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Antibiotic use among hospitalised patients in Sierra Leone: a national point prevalence survey using the WHO survey methodology

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ABSTRACT

Objective Inappropriate use of antibiotics is a major driver of antibiotic resistance. A few studies conducted in Africa have documented that about half of hospitalised patients who receive antibiotics should not have received them. A few hospital-based studies that have been conducted in Sierra Leone have documented a high usage of antibiotics in hospitals. Therefore, we conducted a nationwide point prevalence survey on antibiotic use among hospitalised patients in Sierra Leone.

Design We conducted a hospital-based, cross-sectional survey on the use of antibiotics using the WHO point prevalence survey methodology.

Setting The study was conducted in 26 public and private hospitals that are providing inpatient healthcare services.

Participants All patients admitted to paediatric and adult inpatient wards before or at 08:00 on the survey date were enrolled.

Outcome measures Prevalence of antibiotic use, antibiotics Access, Watch and Reserve (AWaRe) categorisation, indication for antibiotic use prevalence and proportion of bacteria culture done.

Results Of the 1198 patient records reviewed, 883 (73.7%, 95% CI 71.1% to 76.2%) were on antibiotics. Antibiotic use was highest in the paediatric wards (306, 85.7%), followed by medical wards (158, 71.2%), surgical wards (146, 69.5%), mixed wards (97, 68.8%) and lowest in the obstetrics and gynaecology wards (176, 65.7%). The most widely prescribed antibiotics were metronidazole (404, 22.2%), ceftriaxone (373, 20.5%), ampicillin (337, 18.5%), gentamicin (221, 12.1%) and amoxicillin (90, 5.0%). Blood culture was only done for one patient and antibiotic treatments were given empirically. The most common indication for antibiotic use was community-acquired infection (484, 51.9%) followed by surgical prophylaxis (222, 23.8%).

Conclusion There was high usage of antibiotics in hospitals in Sierra Leone as the majority of patients admitted received an antibiotic. This has the potential to increase the burden of antibiotic resistance in the country. We, therefore, recommend the establishment of hospital antimicrobial stewardship programmes according to the WHO core components.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ We used the WHO point prevalence survey (PPS) methodology, and the research team members were trained in this methodology.
⇒ We conducted a 2-day stakeholder engagement for senior hospital managers.
⇒ We were unable to achieve the calculated sample size, this might have reduced the precision of our estimates.
⇒ We did not include the optional variables of the WHO PPS methodology in our study.
⇒ This was a cross-sectional study and hence provides a snapshot of antibiotic use in these hospitals.

INTRODUCTION

Antimicrobial resistance (AMR) is a public health threat that will undo the gains made in modern medicine and public health.[1–3] AMR could potentially result in an economic loss of more than 5% of the gross domestic product in low-income and middle-income countries and more than 10 million deaths annually by 2050.[4] If the necessary steps and proven effective public health interventions are not implemented, the world might be heading towards a post-antibiotic era where these priceless medical tools will be rendered ineffective.[5]

The health and social impacts of AMR have a far-reaching effect in any country as this increases morbidity, mortality and healthcare costs, and negatively impacts economic

growth.[6] Globally, in 2019 alone, nearly 5 million deaths were associated with AMR, and 1.27 million of those deaths were directly attributed to resistant bacterial infections.[7] More alarming is the fact that AMR mortality is higher in low and middle-income countries, especially in sub-Saharan African countries including Sierra Leone.[7 8]

Contributing factors to the development of AMR include inappropriate use of antibiotics, poor laboratory capacity, weak infection prevention and control at healthcare facilities, ineffective water sanitation and hygiene infrastructure, weak legislation to control the sale of antimicrobial drugs, inadequate healthcare worker's education on AMR and low level of community awareness on AMR.[6] Even though there are several contributing factors to AMR, the majority of resistant infections are a result of the inappropriate or unnecessary use of antimicrobial drugs, mainly antibiotics.[9 10]

Antimicrobials have made substantial improvements in clinical medicine and public health.[11] These include antibiotics for treating bacterial infections, antivirals for treating viral infections, antifungals for treating fungal infections and antiparasitic drugs for treating protozoan and helminthic infections.[12] To ensure rational prescribing, the right drug, the right dosage, the right frequency, the right time and the right patient should be considered before the initiation of treatment.[13] The rational prescribing of antimicrobial agents in human, animal and plant health is key in the fight against AMR.[14]

