Assessment of Antimicrobial Resistance Diagnostic Capacity and Antibiotic Use in 10 Counties in Kenya

REPUBLIC OF KENYA

MINISTRY OF HEALTH

GARDP
Global Antibiotic Research & Development Partnership

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Diagnosis for all

JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY
TECHNOLOGY FOR DEVELOPMENT

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EXECUTIVE SUMMARY

AMR presents a serious social, economic and health burden globally. It is estimated that 700,000 deaths per year are attributed to AMR, additionally AMR may cause more deaths than cancer by 2050. In 2019, 1.27 million deaths were directly attributable to bacterial resistance to antibiotics, with most of these deaths occurring in western sub-Saharan Africa. In Kenya, studies suggest high prevalence of AMR. However, the burden of AMR is not well documented due to limited AMR data. Kenya has made tremendous strides in developing structures towards combating AMR including digitizing One Health AMR surveillance and updating Kenya National Action Plan and Surveillance Strategy and many others.

This assessment conducted in 28 health facilities drawn from public, private and Faith-based organizations (FBOs) representing levels 4, 5 and 6 provides an insight into the AMR diagnostic capacity and antibiotic use practices to inform gaps into which capacity can be built to help combat AMR and inform policy formulation and decision-making in Kenya and inform introduction of new antibiotics, blood culture and molecular point of care. The selected Health Facilities (HFs) were sampled from 10 counties (representing 21% of the total counties in Kenya). The counties represent the west, central and northern regions of Kenya. The assessment had two components: diagnostic and therapeutic objectives. The following notable findings were observed during the assessment.

For the diagnostic objective, the study established that Level 4 HFs had the highest number of outpatients (69.6%). Whereas most of the laboratory staff have Diploma qualifications and above. Only 64.3% of HFs had their staff receive annual competency training. Assessment of laboratory certification found that 21 of 28 HFs assessed had no laboratory certification. Of those that were certified, 7 had SLIPTA / SLMTA certification while 6 had valid ISO 15189 certification. Laboratory culture remains the gold standard for detecting micro-organisms. Only 53.6% (n=15) of the HFs had the ability to perform cultures. Out of the 15 that could perform cultures, 14 had capacity for antimicrobial susceptibility testing. Further level 4 HFs had the lowest capacities to carry out gram stain (68%) and culture testing (31.6%, n=6/19).

The study established that only 8 HFs had the capacity to perform blood cultures. Out of these, only 5 could perform blood cultures using an automated machine. 21 of the 28 HFs had a Laboratory Information System for recording antimicrobial susceptibility testing (AST) data. This assessment was able to identify some of the barriers that may contribute to the inability to perform microbial cultures. This included lack of equipment (39.1%), reagents (34.8%), low lab requests (14.7%), inadequate infrastructure (13%), inadequate mentorship and training (8.7%) and insufficient human resources for health (4.3%). Other notable gaps in surveillance practices included lack of computer-based Laboratory Information System (LIS) (81%). Health financing is a key determinant in the provision of accessible, timely, equitable, quality, and affordable healthcare. This study noted that over a third of the clients (36.8%) paid for their culture tests using out of pocket funds. The cost for culture and sensitivity ranged from 200 to 2,900 Ksh. Blood culture price ranged from 1,000 to 6,000 Ksh.

Successful, effective, and efficient AMR surveillance partly depends on the calibre and numbers of health workforce, HF ward infrastructure and drug dispensing specialists. This assessment found only 5 (0.6%) infectious disease specialists in all the 28 HFss assessed.

Antibiotic guidelines and antibiogram are important in clinical practice in that they provide a means of assessing local susceptibility rates, as an aid in selecting empiric antibiotic therapy, and monitoring resistance trends over time within a HF. For the therapeutic objective of this assessment, 11 out of 28

(39.3%) HFs had antibiotic guidelines, with 7 (25%) of them using national guidelines and the other 4 (14.3%) using facility level guidelines. In addition, only 2 (7.1%) HFs had an antibiogram. One of the 2 HFs reported that their antibiogram had not been updated since it was developed in 2021, while the other reported that the antibiogram was updated monthly.

Additionally, most of the HFs rarely updated their antibiotic formulary. Only 7 HFs responded to having done so. The survey revealed that 52.4% of the level 4 HFs visited were aware of the World Health Organization (WHO) Access, Watch, Reserve (AWaRe) classification list of antibiotics. The study established that only 30 (34.5%) of 87 antibiotics in the access category on the WHO Essential Medicines List (EML) AWaRe list were available. Of 141 watch antibiotics, 40 (28.4%) of them were available in the 28 HFs. Out of the 29 listed reserve therapeutics only 6 (20.7%) were available. Notable, cumulatively, level 4 facilities had the 6 reserve 37 Watch antibiotics.

HFs are expected to administer antibiotics in the following order of priority; access, watch and reserve list with at least 60% of total antibiotic prescribing being access antibiotics. The study, however, established that this may not be strictly adhered to as was observed in 2 use cases. The lack of adherence may be a significant contributor to the development of AMR. This assessment determined the types and frequency of prescription of various antibiotics prescribed for different community and hospital-acquired infections and the frequency of further microbiological analysis of samples associated with these infections. The assessment revealed that of the 28 HFs, 13 (46.4%) had staff who had Antimicrobial stewardship (AMS) training, while 12 (42.9%) HFs had AMS Committees, however, only 1 of these committees was functional.

Findings show limited diagnostic capacity and antibiotic use practices in the assessed health facilities. It is critical to prioritize building laboratory infrastructure and strengthening their diagnostic capacity and improve antibiotic use practices to combat AMR in Kenya.

Contents

List of Abbreviations

AADCAUC	assessment of antimicrobial resistance diagnostics capacity and antibiotic use in counties
Abx	Antibiotics
AMC	Antimicrobial consumption
AMR	Antimicrobial resistance
AMS	Antimicrobial stewardship
AMU	Antimicrobial use
ASP	Antimicrobial stewardship programs
AST	antimicrobial susceptibility testing
AWaRe	Access, Watch, Reserve
CA-UTI	community acquired urinary tract infection
CASIC	County Antimicrobial Stewardship Interagency Committee
CCU	critical care unit
CHMT	County Health Management Team
CHP	Community Health Promoter
CHU	community health unit
CME	continuing medical education
CSF	Cerebrospinal fluid
cUTI	complicated UTI
DHARC	Digital Health Applied Research Centre
EML	Essential Medicines List
EMLc	Essential Medicines for Children
FBO	Faith-based organization
FDA	Food and Drug Administration
FIND	Foundation for Innovative New Diagnostics
GARDP	Global Antibiotic Research and Development Partnership
GDP	gross domestic product
HCW	healthcare worker
HDU	high dependancy unit
HF	Health Facility
HIS	Health Information system
HND	higher national diploma
HPT	health products and technologies
HRH	human resource for health
HuQAS	Human Quality Assessment Services
HVS	High Vaginal Swab
IAI	intra-abdominal infection
ICU	intensive care unit
ID	identification
IPC	infection prevention and control
IV	Intravenous
JKUAT	Jomo Kenyatta University of Agriculture and Technology
JKUATES	JKUAT Enterprise Services

KEMCL	Kenya Essential Medical Laboratory Commodities List
KEML	Kenya Essential Medicines List
KEMRI	Kenya Medical Research Institute
KEMSA	Kenya Medical Supplies Agency
KEMSL	Kenya Essential Medical Supplies List
KENAS	Kenya Accreditation Service
KEPH	Kenya Essential Package for Health
KNEQAS	Kenya External Quality Assessment Scheme
KNH	Kenyatta National Hospital
KUTRRH	Kenyatta University Teaching Referral and Research Hospital
LIS	Laboratory Information System
LMICs	Low- and middle-income countries
MEDS	Mission for Essential Drugs and Supplies
MIC	Minimum inhibitory concentration
MLO	Medical Laboratory Officer
MoH	Ministry of Health
MRSA	methicillin-resistant Staphylococcus aureus
MTC	Medicines and Therapeutics Committee
NASIC	National Antimicrobial Stewardship Interagency Committee
NAT	nucleic acid tests
NBU	new born unit
NMTC	National Medicines and Therapeutics Committee
ODK	Open Data Kit
OJT	on-job training
PCR	polymerase chain reaction
PEPFAR	U.S. President's Emergency Plan for AIDS Relief
POCT	Point of care testing
PPB	Pharmacy and Poisons Board
QA/QC	Quality assurance / quality control
SAGAs	Semi-Autonomous Government Agencies
SDG	Sustainable Development Goal
SLIPTA	Stepwise Laboratory Quality Improvement Process Towards Accreditation
SLMTA	Strengthening Laboratory Management Toward Accreditation
SOP	standard operating procedure
SSI	surgical site infection
SSTI	skin and soft-tissue infection
TAT	Turn Around Time
UHC	Universal health coverage
UPS	Uninterruptible Power Supply
UTI	urinary tract infection
VEN	vital, essential and non-essential
VRE	Vancomycin-resistant Enterococci
WHO	World Health Organization

List of Figures

List of Tables

1 INTRODUCTION

1.1 BACKGROUND

AMR is a growing threat to world public health that puts in peril the prevention and treatment of diseases caused by bacteria. The global plan of action by the WHO against AMR and the global strategy of one health considers sensitization and understanding of antimicrobial resistance an essential priority for adoption, deployment and putting in place the national action plans against AMR. Antimicrobials, as such antibiotics, are substances that kill or arrest the growth of microorganisms such as bacteria, viruses and fungi. Antibiotics are specifically used to target bacteria responsible for an infection or ailment and are currently used in human and veterinary medicine. However, the emergence of bacteria that are resistant through continuous or perhaps blind use of antibiotics by humans and animals constitute a grave risk for public health.

One of the biggest threats to global health, food security, and development today is antibiotic resistance. Although it occurs naturally through genetic changes, the incidence of AMR is accelerated by the improper use of antibiotics in humans, animals and plants. AMR occurs through an evolutionary process that is accentuated by a multiplicity of factors. The development of AMR is attributed to the overuse, misuse, improper disposal, use of antimicrobials in animal production, counterfeiting of antimicrobials and lack of AMR action plans among other factors. Ultimately, micro-organisms become resistant to drugs thereby reducing the effectiveness of treatment [11]. In addition, lack of clean water and sanitation and inadequate infection prevention and control (IPC) promotes the spread of microbes, some of which can be resistant to antimicrobial treatment. Because of AMR, a growing number of infections - such as pneumonia, tuberculosis, gonorrhoea, and salmonellosis - are becoming harder to treat as the antibiotics used to treat them become less effective. Subsequently, this resistance to antibiotics leads to longer hospital stays, higher medical costs and increased mortality and disability. In 2019, about 1.3 million deaths were attributed to drug-resistant infections globally.

It is projected that by 2050 the health consequences and economic costs of AMR will be 10 million human deaths and a 2 to 3.5% decrease in gross domestic product (GDP) worldwide. This has seen AMR emerge as one of the leading global public health and development threat expected to deter the achievement of Sustainable Development Goals (SDGs), especially in the Low- and middle-income countries (LMICs) if urgent and united multi-sectoral actions are not taken. Indeed, in 2019, the WHO declared AMR as one of the top 10 global public health threats facing humanity [1].To counter the effects of AMR, there is need to develop a multi-sectoral approach that strengthens human and animal health systems and agricultural practices to foster appropriate use and access to antimicrobial agents. The requirement of a global coordinated action plan is imperative especially in situations where the full burden of AMR is unknown and surveillance activities are minimal compounded by paucity of data.

Kenya has carried out few AMR surveillance activities through the Kenya Medical Research Institute (KEMRI), select central reference laboratories, a few high-volume facilities, and sentinel sites set up to address specific pathogens of major public health concern [20]. However, data from these activities does not give the landscape of AMR nationally. Limited AMR surveillance activities have been attributed to restricted laboratory capacity for AMR diagnostics and especially on pathogen identification (ID) and AST. In addition, poor reporting by facilities has constrained access to AMR-related data, nationally. For instance, as of 2021, 12 health facilities were serving as AMR surveillance sites and were connected to the

[1] https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance

national AMR surveillance system and database in Kenya. However, only 6 facilities were actively submitting AMR data as required [6]. However, there has been a marked improvement in this and currently, NASIC is conducting AMR surveillance and has 17 sentinel sites. They have created a central data warehouse at the national level, and, with the support of FIND, they have developed a one health AMR surveillance system that has analytics for data from human and animal health sectors

AMR surveillance data collected at a private tertiary hospital between 2012 and 2015 revealed that resistance of *Klebsiella pneumoniae* to aminoglycosides, carbapenems and third generation cephalosporins increased from 58%-75%, 3%-23% and 61%-88%, respectively, while resistance to aminopenicillins has been documented to be as high as 100% [2]. The 2015 annual surveillance data from inpatients at a level-6 health facility (Kenyatta National Hospital) in Nairobi, showed that multi-drug resistance and extensive drug resistance levels among all pathogens analyzed were 88% and 26%, respectively. The study also reported high levels of non-susceptibility of *E. coli*, *K. pneumoniae* and *S. aureus* to commonly used antibiotics such as penicillin (52–92%, 67–73% and 55–97%, respectively) and cephalosporins (57–80%, 64–84% and 30%, respectively [23]. These surveillance data rely primarily on clinical isolates collected from tertiary-level health facilities. Little is known about the prevalence of AMR in community settings in Kenya. A laboratory- based surveillance of AMR in Kenya study in 2022 by Moirongo et al. Moirongo et al. [14] identified key gaps in laboratory information management technology, external quality assurance and material and equipment among the surveyed health facilities.

Antimicrobial resistance can be minimized effectively through coherent surveillance that facilitates continuous capture and onward sharing of reliable data for the development of targeted interventions at local, national, and global levels (1-3). In addition, improving basic hygiene and sanitation will reduce the spread of resistant organisms. Primarily, laboratory testing is the foundation for detecting resistance [10] and providing essential information for clinicians to institute appropriate treatment regimens for patients, thereby limiting potential misuse of drugs. Where quality laboratory services are not always available, treatment often involves untargeted empirical administration of antimicrobials, including broad-spectrum agents, accelerating the development, and spread of drug resistant microorganisms. Where available, these tests are largely inaccessible to majority of clients due to high costs.

It is evident that AMR awareness and knowledge in Kenya is low even among healthcare workers. There is no evidence of a national survey addressing AMR and antimicrobial use. Antimicrobial stewardship programs (ASP) are poorly developed at the sub-national levels. A robust ASP should foster appropriate use of antimicrobials (including antibiotics), improve patient outcomes, reduces microbial resistance, and decreases the spread of infections caused by multidrug-resistant organisms. The national Antimicrobial Stewardship guidelines for healthcare settings in Kenya highlight 5 objective areas: i) public awareness and evaluation, ii) surveillance and monitoring, iii) infection prevention and control, iv) appropriate use of antimicrobials and v) research and development. Some cross-sectional studies and point prevalence surveys (PPS) have been conducted in hospitals across the country, and they reflect a high prevalence of antibiotic use (45–69%); irrational antibiotic prescription across wards, especially regarding third generation cephalosporins and extended-spectrum penicillins; and limited or no use of culture and sensitivity tests to guide therapy [7].

A situation analysis on AMR in Kenya conducted by the Global Antibiotic Resistance Partnership in 2011 and updated in 2016 recommended a coordinated national surveillance mechanism and strengthened laboratory capacity to provide the necessary data for risk assessment of AMR. Kenya has since developed a

[2] https://resistancemap.onehealthtrust.org/AntibioticResistance.php

national policy on prevention and containment of antimicrobial resistance in 2017 [8]. The objectives of the policy are to Improve awareness and understanding of AMR through effective communication, education, and training, strengthen the knowledge and evidence base through surveillance and research, reduce the incidence of infection through effective sanitation, hygiene, and infection prevention and control measures, optimize the use of antimicrobials in animals and humans; and develop an economic case for sustainable investment that takes into account Kenya's needs, and increase investment in new medicines, diagnostic tools, vaccines, and other interventions [8].

The NASIC was established in 2017. The steering committee formed in 2019, includes representatives from six government ministries, including the Ministries of Health, Agriculture, Livestock, Fisheries and Co- operatives and is responsible for overseeing policy direction and resource allocation on AMR. A second tier coordinating system, the County Antimicrobial Stewardship Interagency Committees (CASICs) were created in 14 of the 47 counties to oversee AMR-related activities, monitor National Action Plan on AMR implementation and allocate resources at the county level. NASIC and CASICs have developed communication and awareness strategies, surveillance strategies and standard operating procedures [14].

This project carried out an assessment of AMR diagnostic capacity and use, challenges, antibiotic use, and antimicrobial stewardship practices in 28 health facilities (public, private and faith-based) within 10 counties to provide a better understanding of the respective capacities and current practices.

1.2 RATIONALE

Effective antimicrobial drugs are vital for both preventive and curative measures and protecting patients from potentially fatal diseases. The misuse and overuse of antimicrobials in human medicine and food production are likely to put countries at risk of AMR considering that very few antimicrobial agents are currently in development. Without concerted and immediate action using a multi-sectorial approach at a national and county level, the country stands to diminish the tremendous gains made in the fight against infectious diseases.

Currently, most innovations around AMR are focused on pathogen ID and AST technologies that aim at providing the highest sensitivity or the fastest turnaround time. A high level of technological constraint was put on such platforms in order to compete with the comprehensiveness of conventional laboratory assays. Direct testing without culture, combination of ID and AST on the same platform or the ability to provide Minimum inhibitory concentration (MIC) results the same day can be cited among the most constraining features. The downside of such technologies is that they have been designed for high income markets with a focus on high medical value applications (e.g. bloodstream infection). Therefore, their implementation in LMICs is not always possible for several reasons such as high cost, incompatibility with existing infrastructure and equipment or lack of a clear and complete patient management flow that can really showcase the added value of a disruptive tool.

These aforementioned challenges compounded by lack of proper ASP and by paucity of data on AMR diagnostics in different private and public health facilities in different counties across the country. The aim of this work was to conduct an assessment of the AMR laboratory capacity, antibiotic use and existing Stewardship practices in selected 28 health facilities in Kenya. Findings from this assessment will aid in the preparation for introduction of **cefiderocol** (and other antibiotics) and new low blood culture and molecular point of care treatment platforms in Kenya.

1.3 ASSESSMENT OBJECTIVES

This project was about assessment of antimicrobial resistance diagnostics capacity and antibiotic use in counties (AADCAUC). The aim of this project was to assess AMR diagnostic capacity, antibiotic use and existing antimicrobial stewardship practices to prepare for introduction of cefiderocol (and other antibiotics) and new low blood culture and molecular Point of care testing (POCT) platforms in Kenya. The objective was be considered under two broad components, diagnostic- and therapeutic-components.

1.3.1 THE DIAGNOSTIC COMPONENT COMPRISED THE FOLLOWING SUB-OBJECTIVES

(i) To determine the current AMR diagnostics in the selected counties in Kenya

(ii) To determine the supply of equipment and testing commodities

(iii) To determine the gaps in AMR diagnosis continuum in the selected counties in Kenya

(iv) To Establish the average cost and mode of payment for AMR diagnosis in the selected counties

(v) To document use cases for AMR diagnostics, current practices and determine the level of adherence to regulatory needs

This enabled understanding of current AMR diagnostics, supply and gaps, current use cases for AMR diagnostics, practices, regulatory needs, and willingness to pay for AMR diagnostic services in the selected counties.

1.3.2 THE THERAPEUTIC COMPONENT COMPRISED THE FOLLOWING SUB-OBJECTIVES

(i) To understand current reserve antibiotic supply, use cases, and gaps in the selected counties in Kenya.

(ii) To identify access pathways for new reserve antibiotics.

(iii) To map potential early adoption sites, capacities, and barriers.

(iv) To develop relationships with early adoption partners.

2 TECHNICAL APPROACH

2.1 DATA SOURCE

This was a laboratory assessment for AMR diagnostic capacity, antibiotic use, and antimicrobial stewardship carried out in selected HFs in the country. 30 HFs were sampled for data collection for this project. 28 HFs were responsive and data was collected through interviews using 2 data collection tools, one mapping AMR Dx capacity and the other mapping Antibiotics (Abx) use and AMS (See Apenndix F and G).

2.2 ASSESSMENT SITES

The assessment was carried out in 28 selected health facilities from 10 Counties in Kenya. These health facilities were both private and public hospitals.

2.2.1 PARTICIPATING COUNTIES

The 10 participating counties were Nairobi, Kajiado, Kilifi, Kirinyaga, Nyeri, Laikipia, Isiolo, Vihiga, Nandi and Kericho. Nairobi, Kajiado and Kirinyaga counties are found in the central region of Kenya, while Vihiga, Kericho and Nandi are found within the western region of Kenya. Nyeri, Laikipia and Isiolo counties are to the north while Kilifi is found in the southern region of Kenya. Figure 1 shows the participating counties.

