight public secondary and 21 registered private healthcare facilities, most of which are located in the central part of Yenagoa, leaving hinterlands underserved. Low socio-economic status of residents, shortage as safe water and healthcare service gaps such as short-staffing, inadequate laboratory support, out-ofpocket expenditure and weak referral systems still limit access to quality healthcare services. Many residents patronize the numerous patent medicine shops and few private maternity homes in the metropolis which are sources of frequent antimicrobial prescription.

Professional bodies such as the Nigerian Medical Association (NMA) and her affiliates regularly organize Continuing Medical Education (CME) programmes to update doctors' knowledge. Healthcare programmes featuring doctors are regularly transmitted by radio and television stations in Yenagoa. The National Agency for Food and Drug Administration and Control (NAFDAC) state office, located in Yenagoa and responsible for co-ordinating pharmaco-vigilance activities may be limited by staffing and funding gaps.

3.2 Study Setting

This survey was conducted in 11 healthcare facilities. These hospitals were coded HF01 to HF11. The acronym, HF, refers to healthcare facility; thus, HF01 to HF11 refers to Healthcare Facility One to Healthcare Facility Eleven (Appendix 2). Those coded HF01 to HF03 are public healthcare facilities and HF04 to HF11 private healthcare facilities. There is no classification in the state for private hospitals, but the eleven hospitals in this survey are considered secondary level healthcare facilities due to their range of services.

Each hospital is structured similarly for in-patient care into four mixed-type wards that cater for both medical and surgical cases:

i. The Female Wards cater for both adult female and some paediatric patients;
ii. The Male Wards cater for adult males and few older paediatric patients;
iii. The Paediatrics Wards which are for children less than 15 years old
iv. The Neonatal Units (also known as Special Care Baby Units, SCBU) for newborns less than one month old.

3.3 Study Design

A point prevalence survey (PPS) was conducted. It is a one-day cross-sectional survey that evaluates at a point in time. The characteristic of interest is antimicrobial prescription for in-patients. So, this PPS will measure the proportion of in-patients on antimicrobials on the particular day of survey in each hospital.

3.4 Study Population

The study population was all in-patients who met the inclusion criteria on the day of survey in the eleven sampled hospitals. These were patients of both sexes and all ages.

3.4.1 Inclusion Criteria

i. All in-patients in a hospital ward (or the bed occupancy) at 12:00 noon on the date of survey are counted in the denominator data and entered in the Ward Data Form.

ii. All in-patients on antimicrobials are counted in the numerator data and entered in the Patient's Data Form.

3.4.2 Exclusion Criteria

i. All out-patients in the selected hospitals are excluded. Any patient admitted for a short-term procedure ('Day Case') is also considered an out-patient.

ii. Any in-patient for whom prescribed antimicrobial consists of only topical agents (Goossens et al., 2018).

3.5 Sample Size Determination

Calculation:

The sample size for the study subjects was calculated using the formula below:

$$n = \frac{Z^2pq}{d^2}$$

(Lwanga et al., 1991)

where,

n = sample size

Z = standard normal deviate for a two-tailed test = 1.96

p = prevalence of exposure of factors of interest = 69.7% (≈ 0.70) (in this case, prevalence of antimicrobial prescribing in four Nigerian tertiary hospitals (Oduyebo et al., 2017).

q = 1 − p = 1 − 0.67 and

d = desired level of precision = 0.05 (i.e. 5%)

$$n = \frac{(1.96)^2 \times 0.70 \times 1 - 0.70}{(0.05)^2}$$

n = 322.69 ≈ 323 in-patients

A sample size, n, of 323 in-patients could be sampled from a large target population of 10,000 or more. However, the target population for this study was 388, the maximum number of patients that can be admitted (or the combined bed capacity) in all 21 hospitals listed; this is much less than 10,000. So, a finite population correction (FPC) was computed for this sample size.

Thus,

$$FPC = \sqrt{\frac{\text{Total population you want to sample from} - 323}{\text{Total population you want to sample from} - 1}} \times 323$$

$$= \sqrt{\frac{388 - 323}{388 - 1}} \times 323$$

n = 132.37

n = 132

In addition a non-response rate of 10% was considered in this study and added to the above sample size (Naing et al., 2006). This was to address folders that may have incomplete or missing data or folders that may be inaccessible within the hours of the survey.

Thus,

N = (0.1 x 132) + 132

= 13.2 + 132

= 145.2 = 145

N = 145 in-patients

Therefore, a minimum of 145 in-patients was required for this survey but a total sampling of all available in-patients was done in each hospital on their designated survey dates.

3.6 Sampling Technique

A cluster sampling technique was applied. Each hospital is a cluster and each in-patient on the date of survey a sampling unit. The study population were those in-patients on antimicrobials treatment.

A list of 21 public and registered private healthcare facilities was obtained from the Department of Medical and Dental Services, Hospitals Management Board (HMB), and the Department of Medical and Dental Services, State Ministry of Health, (SMOH) respectively. From this list, 11 were selected by simple random sampling. The three public and eight private hospitals sampled are identified herein with codes. HF refers to healthcare facility. Thus, HF01 to HF11 refers to Healthcare Facility One to Healthcare Facility Eleven (Appendix 2). Then a total sampling of all in-patients was done in each hospital (cluster) and those on antimicrobials studied.

3.7 Study Instruments

The standard point prevalence survey (PPS) data instruments were adapted and used in this survey. These instruments were the Ward Data Form (Appendix 3) and the Patient's Data Form (Appendix 4). A KII Guide (Appendix 5) was also used to conduct interviews of eighteen key informants: one from each hospital, AGPMPN and six directors in the State Ministry of Health. Paper forms were used to collect data.

The Ward Data Form contained the survey date, type of hospital and wards, the number of patients on admission that day and number of those on antimicrobial drugs. The

Patient's Data Form contained patient's identification number, age, gender and details of prescriptions. Provision was made for up to eight antimicrobial agents. For each agent, the prescription details were the antimicrobial name, unit dose, route of administration (parenteral or oral), number of doses in 24 hours, indication for prescription and type of treatment. Other data entered for prescribing had dichotomous variables, indicating *Yes* or *No* to the following: Reason for prescription was documented at start of treatment, stop or review date was documented at start, treatment is supported by microbiological testing and treatment is compliant with local policies or guidelines.

Face validation of both data forms and KII Guide was carried out by my academic supervisors and an infectious disease consultant in the Niger Delta University Teaching Hospital, Wilberforce Island, Bayelsa State. Pre-testing of these instruments was conducted at Sagbama General Hospital, Sagbama LGA, Bayelsa State.

3.8 Data Collection Methods

Data collection in all hospitals lasted 28 days. Survey time was from 12:00 noon to 5:00 pm in all hospitals.

3.8.1 Quantitative Data

Once the hospitals were sampled and consent (verbal) received, a date and time was fixed with each of them for the survey and a health management systems (HMS) officer was assigned to introduce us to ward staff and assist us in our tasks. It involved getting the ward data from the ward records and entering it into the Ward Data Form: one form per ward. Entries into the Ward Data Form were also cross-checked using the number folders assembled for patients' data entry below. The ward data formed the denominator for computing prevalence of antimicrobial prescriptions (AMP).

The case notes of all in-patients were then assembled and survey numbers assigned to them for ease of collation. Those for whom no antimicrobial agent was prescribed were put aside while only those on antimicrobials had data of prescription details extracted. Ward staff assisted data collectors in arranging and numbering the case notes. Details for the variable fields in the Patient's Data Form were extracted, one case note at a time, taking care to avoid multiple entries. There was no interaction with any patient for data collection. All variable fields in the Patient's Data Form were filled except those for which there was no documentation, writings were illegible and clarifications could not be provided. Policy compliance was not assessed because no policy document was available. Legibility was not a challenge in the hospitals using electronic medical records.

3.8.1 Qualitative Data

A Key Informant Interview (KII) was also conducted with the Medical Director or his assigned representative (a doctor) in each facility, an officer of AGPMPN and two directors in the State Hospitals Management Board (HMB) and four directors in the State Ministry of Health (SMOH). Each lasted 15-25 minutes. A KII Guide (Appendix 5) with four thematic areas was used. These are: (i) Perception of antimicrobial resistance (AMR) and antimicrobial prescription (AMP) prevalence; (ii) Knowledge of antimicrobial stewardship and prescribing; and (iii) Suggested intervention areas. The interviewed personnel are referred to as key informants or respondents.