Even though antibiotic resistance occurs naturally as a result of the adaptation of bacteria, the emergence and spread of new resistant strains have been accelerated by the overuse and misuse of antibiotics.[10 15 16] Furthermore, it has been documented that up to 50% of inpatients receive antibiotics unnecessarily.[17 18] Several studies have been conducted in Europe and Africa that have shown a high prevalence of antibiotic use in hospitals. A nationwide point prevalence survey (PPS) that was conducted in Italy among 56 hospitals documented a 44.5% prevalence of antibiotic use.[19] Another study conducted in a tertiary hospital in South East Nigeria documented a 78.2% prevalence of antibiotic use and the majority of the treatments were initiated without culture results.[9]

In Sierra Leone, a few studies have been conducted that evaluated the use of antibiotics in hospitals.[15 20–22] A recent study conducted by Kamara and colleagues[15] documented over 50% prevalence of antibiotic use among suspected and confirmed COVID-19 patients admitted to isolation units and treatment centres. Additionally, the majority of antibiotics prescribed to these patients fell under the 'Watch' group of drugs according to the WHO's Access, Watch and Reserve (AWaRe) categorisation. In 2019, an unpublished PPS conducted in selected hospitals in Sierra Leone documented high usage of antibiotics. However, there has never been a comprehensive nationwide PPS on antibiotic use to give a comprehensive account of the utilisation of antibiotics in hospitals in Sierra Leone.

Therefore, using the WHO PPS methodology, this study aimed to assess the use, indications and classification of antibiotics prescribed to patients admitted to 26 hospitals in Sierra Leone. The specific objectives were to determine the national and facility-level prevalence of antibiotic use among patients admitted to hospitals including (1) to categorise the different antibiotics prescribed according to the WHO AWaRe categorisation, (2) to determine the prevalence of and indications for antibiotic prescriptions and (3) to determine the number of patients with bacteria cultures done before antibiotic prescriptions.

METHODS

Study design

This was a hospital-based, cross-sectional survey of antibiotic use in 26 hospitals in Sierra Leone.

Setting and study population

General setting

Sierra Leone is a country in West Africa that shares borders with Guinea, Liberia and the Atlantic Ocean. The country is divided into 5 regions and 16 districts, and the total population is 7.5 million. The healthcare system is organised into three levels, primary, secondary and tertiary.[23 24] The primary level provides promotive and preventive services; the secondary level provides promotive and curative care including surgical procedures; and the tertiary level provides specialised healthcare services. The country is challenged with a double burden of communicable and non-communicable diseases. However, about 60% of all deaths are a result of communicable diseases.[25] Over the past years, several interventions have been implemented to improve the health outcomes of Sierra Leone with a keen focus on maternal and child health which led to the establishment of the Free Healthcare Initiative for pregnant women, lactating mothers and under-5 children.[26]

Specific setting and study population

The list of the total 65 secondary and tertiary hospitals in the country was provided to the research team by the directorate of policy and planning, Ministry of Health. We selected 29 hospitals using a random sampling approach. However, during the data collection process, we noticed that two hospitals were closed and one hospital declined participation. Therefore, a total of 26 hospitals were included in the national PPS. Of the 26 hospitals, 14 were private hospitals, 24 were secondary hospitals and the remaining 2 were tertiary hospitals. 75% of the hospitals included in the survey were from rural areas. In all the hospitals that participated in the survey, all the inpatient wards were included and patients admitted before or at 8:00 on the day of the survey were included.

Hospital sampling

A representative sample of hospitals was achieved using a systematic sampling design developed by the European Centre for Disease Control (ECDC) as stated in the WHO

PPS methodology. A comprehensive public and private hospitals list including bed capacities was obtained from the Directorate of Policy and Planning, Ministry of Health, Sierra Leone. The hospitals were stratified according to the number of inpatient beds to ensure that hospitals of different sizes were represented.