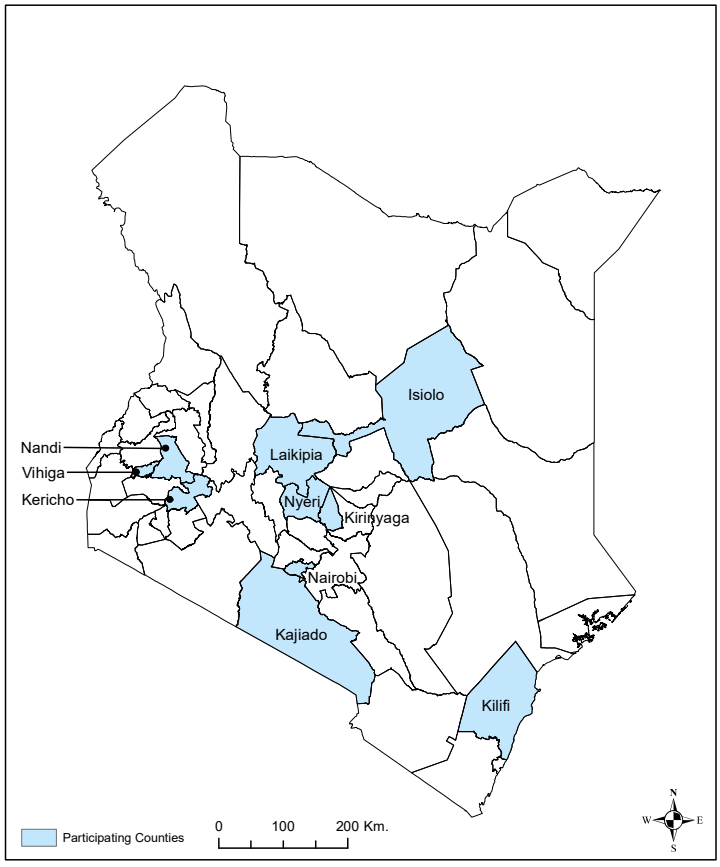

FIGURE 1: **MAP OF ASSESSMENT SITES**

30 HFs were randomly selected by Kenya Essential Package for Health (KEPH) level from counties. The 10 counties (Nairobi, Kajiado, Kilifi, Kirinyaga, Nyeri, Laikipia, Isiolo, Vihiga, Nandi and Kericho). The

distribution of implementation sites is as follows: 2 level 6 HFs owned by the MoH, 4 level 5 facilities (1 MoH, 1 FBO, 2 private), 24 level 4 facilities (12 MoH, 5 FBO, 6 private)

2.2.2 EXCLUSION CRITERIA:

Two HFs where the approval process was too long were excluded since by the time the assessment was closing, they had not given an indication as to when the assessment could be carried out.

2.2.3 PARTICIPATING HEALTH FACILITIES

The 30 participating health facilities were randomly selected based on the KEPH level from the participating counties. The KEPH is a package of services that the government of Kenya is providing or is aspiring to provide to its citizens in an equitable manner. This essential package is expected to achieve multiple goals: improved efficiency, equity, political empowerment, accountability, and altogether more effective care. Health facilities in Kenya are government of Kenya (MoH), FBO or privately managed. The health delivery system in Kenya is organized into 6 levels: Level 1: community health units (CHUs), Level 2: dispensaries and private clinics, Level 3: health centres, Level 4: sub-County hospitals and nursing homes, Level 5: County referral and teaching hospitals, private hospitals, and Level 6: national referral hospitals. Based on the health delivery levels in Kenya, the participating health facilities were grouped as follows; two level 6 (owned by the MoH), 7 level 5 (4 MoH, and 3 FBO), and nineteen level 4 facilities (10 MoH, 5 FBO and 4 private). Table 1 below shows the number and distribution of the health facilities based on their counties, administrative wards, and health delivery level.

TABLE 1: **LIST OF PARTICIPATING HFS BY COUNTY, SUB-COUNTY AND WARD**

County	Sub county	Ward	Name of health facility	Level	Ownership
Isiolo	Isiolo	Bulla Pesa	Anka Hospital Isiolo	Level 4	Private
Isiolo	Isiolo	Bulla Pesa	MaterCare Maternity Hospital	Level 4	Faith Based Organisation
Isiolo	Isiolo	Wabera	Isiolo County and Referral Hospital	Level 4	Public
Kajiado	Kajiado Central	Ildamat	Kajiado County Referral Hospital	Level 4	Public
Kajiado	Kajiado East	Kitengela	Kitengela Medical Services	Level 4	Private
Kajiado	Kajiado North	Ngong	Ngong Sub-County Hospital	Level 4	Public
Kericho	Ainamoi	Kipchebor	Kericho County Referral Hospital	Level 5	Public
Kericho	Bureti	Litein	AIC Litein Mission Hospital	Level 5	Faith Based Organisation
Kilifi	Kaloleni	Mariakani	Mariakani Sub County Hospital	Level 4	Public
Kilifi	Kilifi North	Sokoni	Kilifi County Hospital	Level 4	Public
Kilifi	Malindi	Barani	Tawfiq Hospital	Level 4	Faith Based Organisation
Kirinyaga	Kirinyaga Central	Kerugoya	Kerugoya County Refferal Hospital	Level 5	Public
Kirinyaga	Kirinyaga Central	Kerugoya	Mt Kenya (ACK) Hospital	Level 4	Faith Based Organisation
Kirinyaga	Kirinyaga South	Tebere	Afya Link Medical Centre	Level 4	Private
Laikipia	Laikipia East	Nanyuki	Nanyuki teaching and Referral Hospital	Level 4	Public
Laikipia	Laikipia west	Igwamiti	Pope Benedict XVI Hospital	Level 4	Faith Based Organisation
Nairobi	Dagoreti North	Kilimani	Coptic Hospital	Level 4	Faith Based Organisation
Nairobi	Embakasi Central	Komarock	Mama Lucy Kibaki Hospital (Embakasi)	Level 5	Public
Nairobi	Roysambu	Kahawa	Kenyatta University Teaching Refferal and Research Hospital	Level 6	Public
Nairobi	Ruaraka	Korogocho	Mama Margaret Uhuru Hospital	Level 4	Public
Nairobi	Starehe	Nairobi South	The Mater Misericordiae Hospital (Mukuru)	Level 5	Faith Based Organisation
Nandi	Chesumei	Chemundu/Kapng'etunyi	Kapsabet Health Care Centre	Level 4	Private
Nandi	Emgwen	Kapsabet	Kapsabet County Referral Hospital	Level 5	Public
Nandi	Mosop	Chepterwai	Chepterwai Sub-County Hospital	Level 4	Public
Nyeri	Nyeri South	Iria-ini	KNH Othaya Annex	Level 6	Public
Vihiga	Hamisi	Shiru	Jumuia Mission Hospital Kaimosi	Level 5	Faith Based Organisation
Vihiga	Luanda	Emabungo	Emuhaya Sub County Referral Hospital	Level 4	Public
Vihiga	Vihiga	Lugaga-wamuluma	Vihiga County Referral Hospital	Level 4	Public

2.3 HEALTH FACILITY WORKFORCE ENGAGED DURING THE ASSESSMENT

The following cadre of healthcare workers from the participating HFs were engaged to aid in data collection or as respondents, Head Physicians (or facility AMR focal persons), Medical Laboratory Managers and/ or Medical Microbiologists, Head Nursing Officers, Head Pharmacists and Hospital Administrators. The first activity undertaken in seeking buy-in from stakeholders in preparation for the launch of the project was stakeholder engagement.

2.4 STAKEHOLDER ENGAGEMENT

To foster effective collaboration, coordination and implementation of project activities, key stakeholders in the space of AMR were engaged. These stakeholders included officials at the national level (MoH), County levels (CHMTs), leadership of select public and private health facilities, private-sector players and Faith-Based Organizations (FBOs) leadership in health.

The project undertook various sensitization meetings as part of its entry and buy-in strategies to onboard various stakeholders and partners. These meetings also provided opportunities for engagement of stakeholders aimed at alignment of the protocol, the data collection tools and for national and county-level approvals.

The first sensitization was carried out at the national level. This consisted of presenting the aims and objectives of the assessment to the Director General of Health and NASIC membership. The second sensitization meeting was held with the representatives of the CHMTs from the 10 participating Counties and leadership of the participating HFs (public, private and FBO owned). This strategy ensured seamless approval and implementation of the project in the Counties and participating HFs by onboarding all key stakeholders.

2.5 PROJECT IMPLEMENTATION AND MANAGEMENT

The project team partnered directly with NASIC to ensure smooth implementation of the project. Their key responsibilities were to provide strategic guidance and technical expertise for the project. The two teams prepared a work breakdown structure highlighting the deliverable and work packages in a time bound manner. Biweekly meetings with partners (FIND and GARDP) were undertaken to ensure that all implementing partners were sufficiently informed about the overall project progress. These regular interactions provided a forum for exchange of ideas and insights, tracked progress and course-correction whenever necessary in the implementation strategies were applicable. The implementation team prepared regular reports to appraise the stakeholders on the progress of the pilot.

2.6 DEVELOPMENT AND PILOTING OF THE DATA COLLECTION TOOLS

The assessment tool was digitized on Open Data Kit (ODK) and data aggregation was done using the KOBO toolbox. The tool was made available through *KoboCollect application* which was installed in tablets that were provided to each of the assessors. Collected data was transmitted and stored in the DHARC server for analysis.

2.7 DEVELOPMENT OF TRAINING MATERIALS

Training and sensitization materials were developed covering the following areas.

1. AMR diagnostic assessment.
2. Stepwise navigation of the digitized data collection tools.
3. Harmonisation of the interview guides for collecting qualitative information
4. The assessment protocol for data collection.

2.8 TRAINING ASSESSORS AND SENSITIZATION OF HF PARTICIPANTS

Assessors identified by NASIC were trained on the assessment of AMR diagnostic capacity and use of the digitized data collection tool. During the training all AADCAUC questions were reviewed in advance to establish familiarity with the sections, contents and flow of the questionnaires, and all necessary clarifications and amendments made. The HF personnel who were earmarked to participate in this assessment were also sensitized on the various sections in the assessment tool prior to visiting the HF.

2.9 STUDY WORKFLOW

The study was carried out as shown in the schematic workflow in Figure 2 below. The flow diagram shows the continuum of the study by highlighting the key phases of development of the data collection tools, preparation of the team of assessors and data collection at the HF.

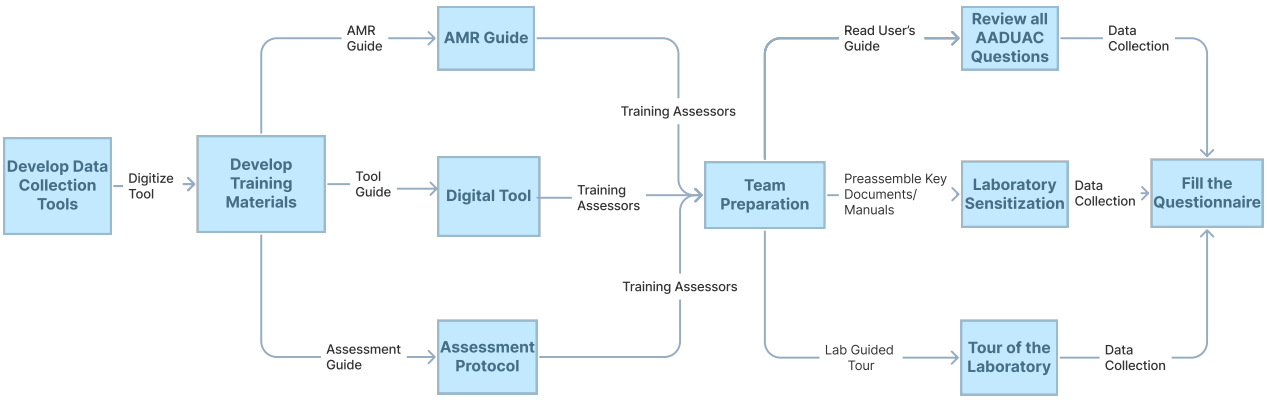

FIGURE 2: **ASSESSMENT WORKFLOW**

The following steps were followed during the assessment

2.9.1 HF AND LABORATORY SENSITIZATION

A week in advance of the assessment, an agenda was shared with the participating HFs and specifically the laboratory and pharmacy departments for alignment on the expectations that would assist in planning for data collection. This included a request that the HFs pre-assemble key documents and manuals for review. Doing so saved a significant amount of time during the actual assessment.

2.9.2 HEALTH FACILITY STAFF BRIEFING

Prior to the commencement of the HF assessment, a brief meeting was held with facility and laboratory leadership, and staff with the main purpose of reviewing the agenda of the visit and ensure that the assessment purpose, process, and expected outcome are understood and aligned. The briefing helped to clarify that the assessment activity was intended to unveil areas requiring improvement, and not a "regulatory inspection" by the national government.

2.9.3 TOUR OF THE LABORATORY

After the HF staff briefing, the assessment team had a guided tour of the laboratory, in preparation of documentation and data collection.

2.9.4 REVIEW OF DOCUMENTS, FILLING OF THE QUESTIONNAIRES AND INTERVIEWS WITH HF ADMINISTRATION

Upon completion of the tour, the assessment process commenced with the assessor interviewing the key identified respondents. For the diagnostic component of the assessment, a Medical Laboratory Officer (MLO) was the lead assessor, and (s)he led the project team in data collection and review of documentation during the laboratory assessment session which mainly focused on the microbiology capacity in the laboratory.

For the therapeutic component of the assessment, a pharmacist was the lead assessor, and and (s)he led the project team in data collection and review of documentation during the pharmacy and antibiotic use assessment session which focused on antibiotic use, enquirers on the hospital antibiogram, empiric antibiotic use, and utilization of microbiology results in the management of various infectious diseases was made. Data collection was collected and stored in the digitized tool during the face-to-face interviews with HF pharmacist and his team.

Tablets were used for the digitised responses, and notes were taken alongside this for the qualitative insights that arose during the discussions, especially with HF administrators and other relevant staff including nurse in charge, medical superintendents or human resource manager depending on the setup of the specific HF.

3 DATA ANALYSIS AND RESULTS

3.1 OVERVIEW OF THE ASSESSMENT SITES

As shown in Table 1, 28 HFs participated in the assessment. 2 of the HFs were level 6 and MoH owned, one in Nairobi county and the other in Nyeri County. Of the level 6 HFs, 1 was an annex of KNH, the oldest hospital in Kenya. One of the level 6 hospitals. 7 of the HFs were level 5, 4 being MoH owned and 3 owned by FBOs. The remaining 19 HFs were level 4, 10 owned by MoH, 5 owned by FBOs and 4 owned by private enterprises. Table 2 details the bed capacities and workloads for the participating HFs.

TABLE 2: BED CAPACITIES AND WORKLOADS FOR PARTICIPATING HFS

KEPH/ Ownership	No. of HFs	Bed capacity	Average bed occupancy rate (%)	Inpatient/ Year	Outpatient/ Year	Total workload	% of inpatient	overall % of inpatient
Level 4	19	2,588	59.4	100,304	1,362,839	1,463,143	7.4%	34.64%
NGO/Faith-based/Donors	5	544	59.0	32,074	261,731	293,805	12.3%	11.08%
Private	4	234	54.5	9,006	150,396	159,402	6.0%	3.11%
Public/ Government	9	1,810	61.6	59,224	950,712	1,009,936	6.2%	20.45%
Level 5	7	1,538	50.9	174,019	993,754	1,167,773	17.5%	60.10%
NGO/Faith-based/Donors	3	468	33.6	24,603	307,330	331,933	8.0%	8.50%
Public/ Government	4	1,070	63.9	149,416	686,424	835,840	21.8%	51.60%
Level 6	2	1,000	48.5	15,221	226,798	242,019	6.7%	5.26%
Public/ Government	2	1,000	48.5	15,221	226,798	242,019	6.7%	5.26%
Total	28	5,126	56.5	289,544	2,583,391	2,872,935	11.2%	100.00%

For the one year period under consideration, a total of 2,872,935 patients were seen, with 11.2% (289,544) being inpatient cases. 59% of the inpatient cases seen at level 4 were admitted at government owned HFs, 32% at FBO-owned and 9% at private hospitals. For outpatient cases, 69.6% of those seen at level 4 went to public HFs, 19.3% to FBO owned and 11.1% to private HFs. At level 5 HFs, 85.8% of the inpatient cases were seen at public HFs and 14.2% at FBOs owned HFs. For the outpatient cases, 69.1% were seen at public HFs and 30.9% at FBO owned HFs. Overall, 60.1% of the inpatient cases were seen at level 5, 34.6% at level 4 and 5.3% at level 6.

Established findings suggests that, in balancing variability in patient demand and length of stay, an average bed occupancy of 85% should be targeted for acute hospital wards [19]. Based on this assessment, bed occupancy rates were highest at level 4 with an average of 59.4%. Government owned HFs at both levels 4 and 5 stood at 61.6% and 64% respectively, with the highest occupancy rate being reported by Mama Lucy Kibaki Hospital at 182%, more than 2.5 times the recommended rates. The lowest bed occupancy rates

were observed in the 3 FBO-owned level 5 HFs. The overall average bed occupancy rate for all the HFs considered was 56.5% (Table 2).

The assessment of antimicrobial resistance diagnostics capacity and antibiotic use in counties (AADCAUC) was considered under two broad components, the diagnostic which focused mainly on AMR diagnostic capacity and the therapeutic component which focused mainly on Abx use. These are discussed in detail in the sections below.

3.2 DIAGNOSTIC COMPONENT

The findings from analysis relating to this component enabled understanding of current AMR diagnostics, supply and gaps, current use cases for AMR diagnostics, practices, regulatory needs, and willingness to pay for AMR diagnostic services in the selected counties. Reporting was aligned with specific sub-objectives as discussed in the sections below.

3.2.1 CURRENT AMR DIAGNOSTICS IN THE SELECTED COUNTIES

In order to understand the AMR diagnostics in the counties, the assessment considered the laboratory human resource establishment including their levels of training, the number of HFs able to perform cultures and the different types of diagnostic equipment available.

LABORATORY STAFF ESTABLISHMENT

TABLE 3: LABORATORY STAFF ESTABLISHMENT AT THE PARTICIPATING HFS

KEPH/Ownership	No. of HFs	Total staff	GoK Employed	Paid by other organization	Aged 20-35	Aged 36-50	Aged over 50
Level 4	19	200	123	5.5%	60.0%	34.5%	7.0%
NGO/Faith-based/Donors	5	58	-	0.0%	75.9%	20.7%	3.4%
Private	4	11	-	0.0%	63.6%	18.2%	18.2%
Public/ Government	10	131	123	8.4%	52.7%	42.0%	7.6%
Level 5	7	173	99	1.7%	51.4%	41.6%	6.9%
NGO/Faith-based/Donors	3	71	-	0.0%	57.7%	38.0%	4.2%
Public/ Government	4	102	99	2.9%	47.1%	44.1%	8.8%
Level 6	2	73	58	20.5%	52.1%	45.2%	2.7%
Public/ Government	2	73	58	20.5%	52.1%	45.2%	2.7%
Grand Total	28	446	280	6.5%	55.4%	39.0%	6.3%

Staff are the most important resource for any laboratory. There must be sufficient numbers of staff with appropriate qualifications and training to ensure that laboratory operations are effective, and all staff are

adequately supervised. All laboratory staff must be properly trained for the work they are expected to perform, and provided with the authority and resources to carry out their responsibilities [25].

Level 6 HFs had an average of 27 laboratory staff per HFs. The average number of laboratory staff at MOH owned level 5 HFs is 26, and for the FBO owned is 24. For level 4 HFs, the average numbers are 14 for MOH owned, 3 for private and 12 for FBO owned HFs.

However, in many countries, especially in LMICs, there is scarcity of skilled professionals, capable of generating quality AST laboratory results, interpreting AMR data, or designing relevant and representative AMR surveillance protocols that are required for solid AMR surveillance systems. Efforts to address the laboratory workforce shortage are further complicated by the fact that competency standards for AMR surveillance are not well defined, even in reference laboratories [2]. One of the ways of bridging this gap is in ensuring availability of adequate laboratory staff in HF with requisite and relevant trainings.

From the assessment, we see from the summary provided in Table 3 that there were a total of 446 laboratory staff available at all the participating HFs. 55.4% of the laboratory staff were in the 20-35 age bracket, 39% in the 36-50 and only 6.3% are aged over 50. Level 4 HFs have a slightly higher number of the younger laboratory staff compared to the other levels of service. Overall, 6.5% of the laboratory staff in government owned HFs are supported by other organisations. 19% of the laboratory staff working in level 6 HFs that were assessed are paid for by other organisations, 2.9% of those in level 5 and 8.8% of those in level 4 are also paid for by other organisations. To obtain the average number of lab staff reported in the text box, the total staff numbers were distributed across the HFs visited for the assessment as summarised in Table 3.

A well-trained laboratory workforce is critical in ensuring that laboratories have the requisite capacity to perform the critical activities that are needed to competently and effectively safeguard the health of members of the public or population. Laboratory competencies include general domains that apply to the responsibilities of all public health laboratory professionals, including bench scientists, laboratory managers and leaders and other laboratory staff. This general domain covers ethics, management and leadership, emergency response, communication, security and work force training. Laboratory competencies also cover cross-cutting technical domains that apply to all laboratory scientists regardless of the discipline in which they work such as general laboratory practices, safety, surveillance and informatics. Finally, laboratory competencies also cover specialized domains specific to laboratory scientists who work in particular scientific disciplines or specialized functional areas such as chemistry, microbiology, bioinformatics and research [5]. Concerning education and training levels, 64.9% of the

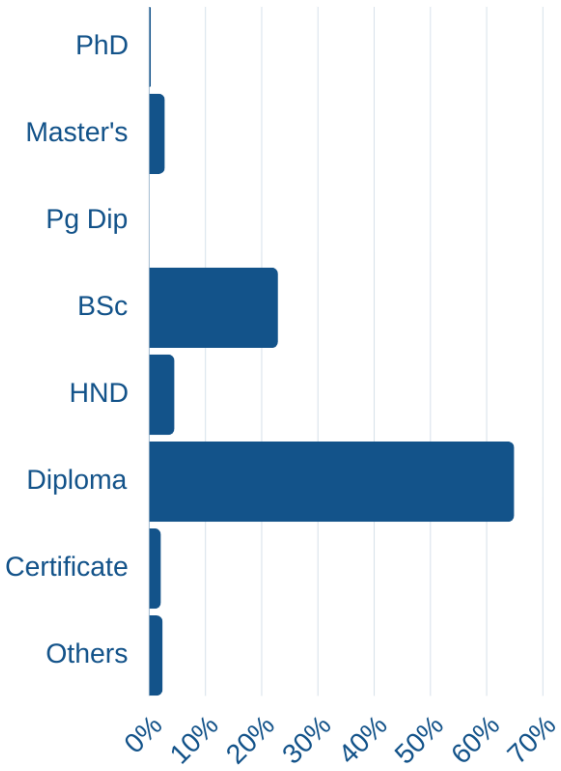

FIGURE 3: **DIFFERENT LEVELS OF TRAINING FOR LABORATORY STAFF**

laboratory staff from assessed HFs held a diploma, 22.9% held a Bachelor of science (BSc.) and 4.5% had a higher national diploma (HND), either in medical microbiology or medical laboratory sciences. Other levels of training included PhD. (1 staff from one of the level 5 FBO HF), Masters (2.8%), certificate (2.1%) and a cluster of unspecified trainings (2.4%) (Figure 3).