3.9 Operational Definitions used in this survey

1. *Point Prevalence:* The prevalence of the outcome of interest at that point in time (which could be a day or an epidemiological week). In this survey it is calculated as the number of in-patients on antimicrobials (numerator) divided by all the in-patients on admission on day of survey (denominator) expressed in percentage.
2. *Guideline compliance*: A written document of the local policy or guideline for prescribing antimicrobials should be sited. If the antibiotic prescribed is in agreement with such a guideline, it is considered compliant (Goossens et al., 2018).
3. *Appropriateness of Antimicrobial Prescription:*

A description of appropriate prescribing based on three quality indicators was derived from experts opinion and literature review (Oduyebo et al., 2017) was used. The quality indicators used are:

I The reason for prescribing was documented at start of treatment

II Stop or review date was documented

III Treatment was supported by microbiological testing or data

a. *Appropriate Antimicrobial Prescription:* one that meets all three indicators above.

b. *Inappropriate Antimicrobial Prescription:* one that meets less than three of the indicators above, or is prescribed for a condition it is not meant for.

4. *Indication for treatment*: This is not typically documented in folders in this clime but was inferred or determined by the survey team, after interviews with attending clinicians as either of these four:

   i. Therapeutic

      - Community-associated Infection (CAI)
      - Healthcare-associated Infection (HCAI)

   ii. Prophylactic

      - Medical Prophylaxis (MP)
      - Surgical Prophylaxis (SP)

4. ***Diagnosis of illness:*** refers to the anatomical site or pathological definition of the condition the clinician wants to treat e.g. Upper Respiratory Tract Infection (URTI), Urinary Tract Infection (UTI), Pneumoniae, Gastroenteritis, Malaria etc.

5. ***Nature of Treatment:*** This is designated either *Empirical (E)* or *Targeted (T)*.

   a. *Empirical Treatment* refers to when the antimicrobial is being used based on physician's experience of proven benefits, a local guideline or an informed guess.

   b. *Targeted Treatment* refers to when the antimicrobial is being used based on results of a microbiological test (e.g. microscopy, culture and sensitivity (MCS) or others such as a suitable antigen detection test), performed using a relevant clinical specimen.

6. ***Prescribing or Prescription:*** Antimicrobial prescribing in this study is defined as the written instruction seen in patients' case notes that determines what drug he/she receives and how. Variables on prescribing are analysed at two levels:

a. Patient-level or patient-based (i.e. based on the number of patients on antimicrobials surveyed).

b. Agent-level or prescription-based (i.e. based on the number of times antimicrobials were prescribed for all patients surveyed).

7. *In-patients on Antimicrobials:* Those who have either commenced antimicrobial treatment, had an antimicrobial agent prescribed but not yet commenced, or have completed, missed or been withdrawn from a prescribed antimicrobial agent.

3.10 Data Management and Analysis

The data from the Patient's Data Form was cross-checked daily before collation into the MS-Excel spreadsheets. Entries in the spreadsheets were filtered, cleaned and harmonised with contents of each patient's data form, using Epi-Info 7.2 and MS-Excel. Spelling, spacing and font errors were corrected in the database. The data generated from the KII were contained in notes and entered into a separate spreadsheet in the database. Only two respondents consented to audio recordings of the interviews. Data was also managed and analysed using MS-Excel 2007 and Epi-Info version 7.2.

Univariate analyses was done to show frequencies and proportions (%) of demographic characteristics of in-patients seen namely, gender, age and ward; drug type and class, their routes of administration, indications and diagnoses; facility-specific prevalence and overall prevalence (%); antimicrobials prescribed with support of microbiological data; and antimicrobials that were appropriately prescribed based on indicators. Bivariate analyses of relationship between independent variables and appropriateness of antimicrobial prescribing at 95% significance level was also done. A logistic regression was also done to identify variables that have the most significant association with inappropriate prescriptions.

3.11 Variables of Interest in this Study

3.11.1 Independent Variables

1. Hospital Type
2. Age group
3. Gender
4. Antimicrobial Class
5. Route of Administration
6. Duration of Admission.

3.11.2 Dependent Variables

1. Number of Antibacterials per Patient
2. Appropriateness of Antibacterial Prescribing

3.13 Ethical Considerations

Ethical approval was received from the Department of Planning, Research and Statistics, Ministry of Health, Bayelsa State. Participation of healthcare facilities in this survey was voluntary. Informed verbal consent was received from the healthcare facilities on receipt of the letter of introduction from the State Ministry of Health. The quality and integrity of the data generated was assured by adherence to study protocol and the guidance of academic supervisors from the Faculty of Public Health, University of Ibadan. Confidentiality and anonymity was assured by non-usage of patients' and facilities' true names in reporting. Findings shall be communicated to the facilities and the State Ministry of Health for improvements of prescription practices and shall not be evidence for audits or litigation.

CHAPTER FOUR

RESULTS

4.1 Point Prevalence of Antimicrobial Prescription in Hospitals in Yenagoa

Eleven hospitals were surveyed; three Public (i.e. government-owned) and eight Private, each identified with a code. The 11 hospitals had a combined bed capacity of 299. There were 209 in-patients and 189 of these had at least one antimicrobial prescription. Thus, the point prevalence of antimicrobial prescription (AMP) in Yenagoa was 90.4% (Table1). This ranged from 78.3% to 100%. Median (±IQR) was 92.3% (±16.7%). The mean prevalence of antimicrobial prescribing was 91.4% and 89.9% in the public and private hospitals, respectively.

Among the 189 on antimicrobials, 95 (50.3%) had only antibacterials while the other 94 (45.9%) had an antimalarial prescribed in addition.

Table 4.1: Point prevalence of antimicrobial prescription in hospitals, Yenagoa, Bayelsa State, May 2018.

Hospital Code	Number of In-patients	In-patients on Antimicrobials	
	N	*n*	*Point Prevalence (%)*
HF01	25	20	80.0
HF02	26	26	100.0
HF03	19	18	94.7
HF04	26	24	92.3
HF05	25	25	100.0
HF06	23	18	78.3
HF07	22	19	86.4
HF08	18	15	83.3
HF09	13	13	100.0
HF10	6	6	100.0
HF11	6	5	83.3
All HFs	209	189	**90.4**

4.2 Characteristics of the In-patients on Antimicrobials

Among 189 in-patients on antimicrobials. 113 (59.8%) were females; female to male ratio of 1.5 (Table 2). Patients' ages ranged from one day to eighty-eight years, with a mean age (±1SD) of 25 ±19.1years. Median age was 27 years and median age group, 25 - 34 years. This age group had 43 (22.8%) in-patients, among whom 32 (74.4%) were female (Table 2). There were 46 (24.3%) under-five children, among who were 18 neonates (39.1% of under-fives). Number of days on admission as at survey day ranged from one to fourteen days.

Table 4.2: Characteristics of the in-patients on antimicrobials in Yenagoa, May 2018. [N = 189]

Variable	Frequency (N)	Percentage (%)
Age group (years)		
< 1 month	18	9.5
1 - 59 months	28	14.8
5 - 14 years	29	15.3
15 - 34 years	76	40.2
35 - 44	28	14.8
≥ 45 years	10	5.3
Mean Age (± SD) = 25 ± 19.7		
Median Age (± IQR) = 27 ± 32		
Range: 0 - 88		
Gender (Female : Male = 1.5)		
Female	113	59.8
Male	76	40.2
Number of days on admission (as at survey day)		
< 3	52	27.5
3 - 7	135	71.4
> 7	2	1.1
Median ±IQR: 3.9 ±1.9 days		
Range: 1 - 14 days		
Number of antibacterials per patient		
1-2	118	62.4
3	45	23.8
4-5	26	13.8
Mean ±SD: 2.7 ±1.0		

4.3 Pattern of Diagnoses and Antimicrobial Prescriptions for In-patients in Hospitals in Yenagoa

4.3.1 Pattern of Diagnoses

The range of diagnoses is presented in six groups for the 189 in-patients. Sepsis and other infections were 98 (51.8%) of which 53 (28.0%) had malaria diagnosed in addition to these infections (Figure 5).

Table 4.3: Range of diagnoses for in-patients on antimicrobials in hospitals, Yenagoa, May 2018.