In line with the WHO PPS methodology, the total number of hospitals was calculated using the statistical tool OpenEpi tool (www.openepi.com) which computes sample size using the design effect. Considering the total bed capacity of 5082 based on the available hospitals list, the average bed capacity was 80. Therefore, a design effect of 6.5 was applied according to the ECDC approach.[27 28] An estimated prevalence of 70% (unpublished PPS conducted in selected hospitals in 2019) and a precision of ±4% were used to determine the total number of hospitals. Based on these values, the calculated total bed size was 2329 beds (at a 95% confidence level). As the average hospital size is 80 beds, therefore, 29 (2329/80) hospitals should be included in the national survey.[27 28]

Inclusion and exclusion criteria

Inclusion criteria

We only included acute healthcare hospitals and inpatient wards. For data collection in each hospital, patients who were hospitalised in the ward before or at 08:00 on the day of the survey were included. All neonates born before 08:00 on the day of the survey were included and counted separately from the mother.[27] All antibiotics administered through oral, parenteral, rectal and inhalation routes are included in the survey. All patients meeting the eligibility criteria were included in the survey irrespective of whether they received antibiotic treatment or not.

Exclusion criteria

We excluded the psychiatric hospital and rehabilitation centres. In each hospital, patients undergoing treatment or surgery and discharged the same day, patients seen in outpatient departments and patients in the emergency room were all excluded from the survey.[27] Patients admitted to the ward after 08:00, patients whose antibiotic therapy was initiated after 08:00 on the day of the survey and patients whose antibiotic therapy was stopped before 08:00 on the day of the survey were excluded. Antibiotics administered through topical applications, drops and vaginal suppositories are excluded.

Data collection

Stakeholders' engagement and training of hospital coordinators and data collectors

Stakeholders engagement

A 1-day stakeholders meeting was conducted for the senior managers of all the selected hospitals. The meeting provided an overview of the importance of conducting the PPS on antibiotic use in hospitals. It also provided a platform for the senior hospital stakeholders to ask questions on the PPS processes and how they could take ownership of the project and conduct follow-up PPS annually.

Training of hospital coordinators and data collectors

A 4-day training was done for all the hospital coordinators and data collectors. This training was relevant as it provided a platform for WHO technical officers and experts in the WHO PPS methodology to train the hospital coordinators and data collectors on antimicrobial stewardship, the different phases in the conduct of PPSs and the different WHO PPS data collection forms.[27] These included the hospital, ward, patient, antibiotic, indication for antibiotic and microbiology forms. These data collection tools were pretested by the researchers in a hospital that was not selected to participate in the survey. These processes ensured a detailed understanding of the WHO PPS methodology and uniform data collection during the survey.

Data collection at the 26 hospitals

There was no interaction between patients and the researcher team, and the process of data collection did not interrupt patient care. No patient identifiers were collected and a unique code was assigned to each patient record. Data collection was done using standardised WHO PPS methodology data collection forms in all 26 hospitals. The data collection period was from July 2021 to August 2021. In each hospital, data collection lasted between 3 and 10 days based on the bed capacity. A team from the WHO country office and the national AMR unit supported the hospital PPS team to collect data in all the eligible hospital wards. Observations on each ward were completed on the day they were started. Following the WHO PPS methodology, since each of the 26 hospitals has <500 inpatient beds, the records of all eligible patients meeting the inclusion criteria were reviewed and included in the survey. Data were captured using the WHO PPS methodology data collection form. The PPS forms collect basic information from medical records and associated patient documentation on all hospitalised patients, which are of relevance for the treatment and management of infectious diseases regardless of whether these patients were on antibiotic treatment at the time of data collection or not. Infections were considered as community-acquired infections (CAIs) if symptoms of infection were present on admission; as healthcare-associated infection (HAI) if symptoms appeared 48 hours or more after admission; surgical prophylaxis (SP) included any antimicrobial administered to prevent surgical-site infections; and medical prophylaxis was defined as the use of antibiotics to prevent infections in patients with non-surgical conditions based on the review of patients' notes.[29]

Data analysis

Data were reviewed by members of the research team and were entered into the online WHO PPS platform. The Data set was exported from the online WHO PPS platform to the Stata software V.17 (StataCorp, Texas, USA) which we used for the data cleaning and analysis. We used the χ^2 test to check for an association between antibiotic use and age and sex. Categorical data were reported as

Table 1 Hospital characteristics in the national point PPS on antibiotic use across 26 hospitals in Sierra Leone, 2021