On workplace skills development, 8 out of 28 (28.6%) HFs reported that there were no standardized process for training new employees. For the remaining HFs, the training process for new employees was mainly through on-job training (OJT) , staff orientation using standard operating procedures (SOPs), competency trainings, mentorship and continuing medical education (CME) sessions. 18 (64.3%) of the HFs reported that their staff received annual competency trainings which involved review of the laboratory test menu.

LABORATORY CERTIFICATION, MENTORSHIP AND OPERATIONS

Laboratory certifications are important for verifying that the laboratory staff have sufficient knowledge of laboratory practices and regulations to meet care and safety standards for HFs. Through certification preparation, training and renewal, the laboratory personnel remain updated on new developments for laboratory standards and systems. Medical laboratory accreditation is a means of determining the technical competence of a medical laboratory to perform specific types of testing, measurement, and calibration of equipment. Medical laboratory accreditation also provides a formal recognition to competent laboratories, thus providing a ready means for customers to identify and select reliable testing and measurement services able to meet the customers' needs [13].

The SLIPTA is a programme that trains laboratory managers to improve laboratory operations using available resources and achieve international accreditation standards. It provides a stepwise approach to measuring progress towards accreditation. SLMTA is a U.S. President's Emergency Plan for AIDS Relief (PEPFAR) flagship program for strengthening laboratory systemsSLMTA is an international laboratory improvement program designed for LMICs. While SLIPTA measures the laboratory quality by conducting audits, SLMTA provides the how-to with training and mentoring. These 2 programs complement each other and together they provide the tools and processes needed to turn the aspirations of lab accreditation into reality [4, 21].

This assessment sought to establish which HFs had obtained the SLIPTA and /or SLMTA certification by the time of the assessment and whether this certification had been obtained within the last 2 years of the assessment or 2 years prior. It also sought to establish if the HFs had obtained a valid ISO 15189 certification. From Table 4, only 7 (21.4%) HFs had enrolled in either the SLIPTA or SLMTA mentorship programme or both. 2 HFs reported that they had commenced the enrolment process into the SLIPTA and/ or SLMTA programmes. With respect to laboratory certification, only 6 HFs had a valid ISO 15189 certification. None of the 2 level 6 HFs assessed had obtained either of the certifications or a valid ISO 15189 certification. All the 4 MoH owned level 5 HFs and 2 out of the 9 MoH owned level 4 HF visited had the SLIPTA or SLMTA certification. All HFs with SLIPTA or SLMTA had received their certification more than 2 years prior to the assessment date. Of these, only 3 indicated the star levels for their latest SLIPTA audits. One had a 5 star rating, one a 3 start and the last one a 2 star rating. In addition, Only 14.3% (4) of the HFs had enrolled for the Kenya External Quality Assessment Scheme (KNEQAS) programme, one enrolled in 2019, another in 2021 and the other two in 2023. Another 2 HFs were enrolled in the Human Quality Assessment Services (HuQAS) programme.

TABLE 4: LABORATORY CERTIFICATION

KEPH/Ownership	No. of HFs	SLIPTA/ SLMTA	None	Ongoing Registration	valid ISO 15189	Functioning Backup for critical equipment	UPS for critical equipment
Level 4	19	2	17	0	3	8	6
NGO/Faith-based/Donors	5	0	5	0	1	2	1
Private	4	0	4	0		2	2
Public/Government	9	2	2	0	2	4	3
Level 5	7	5	2	2	3	3	2
NGO/Faith-based/Donors	3	1	2	1	1	2	1
Public/Government	4	4	0	1	2	1	1
Level 6	2	0	2	0	0	1	1
Public/Government	2	0	2	0	0	1	1
Grand Total	28	7	21	2	6	12	9

TABLE 5: HFS ENROLLED IN SLIPTA AND SLMTA PROGRAMMES

(a) ENROLLED FOR SLIPTA

County	Sub-county	Ward	Name of HF	KEPH Level	Ownership
Nandi	Emgwen	Kapsabet	Kapsabet County Referral Hospital	Level 5	Public
Kericho	Ainamoi	Kipchebor	Kericho County Referral Hospital	Level 5	Public
Vihiga	Hamisi	Shiru	Jumuia Mission Hospital Kaimosi	Level 5	FBO

(b) ENROLLED FOR SLMTA

County	Sub-county	Ward	Name of HF	KEPH Level	Ownership
Kericho	Ainamoi	Kipchebor	Kericho County Referral Hospital	Level 5	Public
Kilifi	Kaloleni	Mariakani	Mariakani Sub County Hospital	Level 4	Public
Kilifi	Kilifi North	Sokoni	Kilifi County Hospital	Level 4	Public

The assessment also covered whether the laboratories had a functioning back-up or Uninterruptible Power Supply (UPS) for critical equipment. For this, 12 (42.9%) HFs had a functioning back-up system, and 9 (32.1%) had a UPS for critical equipment. The assessment also investigated what tests were covered by the ISO 15189. Only one HF specified that their ISO certification covered AST, urine Cultures and organism identification. The ISO 15189 certification for the laboratories had been awarded by Kenya Accreditation Service (KENAS). In addition, from the assessment it was established that 89.3% (25) of the HFs had an inventory control system, out of which 80% (20 out of 25) used a manual system. Only 3 HF reported to have a software for inventory control.

ABILITY TO PERFORM CULTURES

The majority of infectious diseases are bacterial in origin. In the care continuum, the ability of a laboratory to culture these microorganisms and determine the sensitivity and resistance of specific pathogens to a wide range of antimicrobial agents becomes the best way to determine the bacterial pathogens associated with diseases and to guide selection of the appropriate antimicrobial by the healthcare provider[3, 22]. The HFs that were involved in the assessment exercise were asked whether they had the ability to perform cultures. Out of the 28, only 15 (53.6%) had the ability to perform cultures, and only 4 (14.3%) had the ability to perform fungal cultures (see Table 6). The 2 level 6 HFs and all the level 5 HFs had capacity to perform cultures. The largest gap with respect to the ability to conduct cultures was seen in level 4 HFs with only 31.6% having the ability to perform cultures even as 50.9% of the total population served by the HFs considered in this assessment are seen in the level 4 HFs. 80% of FBO owned level 4 HFs had the ability, and only 20% of the MoH owned facilities were able to perform cultures. From Table 6, it was noted that of the 4 level 4 private HFs assessed, none were able to perform any cultures.

TABLE 6: PROPORTION OF HFS WITH ABILITY TO PERFORM CULTURES

KEPH/Ownership	No. of HFs	Ability to perform cultures	Ability to perform fungal cultures	Proportion of workload
Level 4	19	31.6%	5.3%	50.9%
NGO/Faith-based/Donors	5	80.0%	20.0%	10.2%
Private	4	0.0%	0.0%	5.5%
Public/Government	10	22.2%	0.0%	35.2%
Level 5	7	100.0%	28.6%	40.6%
NGO/Faith-based/Donors	3	100.0%	33.3%	11.6%
Public/Government	4	100.0%	25.0%	29.1%
Level 6	2	100%	50%	8.4%
Public/Government	2	100%	50%	8.4%
Total	28	53.6%	14.3%	100.0%

TABLE 7: LIST HFS WITH ABILITY TO PERFORM CULTURES

County	Sub county	Ward	Name of health facility	HF LEVEL	HF OWNERSHIP
Nairobi	Roysambu	Kahawa	Kenyatta University Teaching Refferal and Research Hospital	Level 6	Public/Government
Nyeri	Nyeri South	Iria-ini	KNH Othaya Annex	Level 6	Public/Government
Kericho	Bureti	Litein	AIC Litein Mission Hospital	Level 5	NGO/Faith-based/Donors
Vihiga	Hamisi	Shiru	Jumuia Mission Hospital Kaimosi	Level 5	NGO/Faith-based/Donors
Nandi	Emgwen	Kapsabet	Kapsabet County Referral Hospital	Level 5	Public/Government
Kericho	Ainamoi	Kipchebor	Kericho County Referral Hospital	Level 5	Public/Government
Kirinyaga	Kirinyaga Central	Kerugoya	Kerugoya County Refferal Hospital	Level 5	Public/Government
Nairobi	Embakasi Central	Komarock	Mama Lucy Kibaki Hospital (Embakasi)	Level 5	Public/Government
Nairobi	Starehe	Nairobi South	The Mater Misericordiae Hospital (Mukuru)	Level 5	NGO/Faith-based/Donors
Nairobi	Dagoreti North	Kilimani	Coptic Hospital	Level 4	NGO/Faith-based/Donors
Kajiado	Kajiado Central	Ildamat	Kajiado County Referral Hospital	Level 4	Public/Government
Isiolo	Isiolo	Bulla Pesa	MaterCare Maternity Hospital	Level 4	NGO/Faith-based/Donors
Laikipia	Laikipia East	Nanyuki	Nanyuki teaching and Referral Hospital	Level 4	Public/Government
Laikipia	Laikipia west	Igwamiti	Pope Benedict XVI Hospital	Level 4	NGO/Faith-based/Donors
Kilifi	Malindi	Barani	Tawfiq Hospital	Level 4	NGO/Faith-based/Donors

Table 7 shows a list of the HFs that had the ability to perform cultures. The 15 HFs could be mapped from all the 10 Counties that participated meaning all the 10 counties were represented, even if not by a similar number of HFs. 2 of them were level 6, 7 were level 5 and 6 were level 4 HFs. Of all the HFs visited, no privately owned HFs had the ability to perform cultures. 7 of the HFs were FBO owned, and 8 were public or government owned.

The assessment further investigated which HFs had capacity for the cultures listed in Figure 4. Of the 28 HFs visited, 13 (46.4%) did not have capacity to perform any cultures; only 8 (28.6%) could perform blood and lower respiratory cultures; 11 (39.3%) could perform Cerebrospinal fluid (CSF) cultures, 12 (42.9% could perform upper respiratory and sterile body fluid cultures, 14 (50%) could perform urine, genital, High Vaginal Swab (HVS) and pus, aspirates and tissue cultures, 15 (53.6%) HFs could perform stool cultures and none of the facilities indicated that they performed TB cultures. The HFs further indicated that Samples for blood cultures were only collected by either the lab personnel or the clinical phlebotomist.

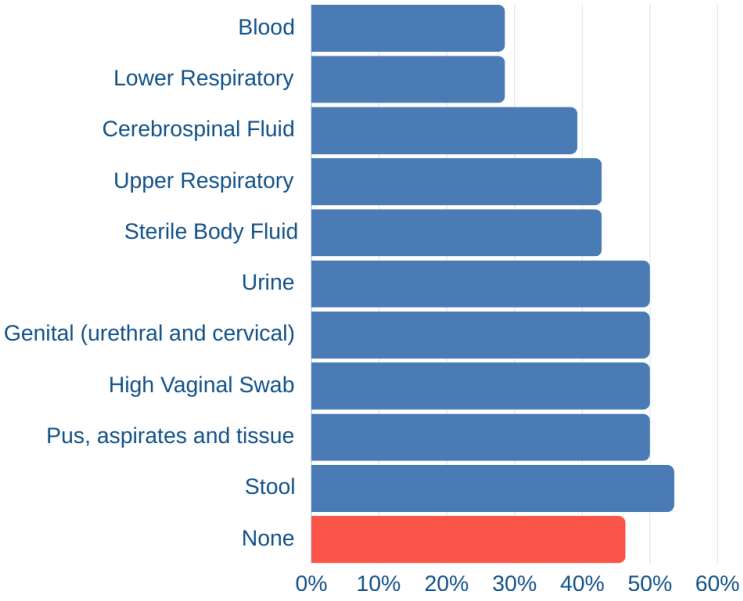

FIGURE 4: **NO. OF HFS WITH LISTED CULTURES**

ABILITY TO PERFORM BLOOD CULTURES

Table 8 provides a list of the 8 HFs that had the ability to perform blood cultures including the type of equipment they owned. Of the 8, 5 used an automated blood culture machine while the other 3 used a manual one. Of the 5 with automated blood culture machines, 4 used Bactec (KUTRRH, Kajiado CRH, Kericho CRH and Mater Misericordiae Hospital), and 2 used BacT/ALERT (Coptic Hospital and Kericho CRH) (Kericho CRH had both). None of the HFs used the TDR automated blood culture system.

TABLE 8: **HFS WITH ABILITY TO PERFORM BLOOD CULTURES**

County	Sub-county	Equipment	Name of HF	KEPH Level	Ownership
Nairobi	Roysambu	Bactec	KUTRRH	Level 6	GoK
Nyeri	Nyeri South	Manual	KNH Othaya	Level 6	GoK
Kericho	Bureti	Manual	AIC Litein	Level 5	FBO
Kericho	Ainamoi	Bactec & BacT/ALERT	Kericho CRH	Level 5	GoK
Nairobi	Starehe	Bactec	Mater Hospital	Level 5	FBO
Nairobi	Dagoreti North	BacT/ALERT	Coptic Hospital	Level 4	FBO
Kajiado	Kajiado Central	Bactec	Kajiado CRH	Level 4	GoK
Laikipia	Laikipia East	Manual	Nanyuki TRH	Level 4	GoK

In order to determine operational levels or deficiencies on the laboratories that had the ability to carry out cultures, the assessment sought to establish whether in the last six months preceding the assessment, the HFs had experienced any prolonged power failures that disrupted their operations, whether they had carried out Quality assurance / quality control (QA/QC), whether they had experienced stock-outs, and how this had affected their operations. For this period, among the 15 HFs with the ability to perform different cultures, it was observed that they had not experienced any Prolonged power failure that disrupted their ability to provide routine bacteriology services, only 8 had carried out a QA/QC audit, 6 had

however experienced stock-outs for specimen collection materials, 4 had experienced stock-outs of consumables such as gloves, agar plates, another 4 had experienced stock-outs of antibiotic disks or strips, and 2 had experienced stock-outs of either ID or AST cards/trays for automated instruments. From the assessment, 14 had the ability to perform AST,

3.2.2 RESULTS FROM SOME OF THE CULTURES PERFORMED

Table 9 shows some results from the cultures that were performed in the HFs in the last 12 months prior to the assessment (August 2022 to September 2023). The largest number of cultures performed were blood cultures while genital cultures were the least performed. There were some data quality issues on the test results since some tests seemed not to have been accounted for. The largest non accounted for tests were blood cultures, where 4,608 cultures were done, but only 59% were accounted for in terms of positive, negative and contaminated samples. Others with large amounts of incomplete data included genital, upper respiratory, lower respiratory, and urine cultures. This data incompleteness could be largely attributed to the use of paper based laboratory reporting systems. Form Table 9, it can also be noted that blood cultures had the longest Turn Around Time (TAT) (8 to 10 days) of all the cultures considered. The others all averaged from 3 to 5 days TAT.

TABLE 9: RESULTS FROM CULTURES PERFORMED

Culture	Average TAT in hrs	No. Performed in last 12 months	No. of Positives	No. of Negatives	No. Contaminated	Unaccounted
Blood	202.4	4608	606 (13.2%)	1815	293	1894 (41.1%)
Urine	80.6	5186	1321 (25.5%)	2709	34	1122 (21.6%)
Stool	88	2933	877 (29.9%)	1758	50	248 (8.5%)
Lower Respiratory	84	725	149 (20.6%)	375	0	201 (27.7%)
Upper Respiratory	90	944	160 (16.9%)	380	0	404 (42.8%)
CSF	78.5	886	100 (11.3%)	774	2	10 (1.1%)
Sterile Body Fluid	84	862	61 (7.1%)	661	0	140 (16.2%)
Genital (urethral and cervical)	84	641	122 (19%)	245	11	263 (41%)
High Vaginal Swab	84	1447	345 (23.8%)	1065	8	29 (2%)
Pus, aspirates and tissue	84	1937	625 (32.3%)	1168	7	137 (7.1%)

3.2.3 GRAM STAINING AND AST

Gram Staining is the common, important, and commonly used differential staining technique in microbiology. This test differentiates the bacteria into Gram Positive and Gram Negative, which helps in the classification and differentiation of microorganisms and is useful for guiding empiric clinical management for bacterial infections pending definitive culture and/or molecular data. Table 10 shows the capacities available for gram staining and AST, including the existing referral approaches for patients or isolates where the capacity lacked. Out of the 28 HFs who participated in the assessment, 78.6 (22) had capacity to perform gram staining and 50% (14) had capacity

TABLE 10: CAPACITY FOR GRAM STAINING AND AST

KEPH/Ownership	No. of HFs	Gram staining	AST Capacity	AST referral	Patient referral	Isolates referral
Level 4	18	68.4%	31.6%	63.2%	58.3%	66.7%
NGO/Faith-based/Donors	5	100.0%	80.0%	20.0%	0.0%	100.0%
Private	4	25.0%	0.0%	100.0%	50.0%	75.0%
Public/Government	9	70.0%	20.0%	70.0%	71.4%	57.1%
Level 5	7	100.0%	85.7%	0.0%		
NGO/Faith-based/Donors	3	100.0%	100.0%	0.0%		
Public/Government	4	100.0%	75.0%	0.0%		
Level 6	3	100.0%	100.0%	0.0%		
Public/Government	3	100.0%	100.0%	0.0%		
Total	28	78.6%	50.0%	42.9%	58.3%	66.7%

for AST. All the level 6, level 5 and FBO owned level 4 HFs had capaity for gram staining.

Of the 14 HFs who did not have capacity for AST, 12 (42.9%) of them relied on referral of either patients or isolates. Of the 12 who referred for AST, 7 (58.3%) referred their patients while 8 (66.7%) referred isolates. Some HFs did both. Referral only happened at the level 4 HFs. Given that most of the referrals originated from level 4, where the privately owned HFs were referring for all their AST needs, 30.8% of the referrals were to private laboratories with another 23.1% going to other private hospitals implying that private establishments received more than 50% of the total referrals. 23.1% of the referrals were also going to other public level 5 hospitals (county referral hospitals) and about 15.4% were sent to the national microbiology reference lab. 7.7% of the referrals ended up in other public level 4 HFs.

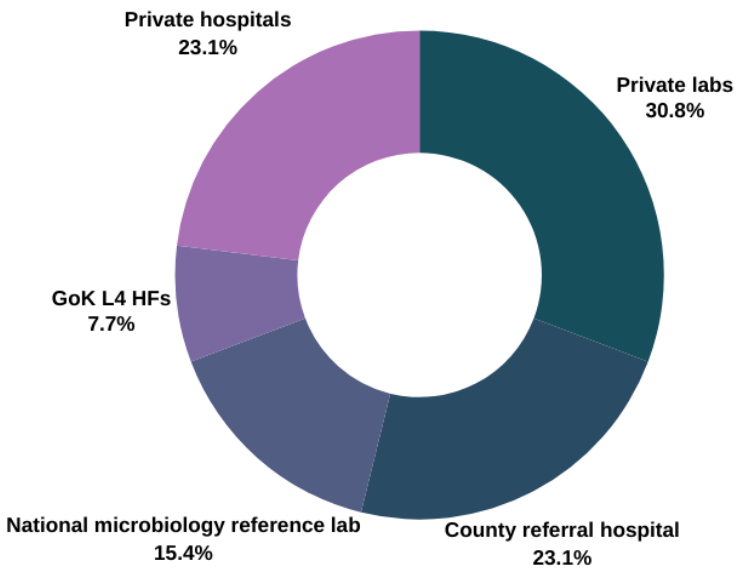

FIGURE 5: AST REFERRAL PATHWAYS FOR PATIENTS OR ISOLATES

3.2.4 SUPPLY OF EQUIPMENT AND TESTING COMMODITIES IN THE SELECTED COUNTIES

EQUIPMENT USED FOR AUTOMATED BLOOD CULTURE

Automated blood culture systems are intended to make the processing of blood cultures more efficient. They enhance the speed of the blood culture report and hence provide improved therapeutic results since they are more sensitive and rapid in detecting septicaemia in patients. 5 of the 8 HFs with the ability to perform blood cultures used an automated machine (See Table 8), and the equipment are as summarised in Table 11 The average TAT on the Bactec was 138 hours, and all of them were functional on the assessment day. 75% (3) of HFs had routine maintenance records, 75% had vendor maintenance records, but there were no service contract in place. Procurement of the Bactec machines was through County government, donor and hospital budgets for different HFs. 75% of HFs using Bactec cited consumable supply constraint as a key challenge in addition to availability of a service contract and trained staff. All Bactec machines were manufactured by BD, and they had all been re-calibrated in 2023 (within the year of assessment).

TABLE 11: AUTOMATED BLOOD CULTURE MACHINES

HF LEVEL	Ownership	Blood culture machine	Manufacturer
Level 4	FBO	BacT/ALERT	Biomerieux
	Public	Bactec	BD
Level 5	Public	Bactec, BacT/ALERT	BD/Biomerieux
	FBO	Bactec	BD
Level 6	Public	Bactec	BD

The average TAT on the BacT/ALERT was 204 hours, all were functional on the assessment day, user manuals, routine and vendor maintenance records were present, and the service contracts were in place.