Diagnoses (Pathological or Anatomical)	Frequency (n)	Percentage (%)
Sepsis/Infections [n = 98 (51.8%)]		
With malaria (suspected or confirmed)	53	28.0
Without malaria (suspected or confirmed)	45	23.8
NCDs with complications	25	13.2
Surgical cases and burns	25	13.2
Labour and delivery related	23	12.2
Neonatal conditions	18	9.6

4.3.2 Pattern of Antimicrobial Prescriptions

A total of 419 prescriptions of antibacterial agents were made for 189 in-pabtients; 200 (47.7%) in public hospitals and 219 (52.3%) in private. Only road spectrum antibacterial agents were used; 262 (62.5%) in females and 157 (37.5%) in males. The most frequently prescribed antibacterial agents were imidazoles (metronidazole). (28.4%). followed by cephalosporins (21.7%). Aminoglycosides and penicillins followed with 14.6% each and fluoroquinolones (14.1%).

There were 232 (55.4%) prescriptions for therapeutic indications and 187 (44.6%) for prophylaxis; with 122 (29.1%) for surgical prophylaxis and 65 (15.5%) for medical.

Table 4.4: Pattern of prescriptions by class of antibacterial agent, route of administration, indications and nature of treatment.

Variable	Frequency (n)	Percentage (%)
Antibacterial Class		
Imidazoles	119	28.4
Cephalosporins	91	21.7
Aminoglycosides	61	14.6
Penicillins	61	14.6
Fluoroquinolones	59	14.1
Combination antibacterials *	19	4.5
Others	9	2.2
Route of Administration		
Parenteral	310	74.0
Oral	109	26.0
Indications for therapy		
Therapeutic [n=232]		
Community-Acquired Infection (CAI)	231	55.1
Healthcare-Associated Infection (HCAI)	1	0.2
Prophylactic [n=187]		
Medical Prophylaxis (MP)	65	15.5
Surgical Prophylaxis (SP)	122	29.1
Nature of treatment		
Empirical	352	84.0
Targeted	67	16.0

* These included amoxycillin-clavulanate and trimethoprim-sulphamethoxazole.

4.3 Appropriateness of Antimicrobial Prescriptions

Table 4.5 shows that the reason for prescription and stop or review date were documented at the start of treatment in 410 (97.9%) and 226 (53.9%) of the antibacterial prescriptions (AMPs), respectively. Support of antibacterial susceptibility testing (AST) was present in 49 (11.7%). Only 20 (4.8%) prescriptions met all three indicators. Thus, inappropriate prescriptions were observed in 399 (95.2%) prescriptions (Table 4.6).

Other indicators were unit dose, in 408 (97.3%) documented and dosage frequency and route of administration each documented in all prescriptions. It was also observed that 174 (92.1%) in-patients were properly identified by name, hospital number, age, gender and address in the case notes. At least one of these patient's identifiers was absent in 15 (7.9%) in-patients.

Table 4.5: Quality indicators used for assessing appropriateness of antimicrobial prescriptions for in-patients in hospitals, Yenagoa, May 2018.

Quality indicators for prescribing	**Frequency** N=419 (100%)
Reason for prescription was documented at start of treatment	410 (97.9%)
Stop or review date was documented at start of treatment	226 (53.9%)
Treatment supported by antibacterial susceptibility testing (AST)	49 (11.7%)

Table 4.6: Appropriateness of specific antibacterial prescriptions for in-patients in hospitals, Yenagoa, May 2018.

Antibacterial Agents	Appropriate 20 (4.8%)	Inappropriate 399 (95.2%)	Total 419 (100%)
Metronidazole	5	115	119
Ceftriaxone	3	69	72
Gentamicin	1	56	57
Ciprofloxacin	7	51	58
Amoxycillin	2	28	30
Ampiclox	1	25	26
Amoxycillin-Clavulanate	1	17	18
Others	0	39	39

4.4 Factors Associated with Inappropriate Antimicrobial Prescriptions

The indications for treatment and nature of treatment have an association with appropriateness of antimicrobial prescriptions (AMP) as shown in Table 4.7. Inappropriate prescriptions are five times more likely to occur with prophylactic treatments than with therapeutic. Likewise empirical treatments are more likely to produce inappropriate prescriptions than targeted ones. The relationship is statistically significant in both instances.

Table 4.7: Association between variables and appropriateness of antimicrobial prescriptions for in-patients in hospitals, Yenagoa, May 2018.

Independent Variables	Appropriate N=20 (4.8%)	Inappropriate N=399 (95.2%)	Total	Odds Ratio	95% Confidence Interval	P Value
Facility Type						
Public	7	193	200	0.5747	0.2246 - 1.4707	0.1742
Private	13	206	219			
Gender						
Male	7	150	157	0.8938	0.3488 - 2.2904	0.5084
Female	13	249	262			
Age Group						
0 - 14 years	6	147	153	0.7347	0.2764 - 1.9532	0.358
≥ 15 years	14	252	266			
Route of Administration						
Parenteral	11	290	301	0.4594	0.1853 - 1.1391	0.0758
Oral	9	109	118			
Indications						
Therapeutic	17	212	229	4.9984	1.4421 - 17.3254	0.0038 *
Prophylactic	3	187	190			
Nature of Treatment						
Empirical	5	345	350	0.0522	0.0182 - 0.1494	0.0000 *
Targeted	15	54	69			

* Statistically significant associations

The identified associations were subjected to logistic regression analysis. Only the intravenous routes of administration and public healthcare facilities were found to be determinants of inappropriate AMP. The odds of getting an appropriate prescription was found to reduce with the intravenous route of administration (OR = 0.50; 95% CI: 0.26 – 0.98; pValue – 0.045) is compared to oral (the reference category). The same occurs in public facilities (OR = 2 .27; 95% CI: 1.11 – 4.64; pValue, 0.025) compared to the private facilities (reference category). Age groups, gender, indications were not significant on logistic regression.

Table 4.8: Logistic regression showing two determinants of inappropriate antimicrobial prescribing

Independent variable – reference	Bivariate Analysis			Multivariate Analysis		
	B	OR (95% CI)	pValue	B	OR (95% CI)	pValue
Age Group – ≥ 45 years						
< 1 month	17.25	≈ ∞ (0 - ∞)	0.999	-24.41	0.00 (0 - ∞)	0.996
1 - 59 months	19.28	≈ ∞ (0 - ∞)	0.998	-22.96	0.00 (0 - ∞)	0.997
5 - 14 years	19.01	≈ ∞ (0 - ∞)	0.998	-23.05	0.00 (0 - ∞)	0.997
15 - 34 years	18.87	≈ ∞ (0 - ∞)	0.998	-2.21	0.11 (0.01 – 3.67)	0.217
35 - 44	19.43	≈ ∞ (0 - ∞)	0.998	-0.90	0.41 (0.04 – 4.32)	0.455
Gender – Male						
Female	0.11	1.12 (0.61 – 2.04)	0.719	-0.19	0.82 (0.31 – 2.17)	0.698
Route of Administration – Oral						
Intramuscular	0.66	1.93 (0.87 – 4.26)	0.105	0.47	1.61 (0.66 – 3.92)	0.296
Intravenous	-0.69	0.50 (0.26 – 0.98)	0.045*	-0.53	0.69 (0.28 – 1.25)	0.169
Indications – Surgical Prophylaxis						
CAI	19.35	≈ ∞ (0 - ∞)	0.996	19.37	∞ (0 - ∞)	0.996
HAI	0.00	1.00 (0 - ∞)	1.000	0.56	1.76 (0 - ∞)	1.000
Medical Prophylaxis	18.61	≈ ∞ (0 - ∞)	0.996	18.60	∞ (0 - ∞)	0.996
Facility Type – Private						
Public	0.82	2.27 (1.11 – 4.64)	0.025*	0.76	2.14 (0.98 – 4.68)	0.058
Constant				-16.96	0.00	0.999

CAI=Community Acquired Infection; HAI=Hospital Acquired infection

4.6 The Key Informant Interviews (KII)

4.6.1 Characteristics of Respondents

All eighteen key informants interviewed were males; 11 medical doctors (clinicians) in the hospitals surveyed, one AGPMPN official and six management level staff in the State Ministry of Health, Hospitals Management Board and AGPMPN. All respondents have been in their respective professions for at least three years, with 16 (89%) of them having served for over 10 years. Each of them has some clinical experience handling in-patients but only the 11 clinicians do so daily. Each interview lasted 15 - 25 minutes.