Variables, n=1199	n (%)
Regions	
Western area	329 (27.4)
East	310 (25.9)
North	300 (25.0)
South	177 (14.8
Northwest	83 (6.9)
Hospital level	
Secondary	958 (79.9)
Tertiary	241 (20.1)
Hospital ownership	
Public	1047 (87.3)
Private	152 (12.7)
Department	
Paediatric	358 (29.9)
Obstetrics and gynaecology	268 (22.4)
Medical	222 (18.5)
Surgical	210 (17.5)
Mixed	141 (11.8)

Paediatric-specialised healthcare services for children; obstetrics and gynaecology-specialised healthcare services for labour, delivery and sexual and reproductive health services; medical-specialised medical healthcare services; surgical-specialised surgical healthcare services; mixed-combined medical and surgical healthcare services.

frequencies with percentages while continuous data were presented as medians (with IQRs). Prevalence of antibiotic use was defined as the number of patients receiving at least one antibiotic on the day of the survey divided by the total number of patients on admission at the time of the survey. Prevalence was presented as percentages with a 95% CI.

RESULTS

Hospital and patient characteristics

A total of 26 hospitals participated in the survey with the majority (87%) being public hospitals located in rural areas. Of the 26 hospitals, 2 were tertiary hospitals and 24 were secondary hospitals (table 1). A total of 1199 patient records were reviewed and the majority of the patients admitted to these hospitals at the time of the survey were women (739, 61.7%). About (423, 36.9%) of the patients were in the age group of 1–14 years with a median age of 22 years, and an IQR of 2–35 years.

Indication for antibiotic use

The most common indication for antibiotic use was CAI (484, 51.9%) followed by SP (222, 23.8%). The majority of the SP was SP2—more than one antibiotic given within 24 hours (58, 26.7%) and SP3—more than one antibiotic given for more than 24 hours (131, 60.4%) (table 2).

Table 2 Indication for antibiotic use across the 26 hospitals included in the national point prevalence survey of antibiotics uses in Sierra Leone, 2021

Indication types (n=932)	n (%)
Community-acquired infections	484 (51.9)
Surgical prophylaxis	222 (23.8)
Surgical prophylaxis 1	28 (12.9)
Surgical prophylaxis 2	58 (26.7)
Surgical prophylaxis 3	131 (60.4)
Not indicated	105 (11.3)
Medical prophylaxis	75 (8.1)
Hospital-acquired infections	46 (4.9)

SP1, one antibiotic given in 24 hours; SP2, more than one antibiotic given within 24 hours; SP3, more than one antibiotic given for more than 24 hours.

Prevalence of antibiotic use and bacteria culture

Of the 1198 patient records reviewed, 883 (73.7%, 95% CI 71.1% to 76.2%) patients were on antibiotics. The prevalence varied across the 26 hospitals from 37.5% to 100%. Of the 883 patients who were prescribed antibiotics, culture and sensitivity were only done for one patient. This is due to the weak laboratory infrastructure in the country.

The majority of patients (385, 44.8%) were on two antibiotics and a few patients (28, 3.3%) were on five or six antibiotics. The main route of antibiotic administration was the parenteral route as the majority (78.9%) of the antibiotics administered were given via intravenous route. The most widely prescribed antibiotics across all 26 hospitals were metronidazole (404, 22.2%), ceftriaxone (373, 20.5%), ampicillin (337, 18.5%), gentamicin (221, 12.1%) and amoxicillin (90, 5.0%) (figure 1). For SP, the frequently prescribed antibiotics were metronidazole, ceftriaxone, ampicillin, cotrimoxazole and gentamicin; and for medical prophylaxis were metronidazole, ampiclox, ceftriaxone, gentamicin and amoxicillin.

Antibiotic use was highest in the 1–14 years age group and lowest among patients that were 45 years and older. Across the 26 hospitals, the prevalence of antibiotic use was highest in the paediatric wards (306, 85.7%), followed by medical wards (158, 71.2%), surgical wards (146, 69.5%), mixed wards (97, 68.8%) and lowest in the obstetrics and gynaecology wards (176, 65.7%) (table 3).

There was no difference in sex (χ^2=0.0008, p=0.98) and hospital levels (χ^2=0.7723, p=0.379) for antibiotic use. However, there was a difference in antibiotic use in hospital ownership (χ^2=3.9140, p=0.05) as there was high usage of antibiotics in public hospitals as compared with private hospitals.