The BacT/ALERT machines had been re-calibrated within 3 months of the assessment date. They had been purchased by county government and hospital budgets. 50% of HFs who had the BacT/ALERT had also experienced a consumables supply constraint. The BacT/ALERT machines were manufactured by Biomerieux

EQUIPMENT USED FOR AST

14 HFs had the ability to perform AST either using manual or automated systems or both. It was noted that none of the HFs used Chromagar to detect antibiotic resistant organisms. In addition, none of the labs had a polymerase chain reaction (PCR) (or other nucleic acid tests (NAT)) instruments or machines used for detecting antibiotic resistance genes. Only one HF conducted specific testing for the detection of methicillin-resistant Staphylococcus aureus (MRSA), Vancomycin-resistant Enterococci (VRE), carbapenem and/or 3rd generation cephalosporin resistance, and they used Phenotypic (Chromogenic media, CarbaNP). This was Jumuia Mission Hospital Kaimosi. 4 of the HFs visited reported to receive samples from other HFs for culture and AST, but none of the HFs received isolates from other HFs. The various equipment used for AST are summarised in Table 12. The most preferred manual AST method was disk diffusion (87.5%). Agar dilution and gradient strip accounted for 6.3% each. None of the HFs used either broth micro-dilution (96-well tray or tube method). On the other hand, the most preferred automated AST method was Vitek (66.7%) followed by Phoenix (22.2%) and finally BIOMIC at 11.2%. None of the HFs used either microscan or SIRScan.

TABLE 12: AST MACHINES

HF LEVEL	HF OWNERSHIP	Manual AST			Automated AST		
		Disk diffusion	Gradient strip	Agar dilution	Vitek	Phoenix	BIOMIC
Level 4	FBO	4			1		
	Public	2			1	1	
Level 5	FBO	3		1	1		
	Public	3			2	1	
Level 6	Public	2	1		1		1

LABORATORY INFORMATION SYSTEMS

The assessment also focused on existing LISs and their functionalities or capabilities. LIS are programs or software used to record and transmit testing data. They aid in the prevention of medical errors during transfer of information or administration of testing, and help in the retrieval of lab results in addition to supporting day-to-day operations of a medical laboratory to run more smoothly. On availability of LISs, the assessment needed to establish whether HFs had any in place and if these LISs supported entry of AST data. Only 19% of the HFs had a LIS. The most popular forms of recording systems were a combination of electronic and paper-based (38.1%) and paper-based (33.3%). A smaller number (9.5%) used an electronic but not LIS. The systems did not record

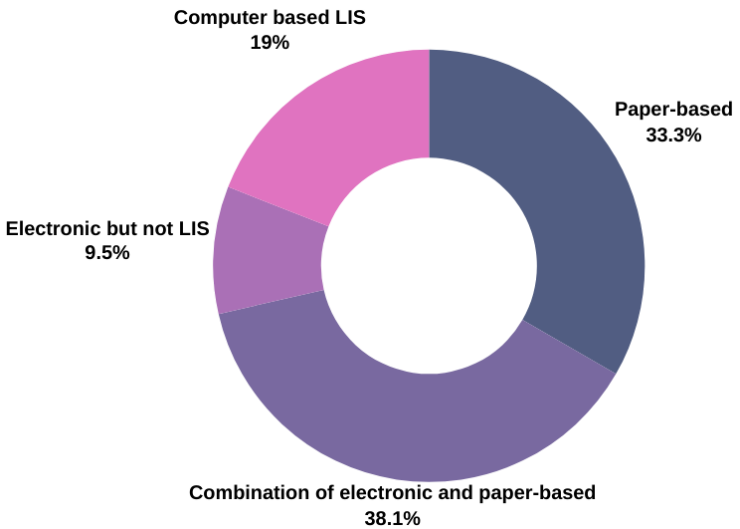

FIGURE 6: LIS USED IN THE HFS

the AST method (with the exception of one HF), and they could not automatically interpret the inhibition zone. The systems could not produce a cumulative antibiogram (with the exception of 1 HF which was able to develop this quarterly). The systems were also not interfaced with the automated AST instruments. 50% of the combined electronic and paper-based systems interfaced with the Health Information systems (HISs) available at some of the HFs, and were used to report to the clinician as well as the clients. For HFs with a LIS, all except one facility had data updated on the system by lab personnel. One HF had data updated by the microbiologist in charge. The was no data entry done by student/interns, data entry clerks or IT personnel based in these HFs.

3.2.5 GAPS IN AMR DIAGNOSIS CONTINUUM IN THE SELECTED COUNTIES IN KENYA

In order to implement a coherent system for AMR surveillance, it is critical for the laboratory to have adequate capacity. The assessment of laboratory capacity to establish capacity for culture and sensitivity, focus should be on infrastructure and resource capacities and management and AMR surveillance practices. In terms of infrastructure and resource capacities, it is important to consider materials and equipment, staffing levels, microbiology competency, safety training, safe environment and certification. Under AMR surveillance practices, the key considerations are quality assurance and management and dissemination of data [14].

From the assessment, 13 HFs did not have the ability to perform cultures. The main reason for lack of capacity to perform cultures was lack of equipment and reagents and consumables Lack of mentorship accounted for 8.7% of these reasons (Figure 7). These barriers were also assessed for HF that did not have the ability to perform blood cultures specifically, and the reasons for these gaps were broken down equipment (2.9%), testing costs (2.9%), human resource for health (HRH) shortages (5.9%), training and mentorship (11.8%), lack of reagents and consumables (14.7%), low requests from clinicians (14.7%) and lack of equipment (38.2%) (Figure 8). Below, we discuss the specific gaps under the two broad subcategories.

GAPS IN INFRASTRUCTURE AND RESOURCE CAPACITIES

For starters, 13 of the HFs assessed could not perform blood cultures since they lacked the equipment and the materials for culture and sensitivity testing. For the 8 HFs that had capacity to perform blood cultures, only 5 used automated machines, and of those with the Bactec, they did not have a service contract in place in addition to 75% of them experiencing consumable supply constraints and lack of trained staff (shortage in microbiology competency). 50% of those HFs using the BacT/ALERT machine also experienced consumable supply constraints. Staff training and mentorship was also a barrier to accessing. One of the biggest barriers was certification and enrolment into

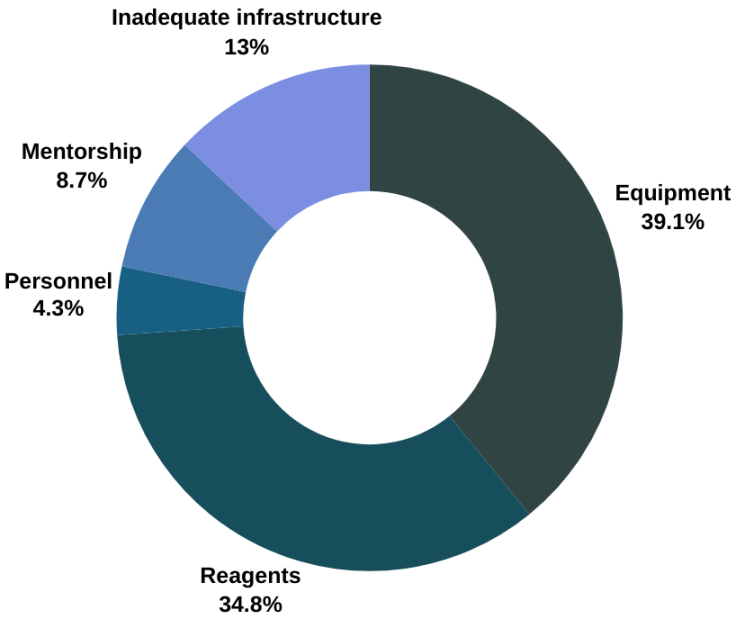

FIGURE 7: **BARRIERS TO PERFORMING CULTURES**

various training programmes like SLIPTA and/ or SLMTA. Only 6 HFs had enrolled into the SLIPTA program, and only 6 HFs had a valid ISO 15189 certification. In terms of ability to operate smoothly even despite power disruptions or outages, only 12 HFs had a functioning backup for critical equipment, and only 9 had UPS for critical equipment.

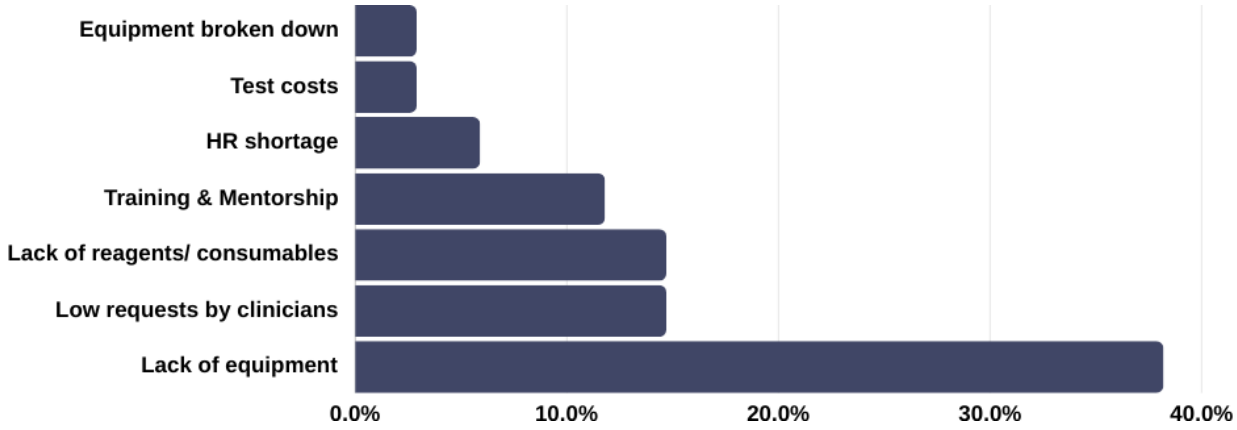

FIGURE 8: BARRIERS TO PERFORMING BLOOD CULTURES

Figure 7 highlights some of the barriers to performing cultures, and Figure 8 further highlights barriers specific to performing blood cultures.

GAPS IN AMR SURVEILLANCE PRACTICES

The biggest gap here was the over reliance on paper based tool and lack of a LIS. Only 19% of the HFs had a computer based LIS, and this contributed to the data management processes experienced in the HFs. There were numerous data gaps, and for example 41% of the blood culture tests during the period under review were not accounted for (Table 9). The systems did not record the AST method (with the exception of one HF), did not automatically interpret the inhibition zone, did not produce a cumulative antibiogram (with the exception of 1 HF which was able to develop this quarterly) and were not interfaced with the automated AST instruments. Other barriers included low requests from blood cultures by clinicians.

3.2.6 AVERAGE COST AND MODE OF PAYMENT FOR AMR DIAGNOSIS IN THE SELECTED COUNTIES

In the healthcare continuum, culture and sensitivity tests are essential diagnostic tools for identification of the presence of bacterial or fungal infections in patients. the testing involves collection of samples from body fluids such as blood, urine or sputum, or tissue, and growing it in a laboratory to observe the growth and activities of microorganisms. In LMICs the costs for culture and AST may at times hinder access to these services since in most cases the patients have to pay for them. From the assessment, it was noted that most of the the culture

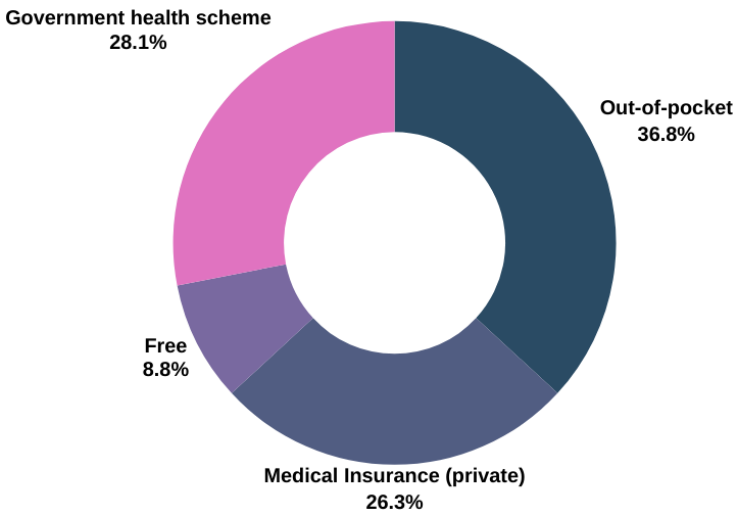

FIGURE 9: MODES OF PAYMENT FOR DIAGNOSTIC TESTS

and sensitivity testing is paid for from
out-of-pocket (36.8%) followed by government health schemes (28.1%), private medical insurance (26.3%) with only 8.8% getting this as a free service. For paying clients, the average cost are Shs. 1,513.6 with prices ranging from as low as Shs. 200 and going as high as Shs. 2,900. With respect to blood culture specifically, paying clients spend on average Shs. 1,900 with prices ranging from Shs 1,000 upto Shs. 6,000.

3.3 THERAPEUTIC COMPONENT

This was the second area of focus in this assessment, and the aim was to establish the practice around Abx use. Prudent and rational utilization of antimicrobials is essential in clinical practice. This approach optimizes treatment effectiveness while minimizing the risks related to emerging infections and the development of resistant pathogens. Judicious antimicrobial management decisions form an integral part of responsible medication prescribing behaviour [3].

When prescribing antimicrobial therapy, it is important to consider obtaining an accurate diagnosis of infection; understanding the difference between empiric and definitive therapy, identifying opportunities to switch to narrow-spectrum, cost-effective agents that will be used for the shortest duration possible where necessary; understanding drug characteristics that are peculiar to antimicrobial agents ; taking into account the host characteristics that influence antimicrobial activity; and recognizing the adverse effects of antimicrobial agents on the host. Some of the most widely, and often injudiciously, used therapeutic drugs the world over are antimicrobial agents [12].

The findings from this assessment will help map and identify the practices in the utilization of antimicrobial therapy in the participating HFs, and help identify pathways for introduction of new reserve antimicrobial therapeutics such as **Cefiderocol (S-649266)**, a novel combination of a catechol-type siderophore and a cephalosporin antibiotic which recently received US Food and Drug Administration (FDA) approval for the treatment of complicated urinary tract infections (UTIs), including pyelonephritis [26].

3.3.1 STAFF STRENGTH, WARD INFRASTRUCTURE AND DRUG DISPENSATION

TABLE 13: STAFF STRENGTH AT MEDICAL AND PHARMACY UNITS

KEPH/ Ownership	No. of HFs	Infectious disease specialists	Physicians at ICU	Medical Officers	Interns	Pharmacists in HFs	No. of pharm techs in HFs	Nearby 24 Hr pharmacies
Level 4	19	1	19	156	218	47	110	19
FBO	5	1	11	32	1	8	24	5
Private	4	0	0	8	0	0	11	2
Public	10	0	8	116	217	39	75	12
Level 5	7	3	3	95	81	21	80	6
FBO	3	2	1	56	11	6	70	4
Public	4	1	2	39	70	15	10	2
Level 6	2	1	11	198	44	31	31	3
Public	2	1	11	198	44	31	31	3
Total/Average	28	5	33	449	343	99	221	29

WHO recommends that health systems engage adequate HRH given that they constitute the building blocks for a well functioning health system for delivery of improved population health [17]. WHO recommends a

[3] https://infectionsinsurgery.org/judicious-use-of-antibiotics

TABLE 14: **HF NURSING STAFF**

KEPH/ Ownership	No. of HFs	Nurses in medical unit	Medical unit bed capacity	Medical unit patient nurse ratio	Nurses in surgical unit	Surgical unit bed capacity	Surgical unit patient nurse ratio	Nurses in ICU	ICU bed capacity	ICU patient nurse ratio	Nurses in HDU	HDU bed capacity	HDU patient nurse ratio
Level 4	19	229	762	7.4	145	553	4.8	51	44	3.8	52	44	7
FBO	5	84	178	4.8	38	81	5	16	17	6.5	10	10	6.5
Private	4	13	28	4.9	8	30	2.6	0	0	0	0	0	0
Public	10	132	556	9.8	99	442	6.8	35	27	2.1	42	34	7.2
Level 5	7	61	210	4.4	48	213	2.4	24	31	3.2	15	14	4.4
FBO	3	15	90	5.7	14	95	1.3	16	14	2.5	8	6	3.6
Public	4	46	120	3.7	34	118	3.4	8	17	4.6	7	8	5.2
Level 6	2	50	152	1.8	48	152	2	37	46	6.4	0	0	0
Public	2	50	152	1.8	48	152	2	37	46	6.4	0	0	0
Total/Average	28	340	1124	6.5	241	918	4.5	112	121	3.8	67	58	5.6

health workforce density of 44.5 doctors, nurses and midwives per 10,000 population if the SDGs are to be achievable [15]. However, there is a chronic shortage of health workers globally.

We see from Table 13 that there were a total of 5 (0.6%) infectious disease specialists out of all the 28 HFs assessed. Only 1 FBO owned level 4 had an infectious disease specialist. All the private and public HFs had none in post during the assessment period. Most of the physician capacity was constituted by medical officers (54.1%) and interns (41.3%). There were a total of 33 (4%) physicians from all the HFs combined. For pharmaceutical staff, all HFs combined had 221 (69.1%) pharmaceutical technologists and 99 (30.9%) pharmacists. From Table 14, we note that most of the nursing staff were found in the medical unit (44.7%) followed by the surgical unit (34.7%), then nurses in intensive care unit (ICU) (14.7%) and high dependancy unit (HDU) (8.8%).

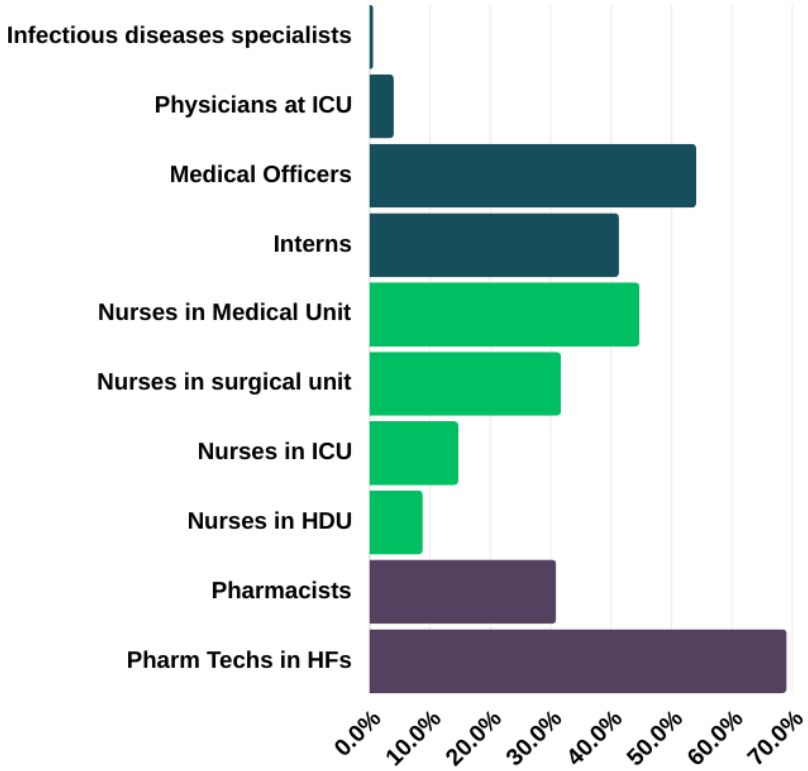

FIGURE 10: **PHYSICIANS, NURSES & PHARMACEUTICAL STAFF**

The current practice at level 6 HFs is that the ICU and HDU units are combined into one critical care unit (CCU) and so the nursing staff available for both units were collapsed into one under ICU in Table 13. In Figure 10, every different shade of colour represents a different classification of staff considered in total. Dirty green represents physician staff of different cadres, the green represents nursing staff in different departments and the purple represents the pharmacy staff. Details of the pharmacists and satellite pharmacies including nearby 24 hour pharmacies are in Table 39. Table 14 also summarises the total bed capacities and patient nurse ratios in the various departments disaggregated by KEPH level and ownership. Patient nurse ratios are higher at level 4 than the other levels despite the fact that lower bed capacities as individual facilities.

3.3.2 ANTIBIOTIC GUIDELINES AND ANTIBIOGRAM

Antibiotics are key in the treatment infections and have saved and continue to countless lives. However, whenever they are used, and depending on how they are used, they can cause side effects and contribute to AMR. Too many antibiotics are prescribed unnecessarily and misused, which threatens the usefulness of these important therapeutics. This is why guidelines on antibiotic use are important so that they are used only when necessary. An antibiogram is key resource for HFs to track changes in AMR and to guide empirical antimicrobial therapy. The cumulative antibiogram is a periodic profile of antimicrobial susceptibilities of various organisms isolated from patients within a HFs or within a broader geographical area areas.

TABLE 15: ANTIBIOTIC GUIDELINES USED IN THE HFS

KEPH/ Ownership	National	HF Specific
Level 4	4	1
Faith based organisation	1	0
Private	0	0
Public	3	1
Level 5	2	1
Faith based organisation	1	1
Public	1	0
Level 6	1	2
Public	1	2
Total	7 (63.6%)	4 (36.4%)

The assessment sought to determine whether HFs had antibiotic guidelines and antibiograms. From the assessment, 11 out of the 28 (39.3%) had antibiotic guidelines, with 7 (25%) of them using national guidelines and the other 4 (14.3%) using facility level guidelines. In addition, only 2 (7.1%) HFs had an antibiogram, and this was disaggregated to the HF level (Table 15). Both health facilities are FBO owned; one, a level 4 in Isiolo county and the other a level 5 in Nairobi county respectively. One of the 2 HFs reported that their antibiogram had never been updated since they ware developed in 2021, while the other reported that the antibiogram was updated monthly. The antibiograms were available online, at the clinic (consultation room), at the pharmacy, ward and nursing station, and were not shared with other HFs. One of the HF reported that they issued the antibiogram during orientation of new healthcare workers (HCWs) such as medical officers, nurses, pharmacists, clinical officers, lab personnel and even consultants, while the other did not provide the antibiogram during orientation of new HCWs. Both facilities did not avail their antibiogram to the public.