4.6.2 Perception of the Prevalence of Antimicrobial Prescription and Resistance

All respondents expected a high prevalence of antimicrobial prescription (AMP) ranging from 50% to 80% for hospital in-patients Yenagoa; 14 (77.8%) respondents expected a point prevalence of AMP of at least 70%. Their reasons for this estimate were similar — *"... infectious disease is the commonest reason for hospital in-patient care".*

All respondents have managed or heard of a suspected or confirmed case of AMR in the past six months. Ten clinicians and five other (88.9%) respondents have experienced one or more suspected cases of antimicrobial resistance (AMR) in the past three months; three in the past one week. There is no routine surveillance report on AMR in Yenagoa or Bayelsa State. Confirmation of AMR is usually done by relating patient's clinical progress with on-going treatment, microbiological testing, and/or change of the antimicrobial agents that have poor clinical outcomes. The microbiological test done is microscopy, culture and sensitivity (MCS), which only one respondent referred to it as antibiotic sensitivity testing (AST). This is not readily available due to logistic problems and costs to the patient. One doctor said,

"There are many logistic challenges, between laboratory request, collection of specimen and receipt of results, especially in this hospital where our laboratory space is too small. We can't cater for additional high risk tests such as cultures. So, we send patients or their specimens to private labs. Some of our state hospitals are even worse. No functional lab at all".

A respondent said,

"We usually manage AMR by simply changing the drug to a 'higher agent' and the patients usually get better. Sometimes we just can't wait for sampling or testing".

Two others said,

"I only insist on doing MCS when the patient's presentation is chronic, treatment is failing or I have few drug options to change to ... especially if funding is a major limitation for the patient".

All respondents perceive AMR to be a major public health problem in the State. They also believe that the prevalence and pattern of antimicrobial prescription or use is affecting the AMR patterns. Though not much has been known, they estimated the burden of AMR to be high and antimicrobial prescription prevalence to be even higher in Yenagoa. Three (16.7%) of them think AMR threatens clinical practice and needs urgent solutions and feared a day when all drugs have failed. One respondent said,

"I think that everybody, even laymen know that antibiotics sometimes do not work. Many drugs are failing but nobody has really put up a serious effort to estimate the problem and address it. We need new drugs urgently because hmm, [pause] I'm afraid of the future of our orthodox medicine ".

Another said,

"I wonder what we would do without antibiotics of if there is no longer an effective antibiotic to treat infections. If the way we use these drugs is worsening it then we need to come together and do something fast before we lose all".

4.6.3 Knowledge of Antimicrobial Stewardship and Appropriate Prescribing

Eleven (61%) respondents have heard about Antimicrobial Stewardship (AMS) and described it similarly as *"measures put in place to control and ensure correct prescribing, dispensing or use of antimicrobial drugs"*. A clinician, who had never heard of AMS, on attempting to describe it, also gave a similar answer. However, none could list its principles or components without a prompt. In response to prompts, they gave *'Yes'* or *'No'* responses to fourteen listed antimicrobial stewardship principles (Figure 4.1). There was 100% agreement from all respondents on only five stewardship principles which had to do with AMP. Citing prevailing practices, an SMOH respondent said,

"These principles you listed are all scientifically sound but they are not all practicable in a low resource environment like Yenagoa. My responses are based on practicability here. Hospitals are still under-equipped and under-staffed and we lack funding for in-service training, supervision and monitoring of doctors and nurses who manage the in-patients. Most of us don't even know about antibiotic stewardship, not to talk of the principles and the roles we must play. I hope your study stirs up something in this line".

There are no AMP guidelines or policy document available in the State. Prescriptions are generally guided by factors such as drug formularies (94% of respondents), personal experience of what works (94%), consensus from fellow professionals (83%), update courses (83%), previous training (67%) and demand from patients (44%). None of them, however, considered patients' demand a good reason to prescribe an antimicrobial agent but think that it occurs.

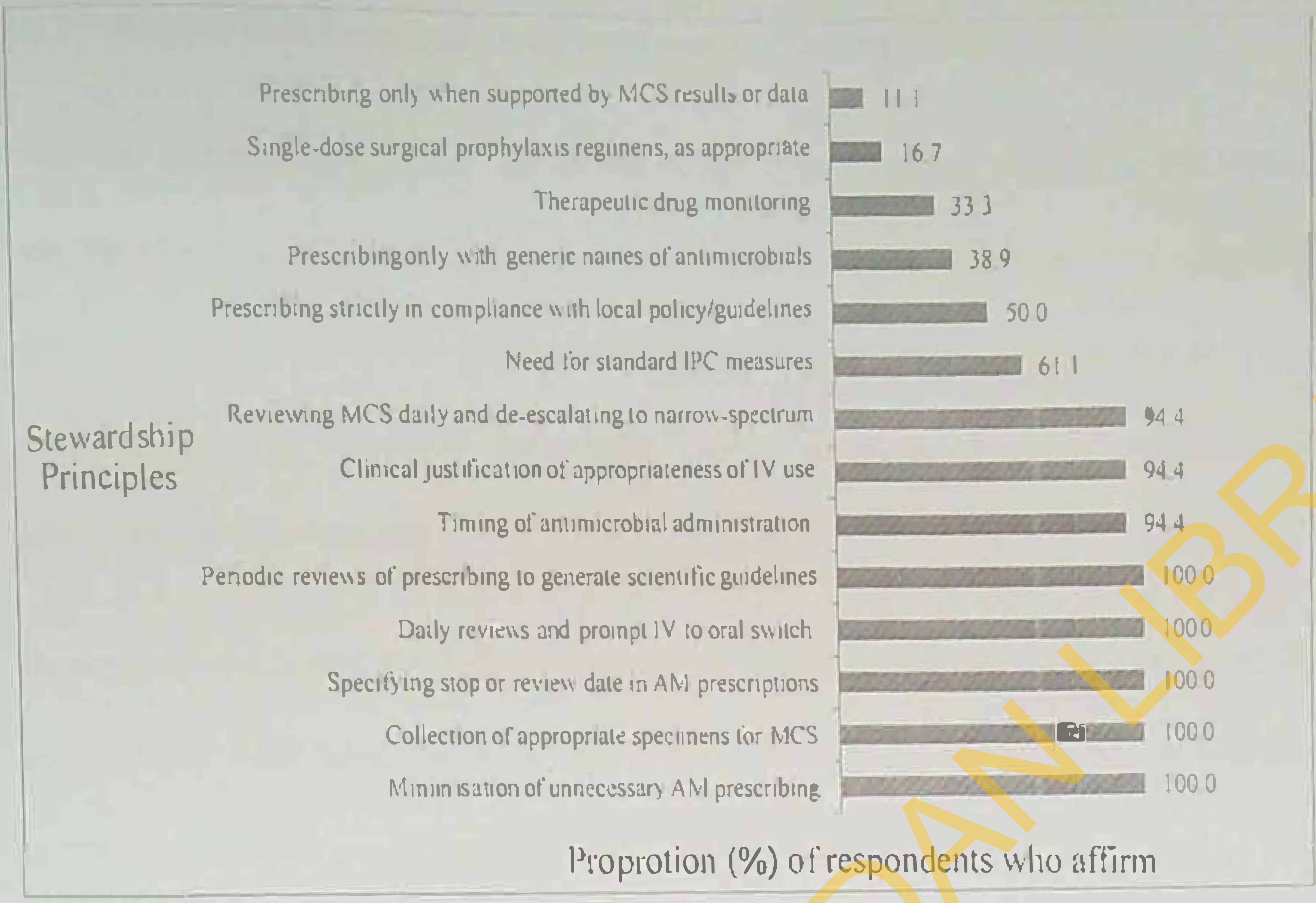

Figure 4.1: Key informants' knowledge of antimicrobial stewardship principles in Yenagoa - May 2018.