Most (1230, 67.6%) of the antibiotics prescribed across all 26 hospitals fell under the Access group of

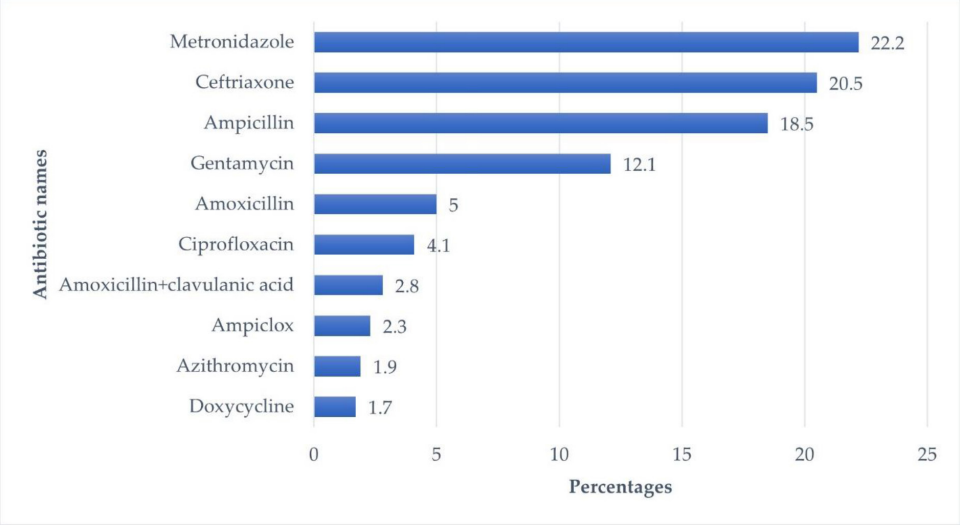

Figure 1 Graph showing the top 10 antibiotics prescribed to patients admitted across 26 hospitals during the national point prevalence survey in Sierra Leone, 2021.

drugs (figure 2) based on the WHO AWaRe antibiotic categorisation.

All the antibiotic treatments were given empirically and there was poor adherence to antibiotic treatment guidelines, as only a quarter (29%) of the antibiotics prescribed were according to treatment guidelines.

DISCUSSION

To our knowledge, this is the first national PPS of antibiotic use in hospitals in Sierra Leone using the WHO PPS methodology. We observed a high usage of antibiotics, with CAIs being the main reason for antibiotic prescription. Culture and sensitivity testing was done for only one patient and there was poor adherence to national treatment guidelines.

There was a high prevalence (73.7%) of antibiotic use across all 26 hospitals as three-fourths of the patients received at least one antibiotic. In keeping with our findings, a recently published study on antibiotic use among suspected and confirmed COVID-19 cases admitted to 35 COVID-19 hospitals in Sierra Leone also documented a high prevalence of antibiotic use, as over half of the patients admitted to these centres received an antibiotic.[15] Several other studies conducted in the general patient population including surgical patients have also demonstrated a high prevalence of antibiotic use.[22 30–32] Additionally, a multicentre PPS on antibiotic use in Ethiopian hospitals that involved a review of over 1800 patient records documented a high prevalence (63.8%) of antibiotic use.[33] Furthermore, a study conducted in a tertiary hospital in South East Nigeria also recorded a high prevalence of antibiotic use as over two-thirds of the patients surveyed were on at least one antibiotic.[9] Additionally, a recent systematic review conducted by Saleem and colleagues with data from 33 PPS conducted in 12 countries in Africa documented that over 50% of the admitted patients received antibiotics. The lowest prevalence was seen in southern Africa and the highest in western Africa.[34] This high prevalence of antibiotic use across these countries confirms that the overuse of antibiotics in patient care is not unique to Sierra Leone, but a regional problem that requires urgent action. The high usage of antibiotics in Sierra Leone might be a result of habitual practices wherein clinicians prescribe antibiotics with the assumption that patients who access healthcare services in secondary and tertiary hospitals might have superimposed bacterial infections irrespective of the working diagnosis. Furthermore, they might use antibiotics as a safety net due to weak infection prevention and control practices and infrastructures.[22]