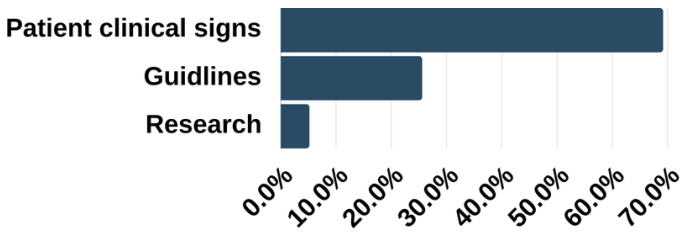

FIGURE 11: REASONS THAT GUIDE CLINICIANS TO REQUEST FOR BACTERIOLOGY TESTS

The assessment also sought to find out what guided clinicians to request for bacteriology tests. From this assessment, it was also established that the main basis for clinicians requesting for bacteriology tests during care and treatment was patient clinical signs (69.2%) followed by guidelines (25.6%). 5.2% of the requests were guided buy research (see Figure 11). An antimicrobial formulary provides a simplified list of available antimicrobials within a hospital, potentially including: accepted indications for use, dosing schedules, drug interactions and side effects. The formulary should include a sub-set of restricted antimicrobials. With respect to updating the antibiotic formulary, only 7 HFs responded in the affirmative, 1 updated in 2013, 1 in 2019, 2 in 2021, 1 in 2022 and 2 in 2023. Only 7 (25%) HFs reported that the

available guidelines matched their antibiotic formulary.

3.3.3 THE CURRENT RESERVE ANTIBIOTIC SUPPLY AND GAPS IN THE SELECTED COUNTIES

Inappropriate use and overuse of antibiotics are driving a global increase in AMR and have an unfavourable impact on the effectiveness of these critical medicines. The remedy to this is in the improvement of antibiotic prescribing globally. The AWaRe classification of antibiotics was developed for the treatment of 31 priority bacterial infections in 2017 by the WHO Expert Committee on Selection and Use of Essential Medicines as a tool to support antibiotic stewardship efforts at local, national and global levels. This list classifies antibiotics into three groups, Access, Watch and Reserve, taking into account the impact of different antibiotics and antibiotic classes on AMR, to emphasize the importance of their appropriate use. It is updated every 2 years. The AWaRe classification is intended as a tool for monitoring antibiotic consumption, defining targets and monitoring the effects of stewardship policies that aim to optimize antibiotic use and curb AMR [24].

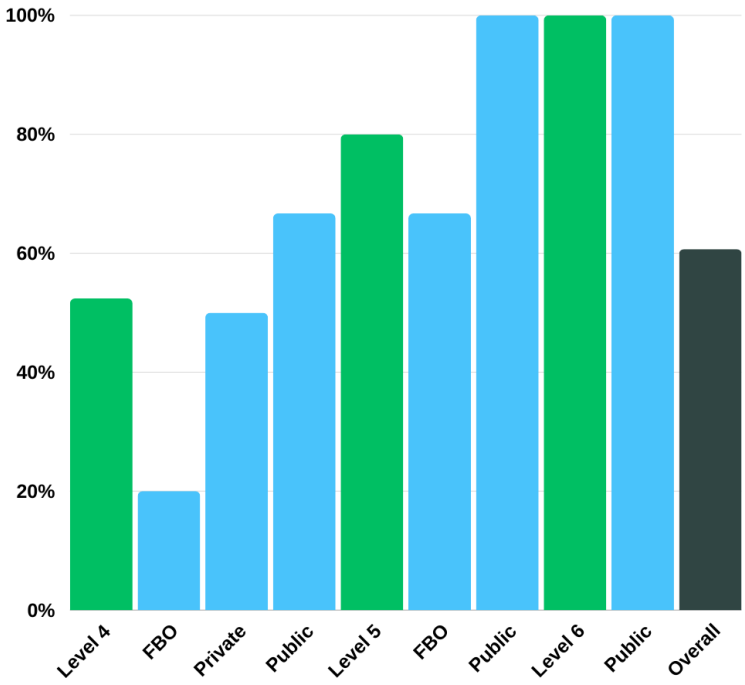

FIGURE 12: **LEVELS OF AWARENESS OF WHO AWARE LIST**

With the AWaRe classification, WHO seeks to make the EML and Essential Medicines for Children (EMLc) more helpful to prescribers. To promote responsible use of antibiotics and slow the spread of AMR, the WHO Global Programme of Work includes a target that at least "60% of total antibiotic prescribing at the country level should be Access antibiotics by 2023" [18]. Since its inception, significant progress has been made in different parts of the world in implementing the AWaRe framework [1]. Figure 12 and Table 16 show the level of awareness of the WHO AWaRe list at the HFs. The green bars represent disaggregation by KEPH level, the blue bars represent disaggregation by ownership and the dirty green bar gives the overall levels of awareness. 52.4% (11 out of the 21) of the level 4 HFs visited were aware of the WHO AWaRe list (2021 AWaRe classification) of

TABLE 16: **LEVEL OF AWARENESS OF THE WHO AWARE CLASSIFICATION**

KEPH/ Ownership	No	Yes
Level 4	9 (50.0%)	**9 (50.0%)**
Faith based organisation	4 (80.0%)	1 (20.0%)
Private	2 (50.0%)	2 (50.0%)
Public	3 (33.3%)	6 (66.7%)
Level 5	**1 (14.3%)**	**85.7%)**
Faith based organisation	1 (33.3%)	2 (66.7%
Public	0	4 (100%)
Level 6	1 (33.3%)	**2 (66.7%)**
Public	1 (33.3%)	2 (66.7%)
Total	**11 (39.3%)**	**17 (60.7%)**

antibiotics. Lowest levels of awareness were noted among the FBO owned (20%) followed by the privately owned (50%), and finally the public HFs where 66.7% were aware of the WHO antibiotic classification. 80% (4 out of 5) of the level 5 HFs were aware of the AWaRe list. All public level 5 HFs visited were aware and 66.7% (2 out of 3) of the FBO owned HFs visited were aware. All level 6 HFs were aware of the WHO AWaRe list. Overall, 60.7% (17) were aware of the list.

ACCESS ANTIBIOTICS

Access antibiotics are first or second choice antibiotics with a narrow spectrum of activity, generally with less side-effects, a lower potential for the selection of antimicrobial resistance and of lower cost. They offer the best therapeutic value, while minimizing the potential for resistance. They are recommended for the empiric treatment of most common infections and should be widely available [27]. Access antibiotics are first- or second-line treatments for common infections and should be widely accessible. The WHO EML AWaRe (2021 AWaRe classification) lists 87 antibiotics in this access category. Of these, only 30 (34.5%) were available in the HFs where the assessment was undertaken (See Table 17). The access antibiotics found available in all the HFs were amoxicillin, cloxacillin, flucloxacillin, metronidazole_IV and oxacillin,and the least available were cefroxadine and chloramphenicol which were only found in one HF.

TABLE 17: **LIST OF ACCESS ANTIBIOTICS IN THE HFS**

S No.	Antibiotic	No. of HFs	Percentage		S No.	Antibiotic	No. of HFs	Percentage
1	Amoxicillin	28	100.0%		16	Tetracycline	17	60.7%
2	Cloxacillin	28	100.0%		17	Tinidazole_oral	14	50.0%
3	Flucloxacillin	28	100.0%		18	Cefalexin	12	42.9%
4	Metronidazole_IV	28	100.0%		19	Cefadroxil	10	35.7%
5	Oxacillin	28	100.0%		20	Ornidazole_oral	9	32.1%
6	Amoxicillin/clavulanic-acid	27	96.4%		21	Cefazolin	8	28.6%
7	Doxycycline	27	96.4%		22	Ampicillin	7	25.0%
8	Metronidazole_oral	27	96.4%		23	Sulfadiazine	7	25.0%
9	Sulfamethoxazole	27	96.4%		24	Phenoxymethylpenicillin	6	21.4%
10	Sulfamethoxazole/trimethoprim	27	96.4%		25	Sulfadiazine/trimethoprim	5	17.9%
11	Trimethoprim	27	96.4%		26	Sulbactam	4	14.3%
12	Nitrofurantoin	25	89.3%		27	Ampicillin/sulbactam	3	10.7%
13	Clindamycin	20	71.4%		28	Spectinomycin	2	7.1%
14	Amikacin	19	67.9%		29	Cefroxadine	1	3.6%
15	Secnidazole	18	64.3%		30	Chloramphenicol	1	3.6%

The first 12 listed in Table 17 were available in almost all the HFs visited by the team of assessors. Table 18 maps the distribution of the access antibiotics in HFs disaggregated by KEPH level. From Table 18, the ones highlighted in green are the list of 22 antibiotics that were available in at-least one HF at all the levels, with most of them being available in all the HFs. The ones highlighted blue were available only at some level 4 and 5 HFs, whereas the ones highlighted in orange were only available in at least 1 level 4 HF

TABLE 18: DISTRIBUTION OF ACCESS ANTIBIOTICS IN THE HFS

Level 4 HFs		Level 5 HFs		Level 6 HFs	
Oxacillin	19	Amoxicillin	7	Amikacin	2
Metronidazole_IV	19	Amoxicillin/clavulanic-acid	5	Amoxicillin	2
Flucloxacillin	19	Cloxacillin	7	Cefazolin	2
Cloxacillin	19	Doxycycline	6	Clindamycin	2
Amoxicillin/clavulanic-acid	19	Flucloxacillin	7	Cloxacillin	2
Amoxicillin	21	Metronidazole_IV	7	Doxycycline	2
Trimethoprim	18	Metronidazole_oral	6	Flucloxacillin	2
Sulfamethoxazole/trimethoprim	18	Oxacillin	7	Metronidazole_IV	2
Sulfamethoxazole	18	Sulfamethoxazole	6	Metronidazole_oral	2
Metronidazole_oral	18	Sulfamethoxazole/trimethoprim	6	Nitrofurantoin	2
Doxycycline	18	Tetracycline	5	Oxacillin	2
Nitrofurantoin	17	Trimethoprim	6	Secnidazole	2
Clindamycin	15	Nitrofurantoin	5	Sulfamethoxazole	2
Amikacin	14	Secnidazole	4	Sulfamethoxazole/trimethoprim	2
Tetracycline	12	Amikacin	3	Trimethoprim	2
Secnidazole	12	Cefadroxil	3	Amoxicillin/clavulanic-acid	1
Tinidazole_oral	10	Cefalexin	3	Ampicillin	1
Cefalexin	9	Clindamycin	3	Ampicillin/sulbactam	1
Ornidazole_oral	6	Sulfadiazine	3	Cefadroxil	1
Cefadroxil	6	Tinidazole_oral	3	Ornidazole_oral	1
Phenoxymethylpenicillin	5	Ampicillin	2	Sulbactam	1
Sulfadiazine	4	Cefazolin	2	Tinidazole_oral	1
Cefazolin	4	Ornidazole_oral	2		
Ampicillin	4	Sulfadiazine/trimethoprim	2		
Sulfadiazine/trimethoprim	3	Ampicillin/sulbactam	1		
Sulbactam	2	Phenoxymethylpenicillin	1		
Spectinomycin	1	Spectinomycin	1		
Chloramphenicol	1	Sulbactam	1		
Cefroxadine	1				
Ampicillin/sulbactam	1				

Given that this is the class ot antibiotics for most of the common infections, there is an opportunity in improving the supply chain in order to expand the level of access to them and improve availability from the current 34.5%. Ensuring their availability and appropriate use is vital for achieving Universal health coverage (UHC) and WHO has set a target that at least 60% of total antibiotic consumption should be from the Access group [9].

"Antibiotics in the access group remain the "strongest", most effective antibiotics for many infections. The classification in one of the AWaRe groups is based on their impact on antibiotic resistance and need for surveillance of use and is not based on differences in clinical effectiveness"[a].

[a] https://aware.essentialmeds.org/groups

WATCH ANTIBIOTICS

Watch antibiotics are first or second choice antibiotics only indicated for specific, limited number of infective syndromes. They generally have a higher potential for the selection of antimicrobial resistance and are more commonly used in sicker patients in the hospital facility setting. They include most of the highest priority agents among the critically important antimicrobials for Human Medicine. Their use should be carefully monitored to avoid overuse [27]. These antibiotics in Watch group should be prioritized as key targets of stewardship programs and monitoring. The WHO EML AWaRe list (2021 AWaRe classification) of antibiotics lists 141 watch antibiotics. Out of these, 40 (28.4%) of them were available in the 28 HFs where the assessment was undertaken. 37 (26.2%) were available in level 4 HFs, 31 (22%) in level 5 and 26 (18.4%) in level 6.

TABLE 19: **LIST OF WATCH ANTIBIOTICS IN THE HFS**

S No.	Antibiotic	No. of HFs	Percentage		S No.	Antibiotic	No. of HFs	Percentage
1	Azithromycin	28	100.0%		21	Fusidic-acid	5	17.9%
2	Ofloxacin	28	100.0%		22	Imipenem/cilastatin	5	17.9%
3	Ceftriaxone	27	96.4%		23	Rifabutin	5	17.9%
4	Ciprofloxacin	27	96.4%		24	Teicoplanin	5	17.9%
5	Levofloxacin	25	89.3%		25	Cefaclor	4	14.3%
6	Cefixime	24	85.7%		26	Cefpodoxime-proxetil	4	14.3%
7	Cefuroxime	22	78.6%		27	Kanamycin_IV	3	10.7%
8	Clarithromycin	22	78.6%		28	Fosfomycin_oral	2	7.1%
9	Ceftazidime	20	71.4%		29	Kanamycin_oral	2	7.1%
10	Vancomycin_IV	18	64.3%		30	Lincomycin	2	7.1%
11	Erythromycin	17	60.7%		31	Rifaximin	2	7.1%
12	Meropenem	17	60.7%		32	Streptomycin_IV	2	7.1%
13	Piperacillin	14	50.0%		33	Vancomycin_oral	2	7.1%
14	Piperacillin/tazobactam	14	50.0%		34	Cefoperazone	1	3.6%
15	Tazobactam	14	50.0%		35	Doripenem	1	3.6%
16	Norfloxacin	11	39.3%		36	Ertapenem	1	3.6%
17	Rifampicin	11	39.3%		37	Lymecycline	1	3.6%
18	Cefotaxime	6	21.4%		38	Neomycin_oral	1	3.6%
19	Moxifloxacin	6	21.4%		38	Rifamycin_oral	1	3.6%
20	Cefepime	5	17.9%		40	Tobramycin	1	3.6%

The observation that more of these watch antibiotics are available in level 4 HF where access to culture and AST is the lowest should be of great concern. One of the easiest interventions would be to further strengthen mentorship and AMS opportunities to guide Antimicrobial use (AMU) and strengthen the monitoring of utilization of these antibiotics and AMR surveillance efforts.

RESERVE ANTIBIOTICS

Reserve antibiotics are last-resort antibiotics that should only be used to treat severe infections caused by multidrug-resistant pathogens [27]. They should be reserved for treatment of confirmed or suspected infections due to multi-drug-resistant organisms. The WHO AWaRe list (2021 AWaRe classification) lists 29 antibiotics as reserve or last-resort therapeutics. Out of these, only 6 (20.7%) of the listed ones were available in some of the HFs considered during this assessment. Level 4 HFs again recorded the highest availability where they had 6 of the antibiotics distributed across. The Level 5 HFs considered in the assessment had 4 of the listed antibiotics distributed across and level 6 had 5 of the antibiotics (See Table 21). The most common reserve antibiotic was linezolid, which was available in 32.1% of the facilities, while the least common was daptomycin found in only 1 of the HFs.

TABLE 20: DISTRIBUTION OF WATCH ANTIBIOTICS IN THE HFS

Level 4 HFs		Level 5 HFs		Level 6 HFs	
Azithromycin	19	Azithromycin	7	Azithromycin	2
Ceftriaxone	19	Cefixime	5	Cefaclor	2
Ciprofloxacin	19	Ceftazidime	5	Ceftazidime	2
Ofloxacin	19	Ceftriaxone	7	Cefuroxime	2
Levofloxacin	19	Levofloxacin	5	Ciprofloxacin	2
Cefixime	18	Meropenem	5	Moxifloxacin	2
Clarithromycin	18	Ofloxacin	7	Ofloxacin	2
Cefuroxime	16	Cefuroxime	4	Piperacillin	2
Ceftazidime	13	Ciprofloxacin	6	Piperacillin/tazobactam	2
Erythromycin	13	Rifampicin	4	Tazobactam	2
Vancomycin_IV	12	Vancomycin_IV	4	Vancomycin_IV	2
Meropenem	11	Clarithromycin	3	Cefepime	1
Piperacillin	9	Erythromycin	3	Cefixime	1
Piperacillin/tazobactam	9	Fusidic-acid	3	Cefotaxime	1
Tazobactam	9	Piperacillin	3	Ceftriaxone	1
Norfloxacin	8	Piperacillin/tazobactam	3	Clarithromycin	1
Rifampicin	7	Tazobactam	3	Erythromycin	1
Cefotaxime	3	Cefepime	2	Imipenem/cilastatin	1
Imipenem/cilastatin	3	Cefotaxime	2	Kanamycin_IV	1
Moxifloxacin	3	Cefpodoxime-proxetil	2	Levofloxacin	1
Teicoplanin	3	Norfloxacin	2	Lincomycin	1
Cefepime	2	Rifabutin	2	Meropenem	1
Cefpodoxime-proxetil	2	Cefaclor	1	Norfloxacin	1
Fosfomycin_oral	2	Doripenem	1	Rifabutin	1
Fusidic-acid	2	Ertapenem	1	Rifaximin	1
Kanamycin_IV	2	Imipenem/cilastatin	1	Teicoplanin	1
Kanamycin_oral	2	Lincomycin	1		
Rifabutin	2	Moxifloxacin	1		
Cefaclor	1	Streptomycin_IV	1		
Cefoperazone	1	Teicoplanin	1		
Lymecycline	1	Vancomycin_oral	1		
Neomycin_oral	1				
Rifamycin_oral	1				
Rifaximin	1				
Streptomycin_IV	1				
Tobramycin	1				
Vancomycin_oral	1				

TABLE 21: RESERVE ANTIBIOTICS AVAILABLE AT HFS

(a) LIST OF RESERVE ANTIBIOTICS IN THE HFS

S No.	Antibiotic	No. of HFs	Percentage
1	Linezolid	9	32.1%
2	Colistin_IV	4	14.3%
3	Fosfomycin_IV	3	10.7%
4	Tigecycline	3	10.7%
5	Polymyxin-B_IV	2	7.1%
6	Daptomycin	1	3.6%

(b) DISTRIBUTION OF RESERVE ANTIBIOTICS IN THE HFS

Level 4		Level 5		Level 6	
Linezolid	5	Linezolid	2	Linezolid	2
Colistin_IV	2	Colistin_IV	1	Colistin_IV	1
Daptomycin	1	Fosfomycin_IV	1	Fosfomycin_IV	1
Fosfomycin_IV	1	Tigecycline	1	Polymyxin-B_IV	1
Polymyxin-B_IV	1			Tigecycline	1
Tigecycline	1				

3.3.4 EMPIRIC ANTIBIOTIC USE

Empiric antimicrobial therapy is treatment given based on experience, directed against an anticipated and likely cause of infectious disease. It is used when antimicrobials are given to a person before the specific bacterium or fungus causing an infection is known. Emergency conditions sometimes require empirical treatment, such as when a dangerous infection by an unknown organism is treated with a broad-spectrum antibiotic while the results of bacterial culture and other tests are awaited. The assessment looked into empiric Abx use at the HFs. To find out the empiric antibiotics preferentially prescribed by physicians for varying conditions among the 28 facilities in the study, as well as the need to send samples to microbiology, seven conditions were considered, namely sepsis, pneumonia, community acquired complicated UTI (cUTI), intra-abdominal infection (IAI), surgical site infection, skin and soft tissue infection and bone & joint infection. Table 22 lists the antibiotics that were cited by the physicians among the 28 health facilities visited. Based on the WHO AWaRe classification, 49% of the empiric antibiotics prescribed were found in the Access list while the other 49% were on the watch list (see Table 44 in the appendix). Linezolid is the only reserve antibiotic that was found to be empirically prescribed. As far as the specific infections were concerned, some antibiotics stood out as being preferentially pre-scribed based on individual responses. For instance, in the question of community and hospital acquired sepsis, the top three empiric antibiotics were ceftriaxone, metronidazole and amoxiclav for community acquired sepsis and ceftriaxone, piperacillin/tazobactam and meropenem for hospital acquired sepsis. The tables that follow show the number of facilities that preferentially prescribe specific antibiotics for the above listed conditions. The most commonly prescribed antibiotic was ceftriaxone, a watch antibiotic, prescribed 19% of the time (see Table 45 in the appendix).

TABLE 22: **LIST OF EMPIRIC ANTIBIOTICS PRESCRIBED IN HFS**

Amoxicillin	Amikacin	Amphotericin
Amoxiclav	Amoxiclav	Azithromycin/Nitrofurantoin
Ampiclox	Ampicillin	Benzylpenicillin
Azithromycin	Ampicillin/Cloxacillin	Cefalexin
Ceftriaxone	Cefazolin	Cefazoline
Cefuroxime	Cefipime	Cefepime
Ciprofloxacin	cefixime	Cefixime/Cefuroxime
Clarithomycin	Ceftazidime	Ceftazitime
Clindamycin	Ceftriaxone.	Ceftriaxone
CoAmoxiclav	Cloxacillin	Ciprofloxin
Flucloxacillin	Doxycycline	Clarithromycin
FluCloxacillin/Amoxicillin	Flagyl	Erythromycin
Gentamycin	Flucloxacin	Imipenem
Levofloxacin	Fluconazole	Klindamycin
Metronidazole	Fluoroquinolone	Metronizole
Nitrofurantoin	Fosfomycin	Ornidazole/ofloxacin
Penicillin	Linezolid	PhenoxymethylPenicillin
Piperacillin/Tazobactam	Macrolide	Piperacillin
Vancomycin	Meropenem	Tazobactam

PRESCRIPTION FOR SEPSIS

Sepsis is a serious condition in which the body responds improperly to an infection. Bacterial infections are the main cause of sepsis, though it can also be a result of other infections, including viral infections, or fungal infections. The infection-fighting processes turn on the body, causing the organs to work poorly, and it may at times progress to septic shock. Most people who develop sepsis have at least one underlying medical condition. It can either be community or hospital acquired. Table 23 provides a summary for the most common prescriptions for both community acquired and hospital acquired sepsis. Community-acquired sepsis is a life-threatening systemic reaction, mainly caused by bacteria, which starts within 72 hours of hospital admittance in an infected patient without recent exposure to healthcare risks.