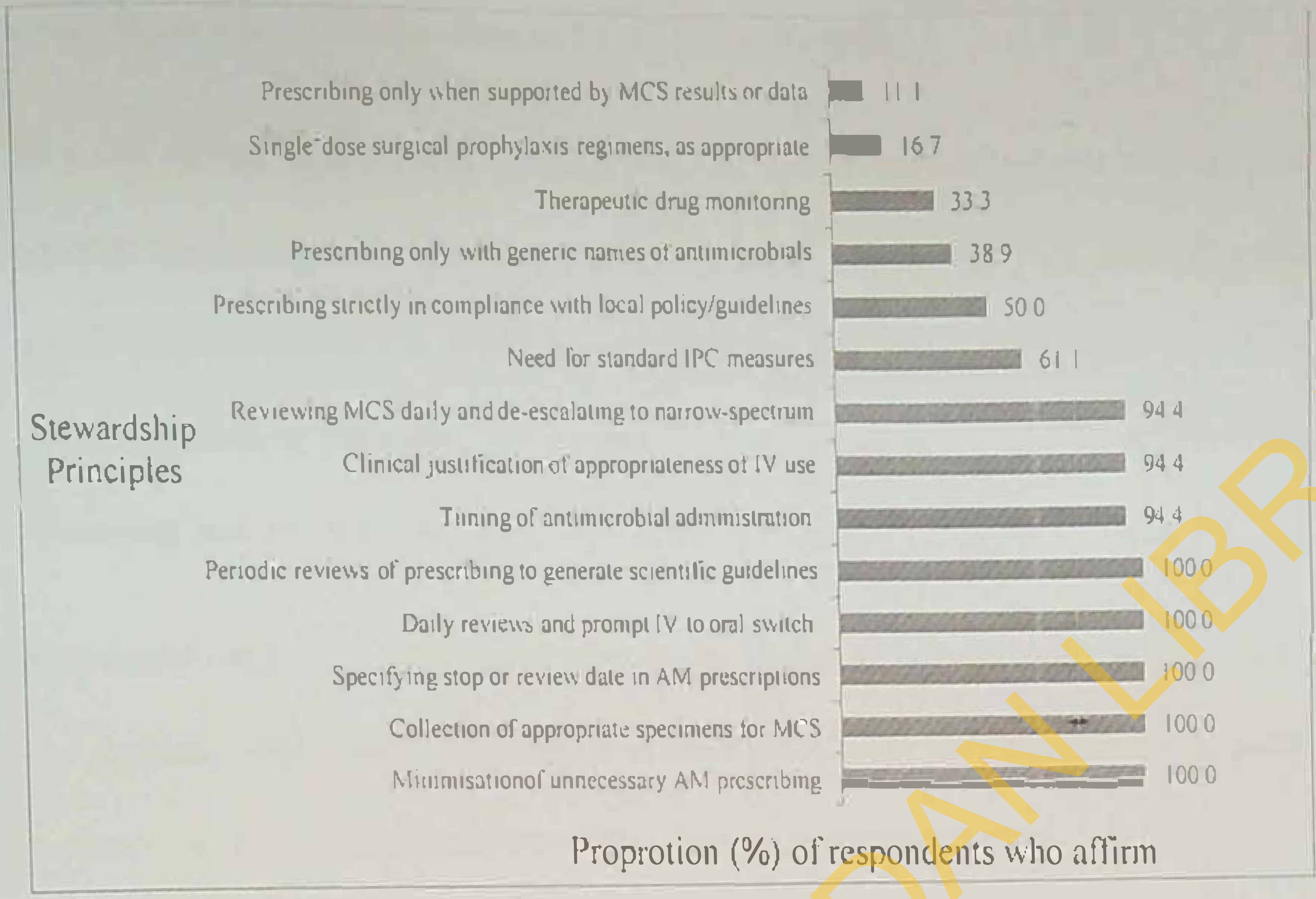

Figure 4.1: Key informants' knowledge of antimicrobial stewardship principles in Yenagoa - May 2018.

4.6.4 Respondents Perspectives on Intervention Targets

They also offered strategic ways governments can standardize and improve antimicrobial prescriptions in the State. The top five are shown in Figure 4.2. They also suggested specific ways researchers or research institutions can help ensure this (Figure 4.3). They were unanimous in requesting for periodic update courses or training on antimicrobial prescribing and stewardship.

Respondents requested the Federal Ministry of Health or relevant agencies to produce and circulate AMP policy or guidelines to states and LGAs. They expressed willingness to comply with such guidelines if available. Two respondents requested.

"We need training of medical students and retraining of doctors on this matter to ensure appropriate prescribing". Another requested that *"innovative ways for providing affordable MCS testing should be sought by governments to guide antimicrobial prescribing".*

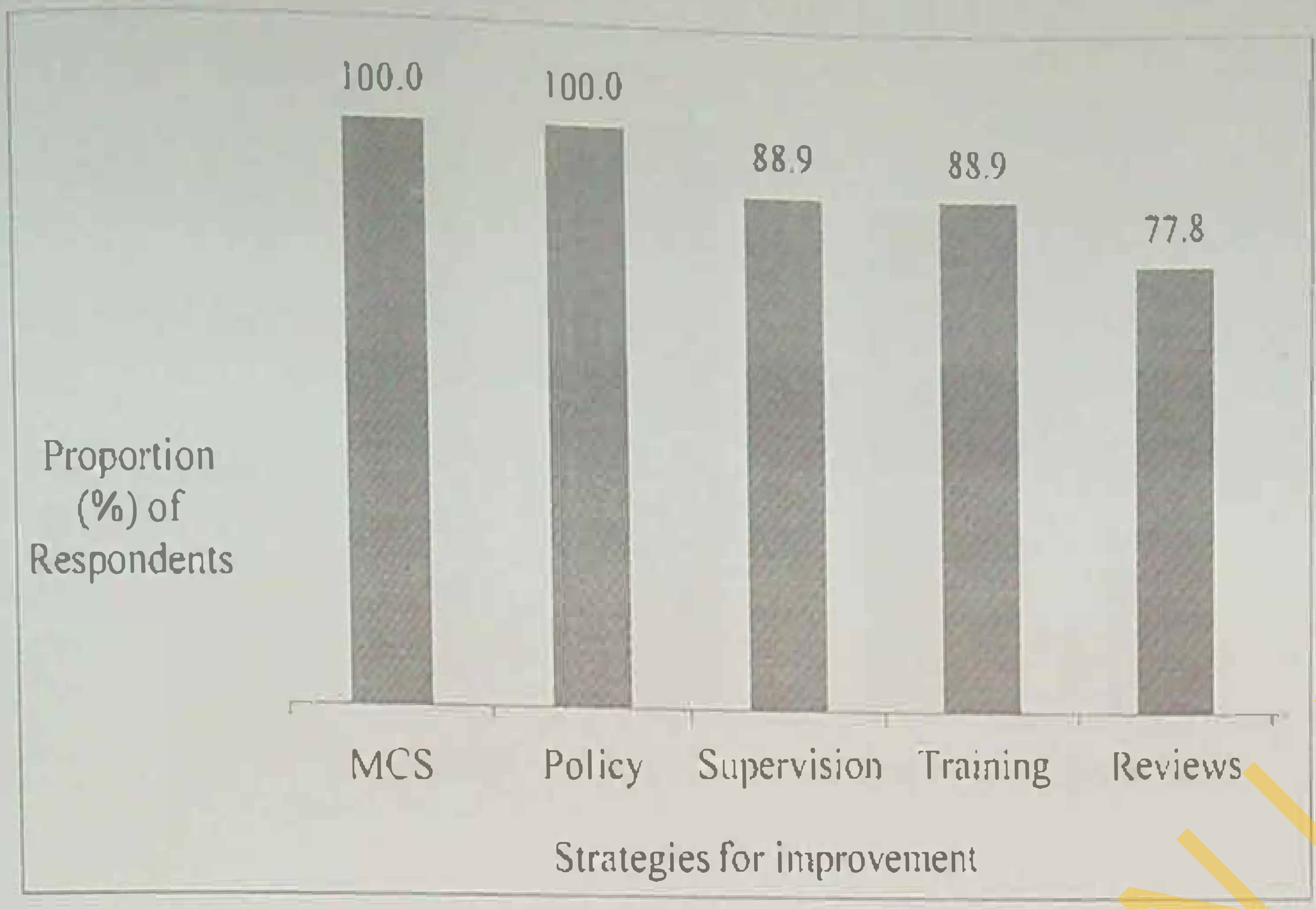

Figure 4.2: Suggested strategies for improving antimicrobial prescriptions in Yenagoa - May 2018.