Over 10 different types of antibiotics were prescribed to admitted patients across the 26 hospitals. The top five prescribed antibiotics were metronidazole, ceftriaxone, ampicillin, gentamicin and amoxicillin. A similar picture was seen in a PPS of 26 hospitals in Saudi Arabia where the most frequently prescribed antibiotics were ceftriaxone followed by penicillin.[35] From our study, the majority of the antibiotics prescribed fell under the 'Access' group of drugs according to the WHO antibiotics AWaRe categorisation. This is a good practice as the WHO has advised countries that 60% of all drugs used at hospitals should be from the Access group of drugs.[36 37] Furthermore, these Access groups of drugs should be accessible, affordable

Table 3 Prevalence of antibiotic use according to ward types across all 26 hospitals in the national point prevalence survey in Sierra Leone, 2021

Ward types	Total	N (%)
Paediatric	357	306 (85.7)
Medical	222	158 (71.2)
Surgical	210	146 (69.5)
Mixed	141	97 (68.8)
Obstetrics and gynaecology	268	176 (65.7)

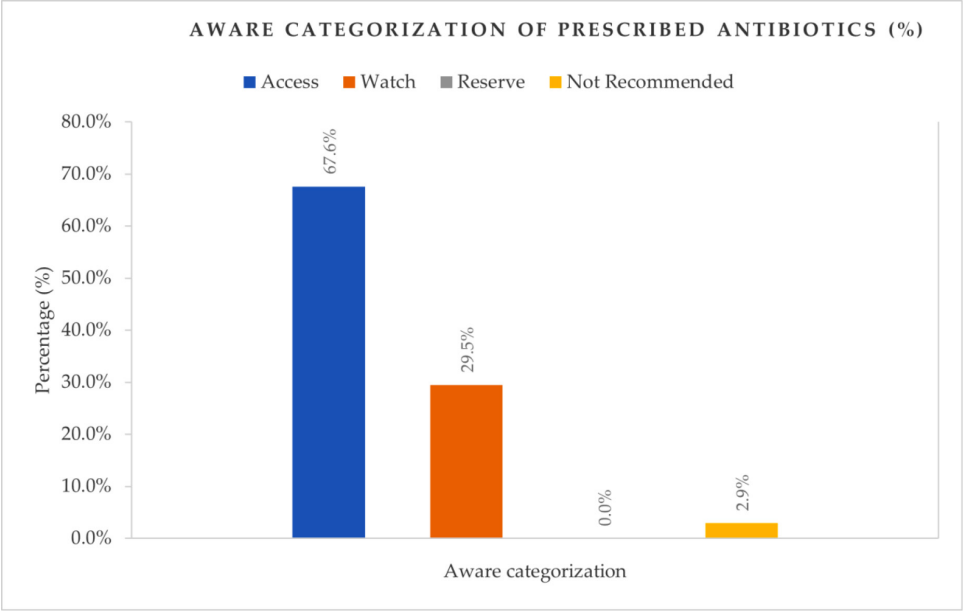

Figure 2 Bar chart showing the classification of antibiotics prescribed to patients across the 26 hospitals in the national point prevalence survey on antibiotic use in Sierra Leone in 2022 according to the WHO AWaRe categorisation.

and of good quality. However, there was also high usage of the 'Watch' group of antibiotics.[36]

The main indication for antibiotic use across the 26 hospitals was CAIs followed by SP. Our findings are consistent with a study conducted in Ghana where the main indications for antibiotic use were CAI followed by SP.[17] Furthermore, a recently conducted study in Thailand on antibiotic use across 41 hospitals documented similar findings where CAI was the main reason for antibiotic treatment initiation.[38] In contrast to our findings, HAI followed by CAI were the main indications for antibiotic use in a PPS on antibiotic use in 10 public hospitals in Ethiopia.[33]

In our study, the main SP used was SP2 (two or more antibiotics within 24 hours) or SP3 (two or more antibiotics more than 24 hours). Similar to our findings, a study conducted in four hospitals in Sierra Leone documented a high level of SP, and more than 50% of the patients that were on antibiotic prophylaxis should not have received any antibiotic according to the hospital SP guideline.[31] This is contrary to the WHO SP guideline that recommends that only one dose of antibiotic should be given before incision and possible intraoperative additional dose(s) according to the duration of the operation.[39]

Adherence to antibiotic treatment guidelines was poor as only about a quarter of the prescriptions were according to the local antibiotic treatment guidelines. Our findings are similar to a recently conducted study in Nigeria where there was limited use of guidelines in the initiation of antibiotic treatment.[9]

Even though the best practice is to conduct culture and sensitivity to guide antibiotic selection, bacterial culture and sensitivity were performed in only one patient. This is not unique to Sierra Leone A recent systematic review on antibiotic use among hospitalised patients in Africa reported limited data on culture and sensitivity to guide antibiotic selection.[40] The low utilisation of culture and sensitivity in hospitals in Sierra Leone reflects the lack of laboratory capacity for microbiology methods.