TABLE 23: EMPIRIC ANTIBIOTICS FOR SEPSIS

(a) COMMUNITY ACCUIRED SEPSIS

Antibiotic	No of HFs
Ceftriaxone	16
Metronidazole	6
Amoxiclav	3
Amoxicillin	3
Flucloxacillin	2
Azithromycin	2
Gentamycin	2
Ampiclox	1
Levofloxacin	1
Benzylpenicillin	1
Phenoxymethylpenicillin	1
Cefazoline	1

(b) HOSPITAL ACQUIRED SEPSIS

Antibiotic	No of HFs
Ceftriaxone	13
Piperacillin/tazobactam	6
Meropenem	6
Metronidazole	5
Ceftazidime	5
Penicillin	4
Flucloxacillin	3
Gentamycin	2
Vancomycin	2
Amikacin	2
Cefipime	1
Ciprofloxacin	1
Imipenem	1
Clindamycin	1
Fosfomycin	1
Cefepime	1
Cefalexin	1
Clarithromycin	1
Amoxicillin	1

For both community and hospital acquired sepsis, ceftriaxone stood out as largely prescribed to the extent that nearly 50 percent of the HFs visited have it as a preferred empiric antibiotic.

Before the administration of any antibiotic, it is recommended that samples are taken to the laboratory for microbiology. It was important to investigate how often this is done in the health facilities that were visited during the assessment. The overall capacity to perform cultures has a direct bearing on the general practice to send samples to microbiology.

By way of establishing the percentage of time samples are taken to microbiology for testing, as was the case for both community and hospital acquired sepsis, only two facilities reported as having sent samples 100% of the time, while another six (6) HFs sent samples 50% of the time. The rest (20 HFs) either sent under 30% of the time or did not send at all. Samples were taken to microbiology 43% of the time. Further to this, it was established those that do send samples to microbiology do so after various considerations; only if the patient deteriorates or there are signs of new infection, when clinical symptoms persist, if there is no response to

empirical treatment within five days as well as the patients' ability to afford the service. Microbiology results were however received within 48 hours only 29% of the time.

PRESCRIPTION FOR PNEUMONIA

From Table 24, we see that for community acquired pneumonia, amoxicillin was prescribed by all the 28 (100%) HFs. Only one health facility sent samples for microbiology over 70% of the time for community acquired pneumonia. The rest either sent samples 30% of the time or did not send at all. This is done when clinical symptoms persisted as well as when the patient could afford. However, for community acquired pneumonia, clinicians received microbiology results within 48 hours only 15% of the time. Ceftriaxone was prescribed most of the time (50%) for hospital acquired pneumonia. In addition seven (25%) HFs sent samples to the laboratory 80% to 100% of the time. Overall, samples were sent to microbiology 31% of the time. This is done when there was no clinical improvement of the patient. Microbiology results were received within 48 hours only 21% of the time for ventilator associated pneumonia.

TABLE 24: EMPIRIC ANTIBIOTICS FOR PNEUMONIA

(a) COMMUNITY ACCUIRED PNEUMONIA

Antibiotic	No of HFs
Amoxicillin	28
Azithromycin	12
Penicillin	5
Gentamycin	5
Ceftriaxone	4
Erythromycin	2
Clarithromycin	2
Macrolide	1
Ampicillin	1
Cefuroxime	1
phenoxymethylpenicillin	1

(b) HOSPITAL ACQUIRED PNEUMONIA

Antibiotic	No of HFs
Ceftriaxone	13
Gentamycin	5
Piperacillin/tazobactam	3
Vancomycin	2
Azithromycin	2
Amoxicillin	2
Meropenem	5
Amikacin	2
Penicillin	6
Metronidazole	2
Ceftazidime	7
Erythromycin	1
Clarithromycin	1
Ciprofloxacin	1
Piperacillin	1
Tazobactam	1
Cefazolin	1

PRESCRIPTION FOR COMPLICATED UTI

A cUTI is a UTI that carries a higher risk of treatment failure, and typically requires longer courses of treatment, different antibiotics, and sometimes additional workups. From Table 25, ciprofloxacin was the most preferred empirical antibiotic by 12 of the 28 HFs visited for community acquired cUTI. Others were nitrofurantoin an amoxicillin. Samples were sent to microbiology only 28% of the time.

Samples were sent to microbiology 28% of the time. In the course of infection, some HFs send samples for microbiology when clinical symptoms persist, on suspected recurrence, when there's no response to antibiotics given or suspected drug resistance. Microbiology results are received 23% of the time within 48 hours of infection.

TABLE 25: EMPIRIC ANTIBIOTICS FOR CUTI

(a) COMMUNITY ACCUIRED CUTI

Antibiotic	No of HFs
Ciprofloxacin	12
Nitrofurantoin	9
Amoxicillin	6
Ceftriaxone	6
Cefuroxime	5
Levofloxacin	5
Cefixime	4
Metronidazole	2
Erythromycin	2
Doxycycline	2
Ceuroxime	1
Nitrofuratoin	1
Fluoroquinolone	1
Fosfomycin	1
Flucloxacillin	1
Vancomycin	1
Azithromycin	1

(b) HOSPITAL ACQUIRED CUTI

Antibiotic	No of HFs
Ceftriaxone	19
Levofloxacin	6
Ciprofloxacin	5
Metronidazole	5
Gentamycin	2
Vancomycin	2
Amoxicillin	2
Piperacillin/tazobactam	1
Fluroquinolone	1
Fluconazole	1
Meropenem	1
Clindamycin	1
Cefixime	1
Cefuroxime	1
Amikacin	1

PRESCRIPTION FOR INTRA-ABDOMINAL INFECTION (IAI)

IAI are a group of infections that occur within the abdominal cavity. Infections within the abdominal cavity typically arise because of inflammation or disruption of the gastrointestinal tract, and successful treatment is based on early and appropriate source recognition, containment and antimicrobial coverage. Table 26 summarises the empiric antimicrobials that were prescribed by the HFs that were assessed. The most commonly used antibiotics for both community and hospital acquired IAI were metronidazole and ceftriaxone.

PRESCRIPTION FOR SURGICAL SITE INFECTION

Surgical site infections (SSIs) are infections that occur after surgery in the part of the body where the surgery took place. sometimes be superficial infections involving the skin only, or more serious that they involve tissues under the skin, organs, or implanted material. Pathogens can infect a surgical wound through various forms of contact, including from the touch of a contaminated caregiver or surgical

TABLE 26: EMPIRIC ANTIBIOTICS FOR IAI

(a) COMMUNITY ACCUIRED IAI

Antibiotic	No of HFs
Metronidazole	14
Ceftriaxone	13
Amoxicillin	5
Flucloxacillin	2
Cefuroxime	2
Levofloxacin	2
Ciprofloxacin	2
Flagyl	1
Doxycyline	1
Ornidazole	1
Ofloxacin	1
Doxycycline	1
Cefixime	1
Meropenem	1

(b) HOSPITAL ACQUIRED IAI

Antibiotic	No of HFs
Ceftriaxone	21
Metronidazole	14
Meropenem	4
Flucloxacillin	3
Piperacillin/tazobactam	2
Ceftazidime	2
Gentamycin	1
Amikacin	1
Clindamycin	1
Cefazoline	1
Flagyl	1
Levofloxacin	1
Amoxicillin	1
Vancomycin	1

instrument, through germs in the air, or through germs that are already on or in your body and then spread into the wound. The main antibiotics used for SSIs in the assessed HFs are flucloxacillin and metronidazole, whether they are hospital or community acquired (Table 27).

PRESCRIPTION FOR SKIN AND SOFT TISSUE INFECTION

Skin and soft-tissue infections (SSTIs), which include infections of skin, subcutaneous tissue, fascia, and muscle, encompass a wide spectrum of clinical presentations, ranging from simple cellulitis to rapidly progressive necrotizing fasciitis. Diagnosing the exact extent of the disease is critical for successful management of a patient of soft-tissue infection. They may be caused by any of a formidable number of pathogenic microorganisms, and they may be either mono-microbial or poly-microbial [4]. They can also be classified as complicated and uncomplicated, and can be acquired in the community or at the hospital. Table 28 provides a summary of the empiric antibiotics prescribed by the HFs visited in this assessment.

[4] https://emedicine.medscape.com/article/1830144-overview?form=fpf

TABLE 27: EMPIRIC ANTIBIOTICS FOR SURGICAL SITE INFECTION

(a) COMMUNITY ACCUIRED SURGICAL SITE INFECTION

Antibiotic	No of HFs
Flucloxacillin	22
Metronidazole	15
Ceftriaxone	6
Clindamycin	4
Amoxicillin	3
Ampicillin	2
Cloxacillin	2
Cefuroxime	2
Linezolid	1
Cefazolin	1
Gentamycin	1
Doxycycline	1
Azithromycin	1
Meropenem	1

(b) HOSPITAL ACQUIRED SURGICAL SITE INFECTION

Antibiotic	No of HFs
Flucloxacillin	17
Metronidazole	15
Ceftriaxone	13
Clindamycin	5
Meropenem	3
Amoxicillin	2
Gentamycin	2
Linezolid	1
Cefazolin	1
Ampiclox	1

PRESCRIPTION FOR BONE AND JOINT INFECTION

Bone infections, also known as osteomyelitis, are infections of any bone within the body. Joint infections are infections of the joints, the areas where bones meet. Most bone and joint infections come from bacteria, but fungal infections also can happen. Infections also can occur in other parts of the body and work their way to the bones through the bloodstream. Some of the infections can also happen after surgery. Table 29 provides a summary of the antibiotics prescribed for bone and joint infections in the HFs assessed. The most commonly prescribed antibiotic was clindamycin.

3.3.5 IV ADMINISTRATION

Intravenous (IV) administration was also part of the assessment and 19 out of 28 (67.9%) of the HFs reported that the highest frequency of IV administration was done in the medical unit, 6 (21.4%) reported that the highest administration is in the surgical unit and 2 (7.1%) reported that the highest frequency is in the ICU. One L4 public health facility did not respond to this question. 54.4% of the available IV pumps in the HFs are in the ICU departments, 28.9% in the HDU, 11.7% in the medical units and 5% in the surgical departments.

TABLE 28: EMPIRIC ANTIBIOTICS FOR SKIN AND SOFT TISSUE INFECTION

(a) COMMUNITY ACCUIRED SKIN AND SOFT TISSUE INFECTION

Antibiotic	No of HFs
Flucloxacillin	28
Metronidazole	7
Clindamycin	7
Amoxicillin	6
Doxycycline	2
Ampiclox	1
Phenoxymethylpenicillin	1
Ciprofloxacin	1
Ampicillin	1
Cloxacillin	1
Cefuroxime	1

(b) HOSPITAL ACQUIRED SKIN AND SOFT TISSUE INFECTION

Antibiotic	No of HFs
Flucloxacillin	23
Clindamycin	10
Metronidazole	10
Ceftriaxone	7
Amoxicillin	4
Piperacillin/tazobactam	2
Vancomycin	2
Cefuroxime	2
Gentamycin	1
Phenoxymethylpenicillin	1
Meropenem	1
Ciprofloxin	1
Levofloxacin	1
Fluconazole	1
Amphotericin-B	1
Doxycycline	1

The distribution of the IV pumps across the HFs is shown in Table 40.

3.3.6 ACCESS PATHWAYS FOR NEW RESERVE ANTIBIOTICS

Access for reserve antibiotics depends on several factors. Information from key informants indicated that access pathways were partly a function of the ownership of the facility and the available resources. The scenario in public facilities is one in which the medicines are ordered by the pharmacists in charge. Orders for reserve antibiotics are made through the Kenya Medical Supplies Agency (KEMSA) and through the Mission for Essential Drugs and Supplies (MEDS). Procurement of medicines in public facilities is prioritized based on whether the medicines are vital, essential and non-essential (VEN). Essential and vital medicines are part of the Access and Watch list, while Reserve antibiotics are classified as non-essential in the priority list.

In ideal situations, the Medicines and Therapeutics Committee (MTC) meets and discusses the need for the introduction of a new reserve antibiotic, and once it is agreed upon, then it is introduced into the Formulary. This is informed by the antibiogram and the cost of the medicines. The MTC is chaired by the physician in the facility, the pharmacist being the secretary and with membership from other departments. Level 4 and 5 HFs are evaluated on a scorecard based on the establishment and status of MTCs. However, in some cases, patients get a prescription from a physician and are advised to buy the drugs from a pharmacy. In this case, the patient may access a reserve antibiotic without the Pharmacy Department

TABLE 29: **LIST OF EMPIRIC ANTIBIOTICS FOR HOSPITAL ACQUIRED BONE AND JOINT INFECTION**

Antibiotic	No of HFs
Clindamycin	20
Flucloxacillin	12
Ceftriaxone	6
Metronidazole	6
Gentamycin	2
Amoxicillin	1
Levofloxacin	1
Cefazolin	1
Linezolid	1
Cloxacillin	1
Clindamicin	1
Ceftazidime	1
Meropenem	1

being made aware of this. The introduction of a new reserve antibiotic may also be driven by the pharmaceutical industry through marketing by medical representatives.

The MTC operates at the facility level whereas the National Medicines and Therapeutics Committee (NMTC) at the national level. The role of NMTC is to identify appropriate drugs and other health products and technologies (HPT) for use throughout the system and to guide use. The NMTC undertakes the review and revision of the Clinical Management and Referral Guidelines and national essential HPT lists such as the Kenya Essential Medicines List (KEML), Kenya Essential Medical Supplies List (KEMSL) and the Kenya Essential Medical Laboratory Commodities List (KEMCL). The NMTC is appointed by the Director General for Health (DG) and has membership from all key MoH Directorates and MoH-affiliate Semi-Autonomous Government Agencies (SAGAs) with direct relevance to HPT supply and regulation, such as KEMSA and the Pharmacy and Poisons Board (PPB)). The introduction of new products in healthcare is guided by this committee.

3.3.7 MAPPING POTENTIAL EARLY ADOPTION SITES, CAPACITIES, AND BARRIERS

Potential early adoption sites were deemed likely by virtue of their preparedness to have optimal laboratory and clinical/medical practices. This preparedness was a function of having the relevant training required for the health workforce. Furthermore, the readiness of a health facility to be a potential early

adopter was also based on the availability of antimicrobial stewardship guidelines and policies and the adherence to these guidelines.

Of the 28 HFs, 13 (46.4%) had staff who had AMS training. Of the 13 HFs, 2 (15.4%) were faith-based level 4 facilities (MT Kenya ACK Hospital and Tawfiq Hospital), 7 (53.8%) were public level 4 facilities (Isiolo County referral Hospital, Kericho County Referral Hospital, Kilifi County Referral Hospital, Mama Margaret Uhuru Hospital, Mariakani Subcounty Hospital, Vihiga County Referral Hospital and Nanyuki Teaching and referral hospital), 3 (23. 1%) were level 5 FBO (AIC Litein Mission Hospital, Jumuia Mission Hospital Kaimosi and Mater Misericordia Hospital), while 1 (7. 7%) was a public level 6 hospital (Kenyatta University Teaching, Referral and Research Hospital). These are facilities that are identified as early adoption sites.

Regarding antimicrobial stewardship guidelines, 12 (42. 9%) HFs had antimicrobial stewardship committees. Of the 12 HFs 8 (66.7%) were level 4 HFs (Kapsabet County Referral Hospital, Kericho County Referral Hospital, Kilifi County Hospital, Mariakani Sub County Hospital, Mt Kenya (ACK) Hospital (FBO), Nanyuki Teaching and Referral Hospital, Ngong Sub-County Hospital, Vihiga County Referral Hospital), 3 (25.0%) were Level 5 facilities (Jumuia Mission Hospital Kaimosi (FBO), Mama Lucy Kibaki Hospital (Embakasi), The Mater Misericordiae Hospital (Mukuru) (FBO)) while 1 (8.3%) was a Level 6 facility (Kenyatta University Teaching Referral and Research Hospital). Most of these committees were established in 2023, the earliest being established in 2016. However, only 1 of these committees was functional.

Stewardship guidelines and policies were recorded in 7 (25.0%) of the 28 HFs. Of the 7 HFs, 3 (42.9%) were Level 4 HFs (Kapsabet County Referral Hospital, Kilifi County Hospital, Vihiga County Referral Hospital), 2 (28.6%) were Level 5 facilities (Mama Lucy Kibaki Hospital (Embakasi), Mater Misericordiae Hospital) and another 2 (28.6%) were Level 6 HFs (Kenyatta University Teaching Referral and Research Hospital and Kenyatta National Hospital-Othaya Annex).

The opportunities for early adoption of new reserve antibiotics lie in the establishment of the governance framework coupled with requisite HRH that would support rational and judicious use of antibiotics. The HFs that have already moved in this direction are potential early adopters.

3.3.8 BARRIERS TO POTENTIAL EARLY ADOPTION OF NEW RESERVE ANTIBIOTICS

There are several barriers to adoption including; health facilities with a low number of relevant staff members and those who have not received any AMR training. In addition, the lack of Antimicrobial Stewardship Committees, antimicrobial stewardship guidelines, and policies is a barrier to adoption. However, these barriers are surmountable and may be turned into opportunities through proper mentorship programs from NASIC, respective CASICs and via peer-to-peer learning from already functional sites/HFs. Other barriers specific to this work and beyond this work include:

(i) Weak pharmaceutical information management systems

(ii) Weak documentation at facility level

(iii) Lack of capacity for optimal use of laboratory services and laboratory networks

(iv) Inadequate reviews of schedules of antimicrobials agents

(v) Inadequate restriction of use of some antimicrobials

(vi) Lack of hospital-specific antibiograms

(vii) Inadequate regulation of pharmacy practice

(viii) Lack of standardized treatment protocols between the public and private sector

(ix) Weak commodity management systems

(x) Lack of awareness in the community on AMR

(xi) Weak feedback mechanisms to healthcare workers/providers on AMS gains and updates to develop relationships with early adoption partners.

(xii) Ineffective M&E systems for AMS

(xiii) Insufficient resources to implement programs, including IT, human, and financial resources.

(xiv) Lack of national baseline data on AMU and Antimicrobial consumption (AMC)

(xv) Lack of operational research that addresses the issues AMR

3.3.9 DEVELOPING RELATIONSHIPS WITH EARLY ADOPTION PARTNERS

Early adoption partners will benefit enormously from the mentoring provided through the two-tier coordination mechanism of NASIC and CASICs aimed at strengthening the AMS committees within health facilities. Strengthened AMS committees will in turn ensure that the MTCs become functional. Functional MTCs will further foster and institutionalize good antibiotic use and antimicrobial stewardship practices by partly ensuring that there are up-to-date antibiograms and antibiotic formularies in place. Capacity strengthening through training of relevant staff on AMS-related areas for laboratory personnel, clinicians and pharmacists. The results of this evaluation indicated that of the 28 participating facilities, only 13 (46. 4%) had attended training related to AMS. It is noteworthy that no private health facility evaluated reported having staff trained on AMS. Involvement of partners in the space of AMR in the areas of knowledge exchange and sharing is essential. In addition, it is imperative to maintain a reliable commodity supply chain to avoid stock-outs.

3.4 ANTIMICROBIAL STEWARDSHIP

Misuse and overuse of antimicrobials is one of the world's most pressing public health problems. Infectious organisms adapt to the antimicrobials designed to kill them, making the drugs ineffective. Antimicrobial stewardship is a coordinated program that promotes the appropriate use of antimicrobials, improves patient outcomes, reduces microbial resistance, and decreases the spread of infections caused by multidrug-resistant organisms.

AMS training equips clinicians who frequently prescribe antimicrobials with knowledge and tools to improve their use of these essential medications in daily clinical practice. These trainings highlight how antimicrobial stewardship principles can be applied to common clinical scenarios. Staff from 13 out of 28 (46.4%) HFs had attend AMS training. Of these 13, 69.2% are level 4, 23.1% level 5 and 7.7% level 6. The facilities are shown on Table 30.

7 out of 28 (25%) of the HFs had stewardship guidelines/policies: the 2 level 6, 2 level 5 and 3 level 4 HFs respectively. 12 (42.9%) HFs had an existing stewardship committee: 1 level 6, 3 level 5 and 8 level 4 HFs respectively. The distribution of the HFs is shown in Table 46 in the appendix. All AMS committees were functional at the time of assessment except the AMS committee at Nanyuki teaching and referral hospital.

The AMS committees are involved in a number of activities amongst them;

(i) Public campaigns on rational use of antibiotics

(ii) Advice on procurement of antibiotics in the facility

(iii) Sensitization of proper disposal of antibiotics in the environment.