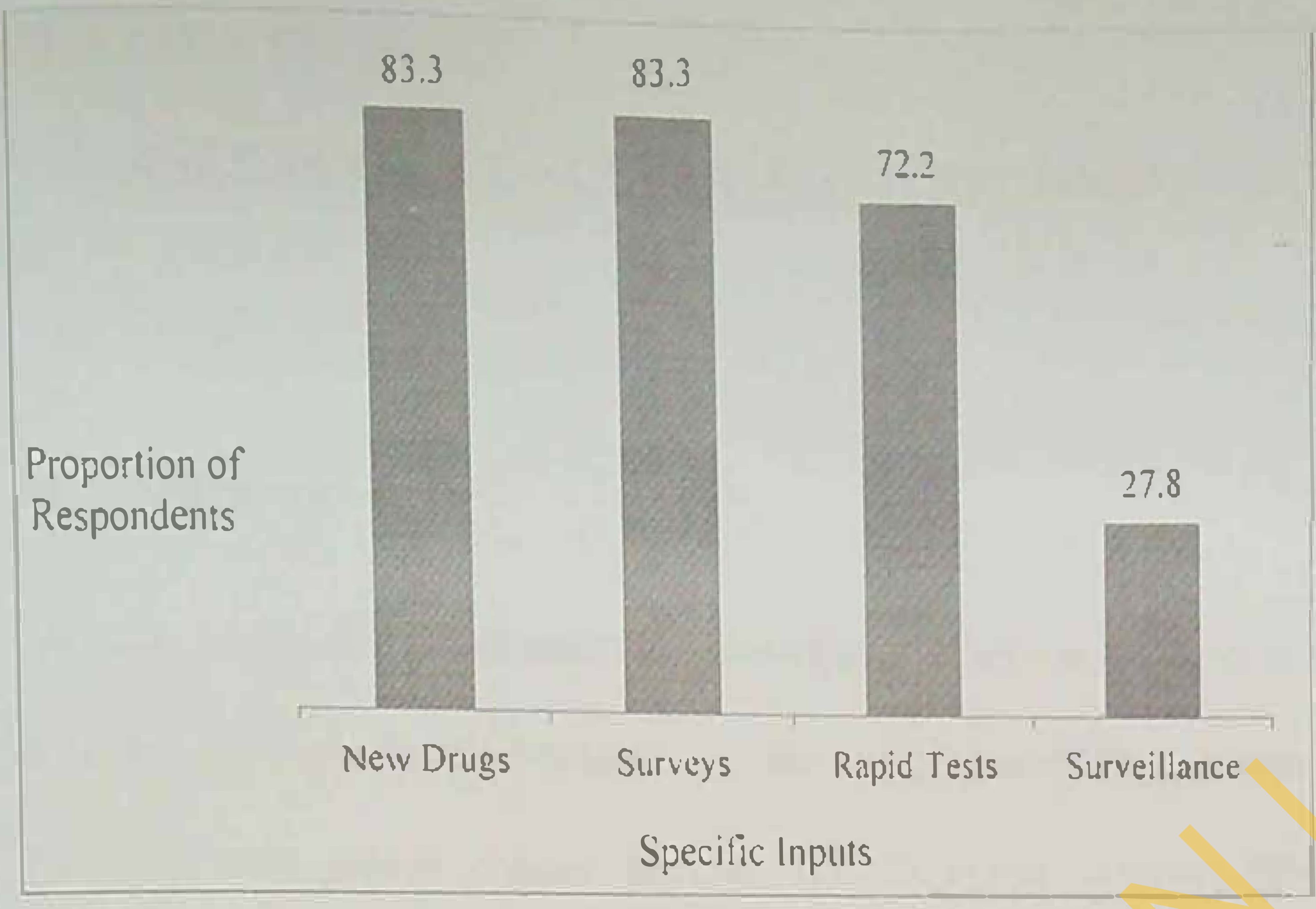

Figure 4.3: Suggested strategies for researchers to improve antimicrobial prescribing in Yenagoa - May 2018.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

The point prevalence of antimicrobial prescription (AMP) in Yenagoa is extremely high at 90.4%. Both the hospital-specific and the overall prevalence are unacceptably high. This is of even greater concern because high prevalence increases risk of developing antimicrobial resistance (AMR) (Llor et al., 2014), (Mendelson, 2015). Studies reviewed showed much lower prevalence ranging from an average of 36.7% in children worldwide (Versporten et al., 2016), to 46% in Australia (Osowicki et al., 2014), 59% in Egypt (Talaat et al., 2014) and 55.6% in Owerri, a Nigeria state capital like Yenagoa (Nsofor et al., 2016). Since antibacterial overuse is a major determinant in the evolution of AMR (Aldeyab et al., 2011) it is logical to expect AMR in Yenagoa and Bayelsa State to increase in concordance with the prevalence of antibacterial use. The hospital-specific prevalence is also generally high with no outliers. Other studies which stratified the prevalence by department type also did not have such a high prevalence (Lee et al., 2015), (Oduyebo et al., 2017), (Cusini et al., 2010) except in intensive care units where up to 100% prevalence could be observed (Xie et al., 2015), (Abdu-Aguye et al., 2016).

This point prevalence suggests that at any point in time about 90% of in-patients in Yenagoa hospitals will be on an antimicrobial agent. There was little variation between public and private hospitals. The low rate (16%) of antibiotic sensitivity testing (AST) and absence of AMP policy or guidelines are possible reasons for this high AMP prevalence.

The KII respondents interviewed prior to completion of data collation expected a high AMP prevalence, but not this high. This under-estimation despite knowledge of AMR may limit their response to the problem. Despite the possibility of overuse or inappropriate prescribing, they generally attributed it infectious disease burden or risk.

Neonates, under-fives, older children, adults and the aged are often in-patients in these hospitals. There was no gender or age group association with AMP as both males and females of all age groups had similar probability of receiving an antimicrobial. This is similar to other Nigerian studies (Oduyebo et al., 2017), (Nsofor et al., 2016). With such a high prevalence it is not unusual to find that almost all patients in Yenagoa are likely to receive AMP once admitted. It also showed a routine to commence antibacterial therapy for any neonate admitted in these hospitals.

There was a wide range of diagnoses among in-patients but these were either primary infections, secondary infections or adjudged risk of infections. In these three scenarios, an antimicrobial agent (AM) was invariably prescribed for most patients. Again the absence of AST and guidelines could be reasons. In addition, KII respondents attributed this high AMP prevalence to the high infectious disease burden and risk for infections. They considered it always indicated to use broad spectrum antibacterials to protect surgical in-patients in the peri-operative and post-operative periods.

The most frequent indication for AMP was community acquired infections (55.1%). This is expected in Bayelsa State and is similar to other studies referred to in NCDC's 2017 AMR situation analysis (NCDC, 2017). It's also similar to other studies in Canada (Lee et al., 2015), Australia (Osowicki et al., 2014) and Egypt (Talaat et al., 2014). Hospital-acquired infections were almost never documented probably due to lack of epidemiological and laboratory diagnostic support. Surgical prophylaxis was more than twice as common as medical prophylaxis. Single dose surgical prophylaxis was not observed.

Narrow spectrum antibacterial use was not practiced. Only broad spectrum antibacterials were widely used even where AST was done. Although broad spectrum antibacterial use is common in Nigeria (Abdu-Aguye et al., 2016), (Oduyebo et al., 2017), narrow spectrum antibacterial use occurs frequently elsewhere following de-escalation (Versporten et al., 2016). De-escalation refers to a change of antimicrobial regimen from a broad spectrum agent to a narrow pathogen-specific agent, usually guided by AST results. Use of only broad spectrum AM has not proven to have better efficacy over narrow spectrum and it poses a higher risk for development of AMR through pressured selection of resistance genes (Dryden et al., 2009), (Goossens, 2005). Overuse of antibacterials and the risk of poly-pharmacy are high because at least two drugs were prescribed per patient.

Metronidazole was by far the most prescribed (28.3%), followed by Ceftriaxone, Ciprofloxacin and Gentamicin. The parenteral route of AM administration was also used most frequently. Most in-patients (74%) were on parenteral medications. This appears to be the trend in African hospitals where most in-patients get similar drugs and by the parenteral route (Talaat et al., 2014), (Nsofor et al., 2016), (Oduyebo et al., 2017).

Measuring appropriateness of AMP often requires assessing compliance with policy or guidelines (Cusini et al., 2010) but this could not be done in Yenagoa as no such document exists there. Quality indicators presented by Gyssens and used in some studies were considered and three of these used (page 25). Table 4.7 shows that the proportion of prescriptions that met each of these indicators were considerable while Table 4.8 indicates that their intersection (prescriptions having all indicators) was abysmally small. At a proportion of 95.2%, inappropriate prescriptions were overwhelmingly and unacceptable high. A closer look at this showed that microbiological testing contributed heavily to this.