Based on our study findings, we recommend the following: (1) the establishment of national and hospital antimicrobial stewardship programmes using the WHO core components of the antimicrobial stewarship (AMS) programme approach. Leveraging the already established Infection Prevention and Control (IPC) committees in these hospitals to form a comprehensive IPC and antimicrobial stewardship committee with different technical teams (IPC team, AMS team) for operational implementation will be a good approach. More attention should be given to the paediatric units as they have the highest usage of antibiotics; (2) the development of a national SP guideline that should be disseminated to all secondary and tertiary hospitals. Additionally, healthcare workers should be trained on this SP guideline to ensure effective implementation at the hospital level. Lessons learnt from the implementation of antimicrobial stewardship programmes in Tanzania, Zambia, Uganda, Ghana and Liberia have shown to be effective in the reduction of inappropriate use of antibiotics in hospitals[41 42]; (3) there should be dissemination of the national standard treatment guidelines and essential medicine list that includes WHO AWaRe categorisation to all the secondary and tertiary hospitals in Sierra Leone. This will ensure guideline compliance by clinicians; (4) healthcare workers should be trained on hospital-based antimicrobial stewardship programmes including prescription audits; and (5) routine antibiotic audits should be conducted by the hospital's antimicrobial stewardship programme. This will ensure the appropriate use of antibiotics which will in turn improve patient outcomes. The Worldwide Antimicrobial Resistance National/International Network Group's 10 golden rules for optimal antibiotic use in hospital settings

have suggested that the above-listed interventions are effective.[43]

Our study has several strengths. First, we used a globally standardised WHO PPS methodology and tools. This supports the easy comparability of our findings to other studies done outside of Sierra Leone. Second, data collection was carried out by medical doctors, pharmacists and nurses, all of whom were well-versed in reading clinical notes. Furthermore, the data collection tools were piloted which ensured uniformity in the data collection by the research team. Third, we adhered to 'STROBE' (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for reporting study findings. Fourth, our findings can be generalised as we included both public and private secondary and tertiary hospitals.

There were some limitations to our study. First, this was a cross-sectional study and hence provides only a baseline assessment and a snapshot of antibiotic use in these hospitals. A prospective audit will give a better understanding of the prescribing pattern, appropriate drug selection and adherence to treatment guidelines to support the streamlining of hospital-based antimicrobial stewardship interventions. Second, we did not include the optional variables on the PPS data collection form which could have provided a better understanding of the co-infection status of patients. Third, we excluded hospitals that were not functional (2) or declined to participate (1) in the survey. This might have reduced the precision of our estimates.

CONCLUSION

Our study confirms that there is a high usage of antibiotics across all the secondary and tertiary hospitals in Sierra Leone that were included in the national PPS. However, the majority of the antibiotics prescribed to the admitted patients were from the Access group of antibiotics according to the WHO AWaRe categorisation. CAI was the main reason for antibiotics prescribing and there was poor adherence to national standard treatment guidelines.

This high usage of antibiotics might cause selection pressure and lead to an increased AMR burden in the country. Therefore, we recommend the establishment of national and facility-based AMS programmes according to the WHO AMS core components, training of healthcare workers on AMS interventions and routine monitoring of antibiotic use, audits and annual conduction of PPS on antibiotic use in these hospitals.

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Contributors AM, JK, IFK, BDF, KNK and BS designed the study. IFK and JK were responsible for writing the original draft. BDDF and BS were responsible for visualisation; and AM, VK, and KNK were responsible for validation. IFK, AM, JK, BDF, KNK, BS, SAD'A, RM, IN, SL, RZK, SMT, ARM, ZK, FT, OTA, ATK, JBWR, JS and MAV contributed to the methods, review and editing of the manuscript until final approval. IFK and JK are the guarantors.

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Patient consent for publication Not applicable.

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