(iv) Antibiotics use audit

(v) Treatment sheets review

(vi) Antibiotics clinical ward round

(vii) Integration with infection prevention control committee,

(viii) Developing of antibiotics formulary

(ix) Launch of antimicrobial empiric use guidelines and policy

(x) Point prevalence survey

(xi) Antimicrobial use surveys

(xii) Development of facility antibiogram

(xiii) Sensitization of the policies and guidelines to clinicians

(xiv) Awareness creation by celebrating WAAW and patient safety

(xv) Continuous medical education on antimicrobial Use

(xvi) Grant writing

(xvii) Antimicrobial case reviews and reports

(xviii) Advocate for more culture and sensitivity tests

TABLE 30: **AMS TRAINING ATTENDANCE**

KEPH Level/Ownership	No	Yes
Level 4	12	9
Faith Based Organisation	3	2
Coptic Hospital	✓	
MaterCare Maternity Hospital	✓	
Mt Kenya (ACK) Hospital		✓
Pope Benedict XVI Hospital	✓	
Tawfiq Hospital		✓
Private	4	
Afya Link Medical Centre	✓	
Anka Hospital Isiolo	✓	
Kapsabet Health Care Centre	✓	
Kitengela Medical Services	✓	
Public	5	7
Chepterwai Sub-County Hospital	✓	
Emuhaya Sub County Referral Hospital	✓	
Isiolo County and Referral Hospital		✓
Kajiado County Referral Hospital	✓	
Kapsabet County Referral Hospital	✓	
Kericho County Referral Hospital		✓
Kilifi County Hospital		✓
Mama Margaret Uhuru Hospital		✓
Mariakani Sub County Hospital		✓
Nanyuki teaching and Referral Hospital		✓
Ngong Sub-County Hospital	✓	
Vihiga County Referral Hospital		✓
Level 5	2	3
Faith Based Organisation		3
AIC Litein Mission Hospital		✓
Jumuia Mission Hospital Kaimosi		✓
The Mater Misericordiae Hospital (Mukuru)		✓
Public	2	
Kerugoya County Refferal Hospital	✓	
Mama Lucy Kibaki Hospital (Embakasi)	✓	
Level 6	1	1
Public	1	1
Kenyatta University Teaching Refferal and Research Hospital		✓
KNH Othaya Annex	✓	
Total	15	13

(xix) Patient management review of treatment within 72hours

(xx) Reviewing of formulary

(xxi) Susceptibolinitiation, resistance patterns, audits adherence on guidelines UTI, Cs prophylaxis, disinfection audit of brands, cessation cef

8 (28.6%) HFs have stewardship intervention on formulary restrictions for various antibiotics such as: Ceftriaxone, Meropenem, Vancomycin, linezolid, Clindamycin, Ceftazidime, Amikacin, Polymyxin B, Aztreonam, Tigecycline, Piperacillin/tazobactam, Cefepime, Colistin and generally for reserve antibiotics.

The restrictions state the following

1. Has to have a prescription by qualified personnel within the hospital: Consultant, medical officer, physician, clinical pharmacists
2. No dispensing without culture and sensitivity,
3. Antibiotics are always under lock and key
4. Prescription should be provided to dispense
5. 72 hours timeout / Reserve antibiotics to be reviewed every 72 hours
6. Need to justify use of tabs with high SE profile,
7. Adherence to 1st line, 2nd line.

This is summarized in Table 31

TABLE 31: **HFS WITH STEWARDSHIP INTERVENTION ON FORMULARY RESTRICTIONS**

KEPH Level/Ownership	Antbiotics	Stewardship intervention
Level 4		
Public		
Emuhaya Sub County Referral Hospital	Ceftriaxone	Prescription by qualified personnel within the hospital
Kapsabet County Referral Hospital	Meropenem, Vancomycin,linezolid	No dispensing without culture and sensitivity, consultant only prescription, always under lock and key
Ngong Sub-County Hospital	Clindamycin, and Ceftazidime on restriction on use. The Obs/gyn was against the use of Ceftazidime,	Adherence to first line and second line What antibiotics can be used for which disease Prophylactic drugs, Duration/number of days on antibiotics eg restriction on the use of Amikacin for community acquired pneumonia
Vihiga County Referral Hospital	Vancomycin for MRSA and renal patients ,Ceftazidime for pseudonomous,Amikacin for pediatrics	Only Medical officers and Consultants can prescribe Vancomycin and Ceftazidime, prescription should be provided to dispense
Level 5		
Faith Based Organisation		
The Mater Misericordiae Hospital (Mukuru)	Ceftriaxone not used in IP except paeds	72 hours timeout,susceptibility test results
Public		
Mama Lucy Kibaki Hospital (Embakasi)	Reserve antibiotics	Need to justify use of tabs with high SE profile, Adherence to 1st line, 2nd line.
Level 6		
Public		
Kenyatta University Teaching Refferal and Research Hospital	Reserve antibiotics	Reserve antibiotics to be reviewed every 72 hours Prescribing of antibiotics to be done by a physician /ID specialist/clinical pharmacist
KNH Othaya Annex	Linezolid, Polymyxin B, Vancomycin, Aztreonam, Tigecycline, Piperacillin/tazobactam, Cefepime, Colistin	Only prescribed by consultants

13 (46.4%) HFs require preauthorization for the following antibiotics: Ceftriaxone, Ceftazidime, Meropenem , Piperacillin/ Tazobactam, Vancomycin iv, Ceftazidime iv, linezolid, Amikacin, tigecycycline, levofloxacin, Polymyxin B, Aztreonam, Cefepime, Colistin and generally reserve antibiotics. The personnel who do preauthorization include medical officers, clinical officers, consultants and pharmacists. It is manly done verbally and in written format.

8 (28.6%) HFs do prospective audits for a range of antibiotics including; Clindamycin iv, piperacillin/tazobactam, Ceftriaxone, Ceftazidime, Vancomycin, Ceftriaxone_IV, Metronidazole_IV, Flucloxacillin_IV. Some HFs reported to conduct prospective audits on all antibiotics. The audit is mainly done in the surgical, medical, pediatric, maternity, HDU, ICU and new born unit (NBU) wards. The personnel in charge includes; consultant surgeons, pharmaceutical technologists, pharmacists, medical officers, medical consultants, lab in charge, nurses and generally members of the AMS committees. This is summarized in Table 33

TABLE 32: PRE-AUTHORIZATION OF ANTIBIOTICS

		Personnel				Mode		Preauthorized antibiotics
KEPH Level/Ownership	Required	Medical Officers	Clinical Officers	Pharmacists	Consultants	Verbally	Manually (written)	Antbiotics
Level 4	9	3	2	4	5	6	8	
Faith Based Organisation	1	0	1	0	0	1	0	
MaterCare Maternity Hospital	✓		1			1		Ceftriaxone, Ceftazidime
Private	2	1	0	0	1	1	2	
Anka Hospital Isiolo	✓	1					1	Meropenem , Piperacillin/ Tazobactam
Kapsabet Health Care Centre	✓				1	1	1	Vancomycin iv, Ceftazidime iv
Public	6	2	1	4	4	4	6	
Emuhaya Sub County Referral Hospital	✓	1	1			1	1	Ceftriaxone
Kajiado County Referral Hospital	✓			1	1	1	1	Meropenem, piperacillin/ tazobactum ,Vancomycin
Kapsabet County Referral Hospital	✓			1	1	1	1	Meropenem, Vancomycin,linezolid
Kilifi County Hospital	✓			1			1	Meropenem,piperacillin tazobactam, Vancomycin
Mama Margaret Uhuru Hospital	✓				1		1	Meropenem, Vancomycin
Vihiga County Referral Hospital	✓	1		1	1	1	1	Vancomycin, Ceftazidime, Amikacin
Level 5	2	0	0	1	2	2	2	
Public	2	0	0	1	2	2	2	
Kerugoya County Refferal Hospital	✓				1	1	1	Vancomycin, Meropenem, Ceftazidime, Linezolid
Mama Lucy Kibaki Hospital (Embakasi)	✓			1	1	1	1	Ceftazidime, Tigecycycline, Levofloxacin inj, Meropenem, Vancomycin
Level 6	2	0	0	1	2	1	2	
Public	2	0	0	1	2	1	2	
Kenyatta University Teaching Refferal and Research Hospital	✓				1		1	Reserve antibiotics
KNH Othaya Annex	✓			1	1	1	1	Linezolid, Polymyxin B, Vancomycin, Aztreonam, Tigecycline, Piperacillin/tazobactam, Cefepime, Colistin
Grand Total	13	3	2	6	9	9	12	

TABLE 33: PROSPECTIVE AUDIT OF ANTIBIOTICS

KEPH Level/Ownership	Audit	Medical Unit	Surgical Unit	ICU	HDU	Paediatric	Maternity	NBU	Personnel in charge	Audited antibiotics
Level 4	5	4	5	1	2	3	1	1		
Private	1	0	1	0	0	0	0	0		
Kapsabet Health Care Centre	✓		1						Consultant Surgeon	Clindamycin iv, Piperacillin/tazobactam
Public	4	4	4	1	2	3	1	1		
Emuhaya Sub County Referral Hospital	✓	1	1			1			Pharmaceutical technologist	Ceftriaxone
Kapsabet County Referral Hospital	✓	1	1	1					Pharmacist, Medical officers, consultants pharmacist,Medical consultants	Ceftriaxone,Ceftazidime
Nanyuki teaching and Referral Hospital	✓	1	1		1	1	1	1	AMS committee	All antibiotics
Vihiga County Referral Hospital	✓	1	1		1	1			Clinical pharmacist	Vancomycin, Ceftazidime
Level 5	3	2	2	0	0	1	1	0		
Faith Based Organisation	2	1	1	0	0	1	1	0		
Jumuia Mission Hospital Kaimosi	✓	1	1			1	1		Medical officers, lab incharge, pharmacy incharge, nurse incharge	Ceftriaxone iv, Metronidazole iv, Flucloxacillin iv
The Mater Misericordiae Hospital (Mukuru)	✓								AMS committee	All antibiotics prescribed in the out patient
Public	1	1	1	0	0	0	0	0		
Mama Lucy Kibaki Hospital (Embakasi)	✓	1	1						Pharmacists	All antibiotics
Grand Total	8	6	7	1	2	4	2	1		

5 (17.9%) HFs reported to conduct stewardship rounds in the medical, surgical, ICU, HDU, paediatric and maternity wards. The personnel in charge includes medical officers, clinical officers, nurses, pharmacists, lab in charge, consultants and generally the AMS committee members. This information is shown in Table 34

11 (39.3%) HFs reported that retrospective audit is done on selected antibiotics. The audit is mainly done in the medical, surgical, ICU, pediatric, maternity and outpatient units. The personnel involved include; PTs, Cos, consultants, nurses, MOs, pharmacists, heath records officers and the general AMS committee. The information on retrospective audits across the HFs is shown in Table 35.

In terms of IPC measures, there were a total of 811 handwashing stations spread across the HFs.

9 out of 28 (32.1%) HFs report various hospital acquired infections through carried reporting channels as shown in Table 37

11 out of 28 (39.3%) HFs do cohorting/ isolating of patients with AMR for various resistance profiles. Out

TABLE 34: STEWARDSHIP ROUNDS IN HFS

KEPH Level/Ownership	Medical Unit	Surgical Unit	ICU	HDU	Paediatric	Maternity	Personnel in charge	Frequency	Date of latest round
Level 4	2	2	1	1	2	0			
Public	2	2	1	1	2	0			
Emuhaya Sub County Referral Hospital					1		Medical officers, Clinical officer, nurses	Two years ago	2021-06-01
Kapsabet County Referral Hospital	1	1	1				Pharmacists, AMR focal person		2023-08-31
Vihiga County Referral Hospital	1	1		1	1		AMS committee	Quarterly	2023-07-31
Level 5	1	1	0	0	0	1			
Faith Based Organisation	1	1	0	0	0	1			
Jumuia Mission Hospital Kaimosi	1	1			1	1	Medical officers, laboratory incharge, pharmacy incharge	Every fortnight	2023-09-13
Level 6	1	1	1	0	0	0			
Public	1	1	1	0	0	0			
KNH Othaya Annex	1	1	1				Infection disease specialist, consultant, medical officer, Pharmacist	Twice weekly	2023-09-25
Grand Total	4	4	2	1	2	1			

TABLE 35: RETROSPECTIVE AUDITS IN THEN HFS

KEPH Level/Ownership	Medical Unit	Surgical Unit	ICU	HDU	Paediatric	Maternity	Outpatient	Personnel	Antibiotics	Frequency
Level 4	2	3	1	0	1		2			
Faith Based Organisation	1	1	0	0						
MaterCare Maternity Hospital								Pharmaceutical technologist, Clinical officer	No specific antibiotic	Weekly
Mt Kenya (ACK) Hospital	1	1	0	0				pharmaceutical technologist, Healthrecords officer	Penicillin Amoxicillin,Amoxicillin Clavulanic acid, cephalosporins Ceftriaxone,cefixime,cefuroxime	
Private	0	1	0	0						
Kapsabet Health Care Centre	0	1	0	0				consultant, nurses,clinical officer, laboratory technologist	Ceftriaxone iv,	Quarterly
Public	1	1	1	0	1		2			
Emuhaya Sub County Referral Hospital	0	0	0	0	1			Clinical officer, medical officer, nurses	Penicillin, Flucloxacillin,	Done two years ago in the pediatrics wards
Kapsabet County Referral Hospital	1	1	1	0					Ceftriaxone, Ceftazidime	
Mariakani Sub County Hospital	0	0	0	0			1	AMS Committee		
Vihiga County Referral Hospital	0	0	0	0			1	AMS Committee	Azithromycin, Amoxicillin for pediatric,	Quarterly
Level 5	3	2	0	0	1	1				
Faith Based Organisation	2	2	0	0	1	1				
Jumuia Mission Hospital Kaimosi	1	1	0	0	1	1		AMS Committee	Ceftriaxone, Metronidazole iv, Flucloxacillin iv	Fortnight
The Mater Misericordiae Hospital (Mukuru)	1	1	0	0				AMS Committee	Antibiotics prescribed for CS prophylaxis, UTI	
Public	1	0	0	0						
Mama Lucy Kibaki Hospital (Embakasi)	1	0	0	0				Pharmacist	All antibiotics	
Level 6	1	1	1	0	1					
Public	1	1	1	0	1					
Kenyatta University Teaching Refferal and Research Hospital	1	1	1	0	1			Pharmacy department	All antibiotics	Annually
Grand Total	6	6	2	0	3	1	2			

TABLE 36: HANDWASHING STATIONS ACROSS THE HFS

KEPH Level/Ownership	No. of handwash stations
Level 4	529
FBO	172
Private	59
Public	298
Level 5	150
FBO	31
Public	119
Level 6	132
Public	132
Grand Total	811

TABLE 37: **HOSPITAL ACQUIRED INFECTIONS**

KEPH Level/Ownership	Reported Infections	Reporting channel
Level 4		
Faith Based Organisation		
Coptic Hospital	Surgical site, catheter related uti	Report to medical team via email, meeting with minutes
Private		
Anka Hospital Isiolo	Sepsis for surgical ward	In staff meetings held monthly or whenever necessary
Kapsabet Health Care Centre	Surgical site infection in surgical ward, hospital acquired pneumonia in surgical ward and medical ward	Multi displinary Clinical meetings in quarterly basis
Public		
Kapsabet County Referral Hospital	Nbu-neonatal sepsis,maternity& surgical ward-SSI	Intergrated departmental meetings inclusive of IPC committee
Mama Margaret Uhuru Hospital	Catheter related infections	Phone
Level 5		
Faith Based Organisation		
The Mater Misericordiae Hospital (Mukuru)	Infections after delivery, catheter associated infections	Escalation matrix in written form
Public		
Mama Lucy Kibaki Hospital (Embakasi)	None yet	By phone to SC PHO
Level 6		
Public		
Kenyatta University Teaching Refferal and Research Hospital	Wards NICU PICU and ICU MRSA, VRE, ESBLA, MDR organisms, CRE	Through phone calls from lab to the director clinical services, doctor , nurse in the wards and the IPC committee
KNH Othaya Annex	Surgical site infections Hospital acquired pneumonia Ventilator acquired pneumonia Klebsiella in NBU	First to primary doctor and nurse, then to others during handover

of the 11 only 4 (36.4%) have their isolation procedures clearly displayed.

TABLE 38: COHORTING/ISOLATION PROCEDURES

KEPH Level/Ownership	No	Yes	Resistance profile	Cohorting/Isolation procedures
Level 4	6	2		
Faith Based Organisation	1	1		
Coptic Hospital		✓	All that may occur	Communicate with the relative ward, preparation of ward for patient ,inform housekeeping and relevant departments
Pope Benedict XVI Hospital	✓		Tuberculosis	From casualty the doctor notifies the isolation team (nurse, clinician, nutritionist, housekeeper) which then wheels patient to isolation room.
Private	1			
Kapsabet Health Care Centre	✓		Pseudonomous aeroginosa, MRSA	If the patients has not being responding to any sensitivity, both to aerobic and anaerobic bacteria upon treatment, take swab for culture sensitivity. Then take them to isolation ward as management is on going with the antibiotics awaiting microbiology results
Public	4	1		
Chepterwai Sub-County Hospital	✓		Tuberculosis	Isolated the patient in the Medical ward
Kapsabet County Referral Hospital	✓		Tuberculosis (MDR)	Incase during medical ward rounds a patient is diagnosed with a antimicrobial resistant strain eg MDR they are moved to the isolation cube within the Medical ward.
Kericho County Referral Hospital	✓		E coli, staph aureus, pseudomonus	Not available
Mama Margaret Uhuru Hospital	✓		HAI catheter related	Patient is referred to KNH for isolation
Vihiga County Referral Hospital		✓	Cephalosporin, extended Beta lactam	They were mostly placed in the isolation room
Level 5		1		
Faith Based Organisation		1		
The Mater Misericordiae Hospital (Mukuru)		✓	All	There is an escalation matrix involving other specialists, culture taken
Public				
Level 6	1	1		
Public	1	1		
Kenyatta University Teaching Refferal and Research Hospital		✓	MDR TB, MRSA,CRE, ESBL, VRE	Have an isolation policy document awaiting approval
KNH Othaya Annex	✓		Tuberculosis	Once resistance results are received the nurses move patient to isolation unit. This is communicated to the clinical team. No SOP. IPC guidelines used.
Grand Total	7	4		

3.5 USE CASES FOR AMR DX AND ABX USE

Use-cases were summarized in a tabular form to address various domains as presented below. Within the body of the report, select use-cases are presented while the remainder are reposited within the appendix.

3.5.1 USE CASE 1: COPTIC HOSPITAL (LEVEL 4 FBO)

For Coptic Hospital, 2 reserve antibiotics are listed as being used empirically. Fosfomycin is used empirically in the treatment of community acquired urinary tract infection (CA-UTI). On the other hand, Linezolid is used empirically in the treatment of both community and hospital acquired surgical site infections.

Category	Community acquired Sepsis	Hospital acquired sepsis
Empiric antibiotics prescribed	Amoxcillin, Clavulanic, Ceftriaxone	Meropenem, Cefipime
Percentage of time samples sent to microbiology	100%	100%
When, during the course of infection are samples sent to microbiology	Day 1	Day 1
Percentage of the time micro results are received within 48hours	100%	100%
Category	**Community acquired Pneumonia**	**Hospital acquired Pneumonia**
Empiric antibiotics prescribed	Amoxicillin, Clavulanic, Macrolide	Meropenem, Vancomycin, Amikacin
Percentage of time samples sent to microbiology for:-	30%	100%
When during the course of infection are samples sent to microbiology	Day 5	Day 1
Percentage of the time micro results are received within 48hours	90%	90%
Category	**CA-UTI**	**Hospital acquired UTI**
Empiric antibiotics prescribed	Fluoroquinolone, Nitrofurantoin, Fosfomycin, Cefuroxime	Ceftriaxone, Gentamycin, Fluroquinolone
Percentage of time samples sent to microbiology for:-	40%	100%
When during the course of infection are samples sent to microbiology	Day 7	Day 1
Percentage of the time micro results are received within 48hours	90%	90%

Category	Community acquired IAI	Hospital acquired IAI
Empiric antibiotics prescribed	Ceftriaxone, Metronidazole	Ceftriaxone, Metronidazole
Percentage of time samples sent to microbiology for:-	100%	100%
When during the course of infection are samples sent to microbiology	Day 1	Day 1
Percentage of the time micro results are received within 48hours	90%	90%
Category	Community acquired surgical site infection	Hospital acquired surgical site infection
Empiric antibiotics prescribed	Clindamycin, Ceftriaxone, Metronidazole, Amoxicillin, Clavulanic, Linezolid	Clindamycin, Ceftriaxone, Metronidazole, Amoxicillin, Clavulanic, Linezolid
Percentage of time samples sent to microbiology for:-	100%	100%
When during the course of infection are samples sent to microbiology	Day 1	Day 1
Percentage of the time micro results are received within 48hours	90%	90%
Category	Community acquired skin and soft tissue infection	Hospital acquired skin and soft tissue infection
Empiric antibiotics prescribed	Phenoxymethylpenicillin, Flucloxacillin, Clindamycin	Phenoxymethylpenicillin, Flucloxacillin, Clindamycin
Percentage of time samples sent to microbiology for:-	40%	100%
When during the course of infection are samples sent to microbiology	Day 7	Day 1
Percentage of the time micro results are received within 48hours	90%	90%
Category		Hospital acquired bone and joint infection
Empiric antibiotics prescribed		Clindamycin, Flucloxacillin
Percentage of time samples sent to microbiology for:-		100%
When during the course of infection are samples sent to microbiology		Day 1
Percentage of the time micro results are received within 48hours		90%

If the patient is not improving on empiric antibiotics within 24 hours, what do you do?	Await 48 hours culture then reevaluate
For patients not improving on empiric antibiotics within 24 hours what do you do?	Complete the course of the broad spectrum antibiotic

3.5.2 USE CASE 2: KERUGOYA COUNTY REFERRAL HOSPITAL (PUBLIC L5 HOSPITAL)

In Kerugoya county Referral Hospital, 1 reserve antibiotic was listed as being used empirically. Linezolid is used empirically in the treatment of Hospital acquired bone and joint infections.