With such a high proportion of inappropriate prescriptions it is necessary to describe factors associated with it. The quantitative study revealed few factors associated with inappropriate AMP. These included the route of administration and the facility type. Less significant associations were indications for treatment and nature of therapy which may be due to effect modification or confounding. Prescriptions given by intravenous route were twice more likely to be inappropriate when compared with the oral route. This may mean that clinicians are more knowledgeable and competent with oral formulations than parenteral ones.

The interviews also suggested that additional physician-specific factors are associated with the prevalence, patterns and appropriateness of AMP. These factors include their perception and knowledge of AMP and AMR, their years in service, availability of policy and antimicrobial stewardship (AMS) programmes, among others (Livorsi et al., 2015). A study of these may have interesting findings. The absence of a circulated policy is a notable gap that was iterated by respondents who agreed that it is an important yardstick for measuring prescribing practice. Indeed, it is important for assessing appropriateness of AMP. There was low level of awareness and non-availability of AMP policy or guidelines, low awareness and knowledge of AMR and sensitivity patterns, lack of shared data on AMR patterns in Bayelsa State, low awareness and absence of AMS programmes in the hospitals or SMOH and inadequate training updates on AMP and AMR for medical doctors (the prescribers).

Antimicrobials must be used in modern medicine but their use must be rational, indicated and appropriate, in all circumstances. This is even more imperative since no new drugs have been approved for the past two decades or so and few are in the pipeline (Cisneros et al., 2014), . Preventing the already rapid development and spread of AMR, extending the lifespan and usefulness of these 'rare weapons', reducing hospital stay and costs as well as improving patients' outcomes depend on rational use of existing agents. Having identified the problems of excessive prescribing, overuse of broad-spectrum antimicrobials and widespread inappropriate prescribing, we are well on track to identify targets for high-impact interventions.

Since previous research suggest more of prescriber-related factors (Howard et al., 2014), (Livorsi et al., 2015), (Skodvin et al., 2015) our interventions may have to target prescriber sensitization and education as well as provision of AMP policies, protocols or guidelines, surveillance and supervision, as well as audits. All of these can be contained in an AMS programme.

The provision and circulation of an AMP protocol (policy or guideline) is a gaping need in Bayelsa State and I consider it a low hanging fruit that must be quickly exploited to improve the current AMP prevalence and pattern. This should be closely accompanied by sensitization campaigns and training for its compliance. It promises high yields of expected outcomes because it is already being requested for by the local experts who expressly acknowledge its absence as a gap. Facility-level Antimicrobial Stewardship Programmes (ASP) should be considered too in Bayelsa State.

The lack of diagnostic support is another target to focus on because, if in place, it will guide clinical diagnosis, choice of AM agent and approaches to their administration. Governments, regulatory bodies and training institutions must consider ways of improving physicians' access to laboratory testing and data.

5.2 Limitations of this Study

Prescribers' knowledge and perception of this subject may be associated factors for prescribing which cannot be fully assessed with this methodology. Incomplete records in patients' case notes also limited the number of variables, especially socio-demographic characteristics that could have been collated. Information bias may still exist to some extent for the same reason. This study may be generalised for Bayelsa State but not for Nigeria.

5.3 Conclusion

A 90% prevalence of antimicrobial prescriptions (AMP) in Yenagoa is extremely high. There is no significant difference in private or public hospitals. This high prevalence of antimicrobial prescribing was influenced by the absence of AMP policy or guidelines and high burden of infectious diseases in Yenagoa, Bayelsa State.

Notable AMP patterns observed include: A wide range of infectious diseases presumptively diagnosed; Only broad spectrum antimicrobials were used; Most medications were administered parenterally; Average number of antimicrobials per patient was three and slightly higher in males and private hospitals; All neonates admitted in Yenagoa hospitals are likely to receive an antimicrobial drug; The most frequent indications for therapy were therapeutic (although prophylaxis was common); Treatment was mostly empirical in nature (rather than targeted); few prescriptions (15.6%) were supported by an AST; Antimicrobials are generally prescribed inappropriately in Yenagoa with private hospitals showing a better likelihood of appropriate prescriptions; Age and gender had no association with appropriateness of AMP; The most significant determinants of inappropriate AMP were intravenous routes of administration and therapeutic indications while public facilities and nature of therapy were less strongly associated; An AMP policy is needed to guide prescriptions and assess appropriateness.

5.4 Recommendations

To reduce the risk of unnecessary, excessive and inappropriate prescriptions:

1. Antimicrobial prescription policy or guidelines should be provided for use by clinicians in Yenagoa and Bayelsa State.
2. Training and supportive supervision of clinicians on antimicrobial prescription policy and other stewardship principles should be provided by the SMOH periodically
3. Broad spectrum antimicrobial prescriptions should be given with caution and only in accordance to policy or guidelines.
4. In-patients with suspected infections should be adequately evaluated and monitored by the clinical teams using microbiological testing as a necessary guide for antimicrobial prescriptions.
5. The oral route of administration of antimicrobials should be utilized more often while ensuring careful clinical justification for parenteral antibacterial use.
6. Empirical treatment of suspected infections should be minimised or avoided.
7. Repeated point prevalence surveys should be conducted routinely in Bayelsa State to assess and monitor trends in the prevalence and patterns of antibacterial prescriptions.
8. Prophylactic use of antibacterials (surgical prophylaxis) should be given only after expert assessment of need, and pattern of use should be guideline compliant.

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APPENDICES

Appendix 1: Ethical Approval for this Study

GOVERNMENT OF BAYELSA STATE OF NIGERIA

MINISTRY OF HEALTH

Fax: 089 - 490257 18th April, 2018
Telephone: 089-490257 [illegible]

BAYELSA STATE HEALTH RESEARCH ETHICS COMMITTEE (BSHREC)
"NOTICE OF FULL APPROVAL"

Re: POINT PREVALENCE SURVEY OF ANTIMICROBIAL PRESCRIBING FOR IN-PATIENTS IN YENAGOA, BAYELSA STATE

To: Dr Bio Bela Abaye
Nigeria Field Epidemiology and
Laboratory Training Programme (NFELTP)
50 Haile Selassie Street, Asokoro, Abuja

Date of receipt of valid application: 18th April 2018
Date of final determination of research for approval: 2nd May, 2018

The Bayelsa State Health Research Ethics Committee (BSHREC), in pursuit of her statutory function has considered your application and grants you a *Full Ethical* Approval to conduct research on *"point prevalence survey of antimicrobial prescribing for in-patients in Yenagoa, Bayelsa State."* The study is approved according to established standards and approved guidelines.

The effective date of this approval is today, 2nd May, 2018 and expires in 12 months from this date. You are advised to inform the BSHREC of any reason for delay in starting and/or completing the research project within the time frame assigned, in order that it may be accommodated. Note also that no participant accrual or activity relating to this research may be conducted outside of the approved date. All informed consent forms used in this study must be within the BSHREC approved duration of the study.

However, in case of Multi-Year Research, effort must be made to submit your annual report to the BSHREC early to obtain renewal of your approval to avoid [illegible].

The Bayelsa State Health Research Ethics Committee (BSHREC) wishes to request that you comply with all [illegible] guidelines, rules, regulations and the tenets of the code of conduct of research ethics. *You are further requested to submit a copy of the final report of your research whenever it is ready to the BSHREC.* No changes are permitted in this research without prior approval by the BSHREC. The BSHREC reserves the right to conduct compliance visits to your research site without prior notification.

Congratulations!!!

Please accept my best wishes.

[illegible]
Assistant Director, Research
Secretary, BSHREC

Administrative Headquarters: Secretariat Complex P.M.B. 24 Yenagoa, Tel: 089 490358, 490458, Fax: 089-490257

Appendix 2:

Hospital Types and Code Names

Hospital Types	Survey Codes
Public (Secondary)	HF01
	HF02
	HF03
Private	HF04
	HF05
	HF06
	HF07
	HF08
	HF09
	HF10
	HF11

Appendix 3:

Ward Form

Date of Survey *(dd/mm/yyyy)*				
Data Collector's Name				
Data Collector's ID				
Hospital Name				
Hospital Type	Primary	Secondary	Tertiary	Private
Ward Name				
Department Type	Medicine		Surgery	
Mixed Department	Yes	No		
Activity in Mixed Department	Medicine	Surgery	Intensive Care	
Number of Beds in Ward				
Number of Admitted Patients				
Number of Patients on Antimicrobials				

Example of Wards where data could be collected: MW, FW, PW, SCBU, PNW, AandE

Appendix 3. Patient's Data Form (Numerator Data - for in-patients who received prescription of antimicrobials)

Point Prevalence Survey of Antibiotic Prescribing in Yenagoa, Bayelsa State	Hospital Name:	Principal Investigator: Dr. Bio Belu Abaye	Data Collector's Name:	Data Collector's ID:	Date: Time:

PATIENT'S DATA FORM

Ward Name	Bed Number	Patient's ID	Survey ID	Gender	Age (*in years, if ≥5years*)	Age (*in months, if 1-59months*)	Age (*in days, if ≤28days*)
Weight (in Kg, if ≥6months old)	Weight (in Grams, if ≤6months old)	Height (*in cm, if applicable*)	Height (*in feet, if applicable*)				
Antimicrobial Agent(s) (Generic Name) - 1	Route of Administration	Unit Dose	Number of Doses per 24hours	Indication *[CAI - HAI - SP - MP]*	Diagnosis	Nature of treatment *[E=Empirical / T=Targeted]*	Reason for prescription documented at the start of treatment? YES / NO
Stop or review date documented? YES / NO	Treatment complies with local policy or guidelines? YES / NO	Treatment is supported by microbiology data or testing? *(if Targeted)* YES / NO	Patient is due for discharge within 24 hours? YES / NO	Any drug allergies noted at the start of treatment? YES / NO			
Antimicrobial Agent(s) (Generic Name) - 2	Route of Administration	Unit Dose	Number of Doses per 24hours	Indication *[CAI - HAI - SP - MP]*	Diagnosis	Nature of treatment *[E=Empirical / T=Targeted]*	Reason for prescription documented at the start of treatment? YES / NO
Stop or review date documented? YES / NO	Treatment complies with local policy or guidelines? YES / NO	Treatment is supported by microbiology data or testing? *(if Targeted)* YES / NO	Patient is due for discharge within 24 hours? YES / NO	Any drug allergies noted at the start of treatment? YES / NO			
Antimicrobial Agent(s) (Generic Name) - 3	Route of Administration	Unit Dose	Number of Doses per 24hours	Indication *[CAI - HAI - SP - MP]*	Diagnosis	Nature of treatment *[E=Empirical / T=Targeted]*	Reason for prescription documented at the start of treatment? YES / NO
Stop or review date documented? YES / NO	Treatment complies with local policy or guidelines? YES / NO	Treatment is supported by microbiology data or testing? *(if Targeted)* YES / NO	Patient is due for discharge within 24 hours? YES / NO	Any drug allergies noted at the start of treatment? YES / NO			
Antimicrobial Agent(s) (Generic Name) - 4	Route of Administration	Unit Dose	Number of Doses per 24hours	Indication *[CAI - HAI - SP - MP]*	Diagnosis	Nature of treatment *[E=Empirical / T=Targeted]*	Reason for prescription documented at the start of treatment? YES / NO
Stop or review date documented? YES / NO	Treatment complies with local policy or guidelines? YES / NO	Treatment is supported by microbiology data or testing? *(if Targeted)* YES / NO	Patient is due for discharge within 24 hours? YES / NO	Any drug allergies noted at the start of treatment? YES / NO			

Point Prevalence Survey of Antibiotic Prescribing in Yenagoa, Bayelsa State	Hospital Name:	Principal Investigator: Dr. Bio Belu Abaye	Data Collector's Name:	Data Collector's ID:	Date: Time:

PATIENT'S DATA FORM

Ward Name	Bed Number	Patient's ID	Survey ID	Gender	Age *(in years, if ≥5years)*	Age *(in months, if 1-59months)*	Age *(in days, if ≤28days)*
Weight (in kg, if ≥6months old)	Weight (in Grams, if <6months old)	Height *(in cm, if applicable)*	Height *(in feet, if applicable)*				
Antimicrobial Agent(s) (Generic Name) - 5	Route of Administration	Unit Dose	Number of Doses per 24hours	Indication *[CAI - HAI - SP - MP]*	Diagnosis	Nature of treatment *[E=Empirical / T=Targeted]*	Reason for prescription documented at the start of treatment? YES / NO
Stop or review date documented? YES / NO	Treatment complies with local policy or guidelines? YES / NO	Treatment is supported by microbiology data or testing? *(if Targeted)* YES / NO	Patient is due for discharge within 24 hours? YES / NO	Any drug allergies noted at the start of treatment? YES / NO			
Antimicrobial Agent(s) (Generic Name) - 6	Route of Administration	Unit Dose	Number of Doses per 24hours	Indication *[CAI - HAI - SP - MP]*	Diagnosis	Nature of treatment *[E=Empirical / T=Targeted]*	Reason for prescription documented at the start of treatment? YES / NO
Stop or review date documented? YES / NO	Treatment complies with local policy or guidelines? YES / NO	Treatment is supported by microbiology data or testing? *(if Targeted)* YES / NO	Patient is due for discharge within 24 hours? YES / NO	Any drug allergies noted at the start of treatment? YES / NO			
Antimicrobial Agent(s) (Generic Name) - 7	Route of Administration	Unit Dose	Number of Doses per 24hours	Indication *[CAI - HAI - SP - MP]*	Diagnosis	Nature of treatment *[E=Empirical / T=Targeted]*	Reason for prescription documented at the start of treatment? YES / NO
Stop or review date documented? YES / NO	Treatment complies with local policy or guidelines? YES / NO	Treatment is supported by microbiology data or testing? *(if Targeted)* YES / NO	Patient is due for discharge within 24 hours? YES / NO	Any drug allergies noted at the start of treatment? YES / NO			
Antimicrobial Agent(s) (Generic Name) - 8	Route of Administration	Unit Dose	Number of Doses per 24hours	Indication *[CAI - HAI - SP - MP]*	Diagnosis	Nature of treatment *[E=Empirical / T=Targeted]*	Reason for prescription documented at the start of treatment? YES / NO
Stop or review date documented? YES / NO	Treatment complies with local policy or guidelines? YES / NO	Treatment is supported by microbiology data or testing? *(if Targeted)* YES / NO	Patient is due for discharge within 24 hours? YES / NO	Any drug allergies noted at the start of treatment? YES / NO			

Appendix 5:

Antimicrobial Prescription Prevalence and Patterns for In-Patients in Hospitals, Yenagoa, Bayelsa State.

KII Guide

1. Have you had suspected or confirmed cases of antimicrobial resistance in the past three months?

   a. How did you confirm and manage it?

2. Do you think Antimicrobial Resistance (AMR) is a problem in your facility, city or state?

   a. If Yes, estimate the magnitude in percentage.

   b. Do you think AMR is a clinical or a public health problem in your facility or state?

3. Do you have a written policy or guideline for antimicrobial prescribing?

   a. If Yes, site it and tell me to what extent you think this influences prescribing in your facility.

   b. If No, what informs the pattern of prescribing in your facility?

4. Have you heard about Antimicrobial Stewardship? If Yes, tell me a bit about.

5. Which of these do you consider to be antimicrobial stewardship principles? (Emphasize those you think are practiced routinely in your state)

   a. Minimisation of unnecessary prescribing of antimicrobials;

   b. Timing of antimicrobial administration;

   c. Therapeutic drug monitoring;

   d. Need for standard infection prevention and control precautions;

   e. Collection of appropriate specimens for microscopy, culture and sensitivity;

   f. Intravenous use only in severely ill patients, unable to tolerate oral treatment, or where oral treatment would not guarantee coverage or tissue penetration;

g. Single dose surgical prophylaxis regimens, as appropriate;

h. Prescribing only with generic names of antimicrobials;

i. Specifying stop or review date in prescriptions of antimicrobials;

j. Prescribing strictly in compliance with local policy or guidelines;

k. Prescribing only when supported by microbiology test results or data;

l. Reviewing microbiology results daily and de-escalating to pathogen-directed narrow-spectrum treatment promptly;

m. Reviewing need for intravenous treatment daily and switching to oral route promptly;

n. Periodic clinical reviews of prescribing patterns to generate scientifically sound consensus or guidelines for prescribing;

7. What proportion of in-patients do you estimate would be on antimicrobials at any point in time? (a minimum)

a. Share your experience or reasons for your estimate.

8. Mention ways you think antimicrobial prescribing practices can be standardized, improved or sustained.

9. How do you think research institutions or researchers can help improve antimicrobial prescribing in your facility?

10. Would you like to receive update courses/training on antimicrobial prescribing/stewardship?