Category	Community acquired sepsis	Hospital acquired sepsis
Empiric antibiotics prescribed	Ceftriaxone	Ceftriaxone, Ceftazidime, Meropenem
Percentage of time samples sent to microbiology for:-	30%	30%
When during the course of infection are samples sent to microbiology	Upon diagnosis	When symptoms persist
Percentage of the time micro results are received within 48hours	0%	0%
Category	**Community acquired Pneumonia**	**Hospital acquired Pneumonia**
Empiric antibiotics prescribed	Ceftriaxone and/or Azithromycin or Ceftriaxone and/or Clarithromycin	Ceftazidime or Meropenem With or without Vancomycin
Percentage of time samples sent to microbiology for:-	30%	30%
When during the course of infection are samples sent to microbiology	Not sent	When symptoms persist
Percentage of the time micro results are received within 48hours	0%	0%
Category	**CA-UTI**	**Hospital acquired UTI**
Empiric antibiotics prescribed	Ceftriaxone or Ciprofloxacin	Ceftriaxone
Percentage of time samples sent to microbiology for:-	30%	30%
When during the course of infection are samples sent to microbiology	When clinical symptoms persist	When clinical symptoms persist
Percentage of the time micro results are received within 48hours	0%	0%
Category	**Community acquired IAI**	**Hospital acquired IAI**
Empiric antibiotics prescribed	Ceftriaxone and flagyl	Ceftriaxone and flagyl or Meropenem
Percentage of time samples sent to microbiology for:-	20%	20%
When during the course of infection are samples sent to microbiology	When symptoms persist	When symptoms persist
Percentage of the time micro results are received within 48hours	0%	0%

Category	Community acquired surgical site infection	Hospital acquired surgical site infection
Empiric antibiotics prescribed	Flucloxacillin, Clindamycin	Flucloxacillin, Clindamycin
Percentage of time samples sent to microbiology for:-	30%	30%
When during the course of infection are samples sent to microbiology	When clinical symptoms persist	When clinical symptoms persist
Percentage of the time micro results are received within 48hours	0%	0%
Category	Community acquired skin and soft tissue infection	Hospital acquired skin and soft tissue infection
Empiric antibiotics prescribed	Flucloxacillin, Clindamycin	Flucloxacillin, Clindamycin
Percentage of time samples sent to microbiology for:-	30%	30%
When during the course of infection are samples sent to microbiology	When clinical symptoms persist	When clinical symptoms persist
Percentage of the time micro results are received within 48hours	0%	0%
Category		Hospital acquired bone and joint infection
Empiric antibiotics prescribed		Clindamycin, Linezolid
Percentage of time samples sent to microbiology for:-		10%
When during the course of infection are samples sent to microbiology		When symptoms persist
Percentage of the time micro results are received within 48hours		0%

3.5.3 USE CASE 3: KENYATTA UNIVERSITY TEACHING REFERRAL AND RESEARCH HOSPITAL (PUBLIC L6)

For KUTRRH, there was no record of empirical use of a reserve antibiotic for the treatment of any of the scenarios recorded.

Category	Community acquired sepsis	Hospital acquired sepsis
Empiric antibiotics prescribed	e	Piperacillin/Tazobactam, Meropenem
Percentage of time samples sent to microbiology for:-		80%
When during the course of infection are samples sent to microbiology		Prior to initiation of antibiotics t
Percentage of the time micro results are received within 48hours		90%

Category	Community acquired Pneumonia	Hospital acquired Pneumonia
Empiric antibiotics prescribed	Amoxicillin, Ceftriaxone, Azithromycin	Piperacillin/Tazobactam, Meropenem
Percentage of time samples sent to microbiology for:-	20%	100%
When during the course of infection are samples sent to microbiology	Prior to initiation of treatment	Prior to initiation of treatment
Percentage of the time micro results are received within 48hours	20%	80%
Category	CA-UTI	Hospital acquired UTI
Empiric antibiotics prescribed	Amoxicillin, ciprofloxcin, Levofloxacin	Ceftriaxone, Meropenem, Levofloxacin
Percentage of time samples sent to microbiology for:-	50%	80%
When during the course of infection are samples sent to microbiology	Prior to initiation of treatment	Prior to initiation of treatment
Percentage of the time micro results are received within 48hours	20%	80%
Category	Community acquired IAI	Hospital acquired IAI
Empiric antibiotics prescribed	Ceftriaxone, Metronidazole	Meropenem
Percentage of time samples sent to microbiology for:-	10%	40%
When during the course of infection are samples sent to microbiology	Prior to initiation of treatment	Prior to initiation of treatment
Percentage of the time micro results are received within 48hours	10%	80%
Category	Community acquired surgical site infection	Hospital acquired surgical site infection
Empiric antibiotics prescribed	Amoxicillin, Clavulate, Clindamycin, Flucloxacillin	Clindamycin
Percentage of time samples sent to microbiology for:-	50%	80%
When during the course of infection are samples sent to microbiology	Prior to initiation of treatment	Prior to initiation of treatment
Percentage of the time micro results are received within 48hours	70%	80%

Category	Community acquired skin and soft tissue infection	Hospital acquired skin and soft tissue infection
Empiric antibiotics prescribed	Flucloxacillin, Amoxicillin, Clindamycin	Clindamycin, Piperacillin/tazobactam
Percentage of time samples sent to microbiology for:-	0%	10%
When during the course of infection are samples sent to microbiology	Prior to initiation of treatment	Prior to initiation of treatment
Percentage of the time micro results are received within 48hours	10%	10%
Category		Hospital acquired bone and joint infection
Empiric antibiotics prescribed		Clindamycin
Percentage of time samples sent to microbiology for:-		20%
When during the course of infection are samples sent to microbiology		Prior to initiation of treatment
Percentage of the time micro results are received within 48hours		20%

4 DISCUSSIONS, LESSONS AND RECOMMENDATIONS

4.1 DISCUSSIONS

AMR data for Kenya are limited to single-center surveillance or point prevalence estimates, most often from tertiary care facilities. These estimates may not be nationally representative, given that patients at tertiary care facilities may represent sicker patients with previous treatment exposure or represent only specific socioeconomic classes or urban-dwelling populations [16]. Despite a national surveillance network for AMR in human health, modest progress has been made in establishing a nationally representative picture of the AMR situation in Kenya. This assessment is timely in providing insight into the AMR situation in Kenya. This study assessed 28 HFs drawn from public, private and faith-based organizations, representing levels 4, 5 and 6. These are the main patient referral HF levels in Kenya. The select HFs were sampled from 10 counties (representing 21% of the total counties in Kenya). They are found in the west, central and northern regions of Kenya. The assessment had two components: one addressing the mapping of AMR diagnostics and the other mapping the use of therapeutics (Abx use). The following notable findings were observed during the assessment.

For the diagnostic objective, the study established that level 4 HF had the highest number of outpatients (69.6%) while level 6 accounted for the lowest inpatient numbers (5.3%). As expected, public HFs had the highest number of laboratory staff compared to FBO and private HFs. Most of the staff have Diploma qualifications and above. Only 64.3% of HFs had their staff receive annual competency training. This suggests that more sensitization campaigns and resource allocation are needed to boost this percentage. The study found that 21 of 28 HFs assessed had no laboratory certification. Of those that were certified, 7 had SLIPTA/SLMTA certification while 6 of the 7 had valid ISO 15189 certification. This finding is of concern because full certification implies expected compliance with policies, guidelines and adherence to good laboratory and allied practices to prevent or minimize AMR. It is therefore important that NASIC and CASIC, the main oversight agencies at the national and county levels, respectively enhance and strengthen their advocacy, sensitize and partnership programs with the national and county governments to prioritize laboratory certification and enrolment of laboratory staff into the relevant certification programs as means of accelerating AMR mitigation efforts in Kenya.

Laboratory culture remains the traditional gold standard for detecting AMR micro-organisms due to its high sensitivity. This technique allows the ease of counting cultivable bacteria and their morphological and biochemical characterization. The assessment found that 53.6% of the HFs had the ability to perform cultures. Importantly, 46.4% did not have any capacity to perform any cultures. The largest gap with respect to the ability to perform cultures was observed in level 4 HFs with only 31.6% of the facilities having the ability to undertake this laboratory technique. This is a major drawback in AMR mitigation given that this study showed that 50.9% of the population is served by level 4 HFs. These findings support the need for increased resource mobilization, allocation, and investment in medical laboratory diagnostics, particularly at the County levels. Only 14.3% of the HFs sampled could perform fungal cultures. Urine samples accounted for the highest number of cultures followed by blood while genital contributed the lowest number. AST is an important parameter in identifying which antimicrobial regimen is specifically effective in treating an infection. This is a key test that informs and supports efforts against AMR. Our assessment showed that level 4 HFs had the lowest capacities to carry out gram stain (68%) and AST (31.6%). Because of this weakness, they had the highest patient referral (63.2%) for these diagnostic services. Approximately one third (30.8%) of these patients subsequently procured these tests from private medical diagnostic laboratories. The findings provide important insights on how low diagnostic

capacity of HFs influences high out of pocket expenditure incurred by referred patients seeking these diagnostic services at alternative sites.

Automated Blood Culture methods are designed to shorten microbial detection time, reduce false positive rates, and increase accuracy. Using comprehensive antibiotic panels, this method assists medical officers determine the most suitable antimicrobial treatment within a much shorter time. Our assessment established that 5 of the 8 HFs with the ability to perform blood cultures used an automated machine. However, only one HF carried out the detection of methicillin-resistant Staphylococcus aureus, Vancomycin-resistant Enterococci (VRE), carbapenem and/or 3rd generation cephalosporin resistance This finding demonstrates the gap in determining the presence of microbial resistance by HFs. There is a need to support HFs to enhance their microbial culture capacities. This can be achieved through sensitizations of HF AMR committees, acquiring automated AST equipment, and enhanced and sustained budgetary allocations for medical diagnostic services. Management and monitoring of diagnostic laboratory processes and storage of patient test data using LIS is an integral part of AMR surveillance. LIS automates and streamlines laboratory workflows, thus eliminating errors due to manual entry of data. Furthermore, it enables laboratories to meet stringent regulatory guidelines and quality standards with ease while reducing the turnaround time for clinical decision making. This assessment revealed that 21 of the 28 HFs had a LIS for recording AST data. This was an encouraging observation as it provides evidence of good data capture and archiving practices that are important in AMR surveillance. Only one HF, however, had a dedicated data entry laboratory staff.

As previously noted, 13 out of 28 HFs were unable to perform microbial cultures. Microbial culture is an important cornerstone of microbe identification that helps in determining the possible development of AMR in an infection. The lack of this diagnostic capacity significantly undermines the ability to have effective and efficient AMR surveillance. This assessment identified some of the barriers that may contribute to the inability to perform microbial cultures. These included lack of equipment (39.1%), reagents (34.8%), inadequate infrastructure (13%), inadequate mentorship and training (8.7%) and insufficient human resource for health (4.3%). Other notable gaps in surveillance practices included lack of computer-based LIS (81%), This results in over reliance on paper-based tools which may partly explain why 41% of blood culture tests could not be accounted for during the period under review by the study. These findings suggest the need to have concerted efforts between the AMR regulatory agencies, national and county governments, HFs, and other stakeholders within the health space to develop plans, policies, resource mobilization and innovative financial allocation strategies that will assist in ameliorating the effects of the above barriers.

Health financing is a key determinant in the provision of accessible, timely, equitable, quality, and affordable healthcare. The ability of citizens to pay for medical diagnostic services is a major determinant in ensuring that there is early detection, documentation, and action on new and emerging AMR microbes in the community. This study noted that over a third of the clients (36.8%) paid for their culture tests using out of pocket funds. This may have the effect of clients not presenting themselves for sample collection or changing their health seeking behaviours with regards to medical laboratory diagnosis. The overall impact would be undetected, undocumented and a high circulation rate of AMR-resistant pathogens. This increases the risks of developing antibiotic resistance in communities making it more difficult and costly to manage medical conditions. This observation suggests that there is an urgent need to revise and develop new health financing models that are “pocket-friendly” and are aimed at lowering out-of-pocket expenditure for medical diagnostic services by the citizens. This would in the long term translate into reducing the risk AMR development in communities.

Successful, effective, and efficient AMR surveillance partly depends on the calibre and numbers of health workforce, HF ward infrastructure and drug dispensing specialists. This assessment found only 5 (0.6%) infectious disease specialists in all the 28 HFs assessed. Only 1 FBO owned level 4 HF had an infectious disease specialist. All the private and public HFs had none in post during the assessment period. The physician capacity was constituted by medical officers (54.1%) and interns (41.3%). There was a total of 33 (4%) physicians from all the HFs combined. Most of the nursing staff were found in the medical unit (44.7%) followed by the surgical unit (34.7%), and nurses in ICU (14.7%) and HDU (8.8%). Patient-nurse ratios were higher at level 4 compared to other levels. This is despite the lower bed capacities at individual HFs. The insignificant number of infectious specialists in the HFs suggests that the entire continuum of infectious disease diagnosis, treatment, monitoring of drug-resistance, ensuring adherence to antibiotic guidelines and Antibiogram and provision of leadership in the HFs antimicrobial stewardship committees is not well optimized. This is a major risk factor for the development and spread of AMR in communities.

An antibiogram is a tool that shows how susceptible a series of organisms are to different antimicrobials. Its importance in clinical practice is it provides a means of assessing local susceptibility rates, and therefore aids in selecting empiric antibiotic therapy, and monitoring resistance trends over time within a HF. It can also be used to compare susceptibility rates across HFs and track antibiotic resistance trends. This is a key information tool in AMR surveillance. Antibiotic guidelines have also been used to guide the use of antibiotics at HFs. These are national guidelines that may be customized at HF level. From the assessment, 11 out of 28 (39.3%) HFs had antibiotic guidelines, with 7 (25%) of them using national guidelines and the other 4 (14.3%) using facility level guidelines. In addition, only 2 (7.1%) HFs had an antibiogram. One of the 2 HFs reported that their antibiogram had never been updated since they were developed in 2021, while the other reported that the antibiogram was updated monthly. These findings demonstrate a major weakness in the availability of a key AMR surveillance tool. There is need for the regulatory agencies to promote the acquisition and maintenance of this tool by HFs. They can develop a “stepwise” or “phased” model that enables HFs to progressively develop the requisite infrastructure, human resource capacity and acquisition, and maintenance of this tool as an enabler of AMR surveillance.

The assessment established that the main basis for clinicians requesting bacteriology tests during care and treatment was patient clinical signs (69.2%) followed by guidelines (25.6%). Most of the HFs rarely updated their antibiotic formulary, only 7 HFs responded to having done so, while 7 (25%) HFs reported that the available guidelines matched their antibiotic formulary. The fact that most HFs do not regularly update their formularies is of concern because antibiotic formularies provide important information on the use, dosing schedules, drug interactions and side effects of antibiotics and list of restricted antimicrobials. This suggests that AMR may not be effectively monitored in HFs, suggesting that the monitoring and adherence oversight function by Antimicrobial Stewardship Committees of the HFs is weak.

The survey revealed that 52.4% of the level 4 HFs visited were aware of the WHO AWaRe list [18] of antibiotics. Lowest levels of awareness were noted among the FBO owned (20%) followed by the privately owned (50%), and the public HFs where 66.7% were aware of the WHO antibiotic classification. 80% (4 out of 5) of the level 5 HFs were aware of the AWaRe list. All public level 5 HFs visited were aware and 66.7% (2 out of 3) of the FBO owned HFs visited were aware. All level 6 HFs were aware of the WHO AWaRe list. Overall, 60.7% (17) were aware of the list. The WHO AWaRe classification is an important information tool used by Antimicrobial Stewardship Committees in auditing compliance with the antimicrobial formulary to ensure that AMR policies are complied with. The fact that 40% of HFs were not aware of the WHO AWaRe list suggests weak oversight by the AMS committees but importantly points to the structural weaknesses

of AMR monitoring that may exist within HFs. It is therefore important to hold regular sensitization meetings at HFs on AMR to address this weakness.

The WHO AWaRe classification lists 87 antibiotics in the access category. The study established that only 30 (34.5%) were available in the assessed HFs. Of 141 watch antibiotics, 40 (28.4%) of them were available in the 28 HFs where the assessment was undertaken. 37 (26.2%) were available in level 4 HFs, 31 (22%) in level 5 and 26 (18.4%) in level 6. Out of the 29 listed reserve or last-resort therapeutics on the WHO AWaRe list, only 6 (20.7%) were available. Level 4 HFs recorded the highest availability where they had 6 of the antibiotics. The most common reserve antibiotic was Linezolid, which was available in 32.1% of the facilities, while the least common was Daptomycin found in only 1 of the HFs. HFs are expected to have administer antibiotics in the following order of priority; access, watch and reserve list. This, however, may not be strictly adhered to as was observed in the 2 use cases described below. The lack of adherence may be a significant contributor to the development of AMR. Accessibility and unrestricted use of reserve antibiotics is further exacerbated by patients with a doctor's prescription purchasing a drug from a private pharmacy or unregistered drug dispensing outlet without a HF pharmacy being made aware. This probably highlights the lack of an effective feedback mechanism on dispensation of medicines between private pharmacies and the HFs where the drug was prescribed. An urgent feedback mechanism needs to be developed between the pharmaceutical regulatory agencies, drug dispensing outlets and HFs to address the above problem.

The study established that for both community and hospital acquired sepsis, 2 HFs reportedly referred samples 100% of the time for microbiology testing, while another six HFs referred samples 50% of the time. The rest either referred samples under 30% of the time or did not refer at all. Microbiology results were received within 48 hours only 29% of the time. For community acquired pneumonia, Amoxicillin was prescribed by all the 28 (100%) HFs. Only one health facility referred samples for microbiology testing over 70% of the time for community acquired pneumonia. The rest of the HFs either referred samples 30% of the time or did not refer at all. Ceftriaxone was prescribed most of the time (50%) for hospital acquired pneumonia. Samples were sent for microbiology testing 31% of the time when there was no clinical improvement of the patient. Ciprofloxacin was the most preferred empirical antibiotic by 12 of the 28 HFs visited for community acquired cUTI. Other antibiotics used to manage this condition were Nitrofurantoin an Amoxicillin. The most highly prescribed antibiotics for both community and hospital acquired intra-abdominal infections were Metronidazole and Ceftriaxone while Flucloxacillin and Metronidazole were the preferred antibiotics for the management of hospital or community acquired surgical site infections. Clindamycin was the most prescribed antibiotic for bone and joint infections.

The study showed that 19 out of 28 (67.9%) HFs reported the highest IV administration in the medical unit. 6 (21.4%) HFs reported that the highest administration was in the surgical unit while 2 (7.1%) reported that the highest frequency is in the ICU. Further, 54.4% of the available IV pumps in the HFs where found in the ICU departments, 28.9% in the HDU, 11.7% in the medical units and 5% in the surgical departments. In addition, the study established and documented the access pathways and the key players involved for new reserve antibiotics. This assessment determined potential early adoption sites based on their levels of preparedness to have optimal laboratory and clinical/medical practices and their health workforce having acquired the relevant training. The assessment revealed that of the 28 HFs, 13 (46.4%) had staff who had AMS training. Of the 13 HFs, 2 (15.4%) were faith-based level 4 facilities, 7 (53.8%) were public level 4 facilities, 3 (23. 1%) were level 5 FBO while 1 (7.7%) was a public level 6 hospital. These are facilities that have been identified as early adoption sites.

Availability of antimicrobial stewardship guidelines and policies and the adherence to these guidelines was an additional criterion that was used in identifying potential early adoption sites. 12 (42. 9%) HFs had antimicrobial stewardship committees. Of the 12 HFs 8 (66.7%) were level 4 HFs , 3 (25.0%) were Level 5 facilities while 1 (8.3%) was a Level 6 facility. Most of these committees were established in 2023, the earliest being established in 2016. However, only 1 of these committees was functional.

The study established the following as barriers to potential early adoption of new reserve antibiotics, health facilities with low numbers of relevant staff members, staff members with no AMR training, lack of Antimicrobial Stewardship Committees, antimicrobial stewardship guidelines, and policies. With the help of 3 use cases the assessment wanted to establish AMR diagnostics and antibiotic use in three select hospitals in the study. In one of the FBO-based hospitals, 2 reserve antibiotics were listed as being used empirically. Fosfomycin was used empirically in the treatment of CA-UTI, while Linezolid was used empirically in the treatment of both community and hospital acquired surgical site infections. In a level 5 public hospital, a reserve antibiotic, Linezolid, was listed as being used empirically for the treatment of acquired bone and joint infections. The study was unable to establish the reasons why reserve drugs are being used for empirical treatments, however what is of concern to the assessors is how pervasive this practice is within HFs across the country and how it may contribute to the development of AMR in Kenya.

Findings from this assessment are expected to aid in the preparation for introduction of Cefiderocol (and other antibiotics) and new low blood culture and molecular point of care treatment platforms in Kenya to enhance AMR surveillance and mitigation measures.

4.2 CONCLUSIONS

4.2.1 THE DIAGNOSTIC COMPONENT

1. Current AMR diagnostics in the selected counties in Kenya
    (a) Level 4 HF had the highest number of outpatients.
    (b) Less than two-thirds of the HFs staff receive annual competency training.
    (c) Infectious disease specialists accounted for less than 1% of the total medical staff in the HFs assessed.
    (d) 50% of the level 4 HF were aware of the WHO AWaRe classification List.
    (e) Community and hospital acquired sepsis samples were referred 100% of the time.
2. Supply of equipment and testing commodities
    (a) Approximately half of the HFs assessed lack capacity to perform laboratory cultures.
    (b) Level 4 HFs had the lowest capacities for carrying out gram stain and AST testing.
    (c) Only 28% of the HFs assessed had the capacity to perform blood culture.
    (d) 18% of the HFs used an automated machine to perform blood cultures.
    (e) 75% of HFs used Laboratory Information System for recording AST data.
3. Gaps in AMR diagnosis continuum in the selected counties in Kenya
    (a) 39.3% of the HFs have antibiotic guidelines.
    (b) 7.1% of the HFs had an antibiogram.
    (c) 63.2% of Level 4 HFs had patient referral for diagnostic services.

(d) Most of the HFs rarely updated their antibiotic formulary,

(e) Lack of equipment, reagents, inadequate infrastructure, inadequate mentorship and training and insufficient human resource for health were among the notable barriers in AMR diagnosis.

(f) 75% of the HF have no laboratory certification.

(g) 25% of HFs have SLIPTA/SLMTA certification.

(h) 21% of HFs have valid ISO 15189 certification.

4. To Establish the average cost and mode of payment for AMR diagnosis in the selected counties

   (a) Over a third of the clients paid for their medical culture tests using out of pocket funds.

5. To document use cases for AMR diagnostics, current practices and determine the level of adherence to regulatory needs.

   (a) Two of three use cases used reserve antibiotics for empirical treatment.

   (b) Less than half of the HFs have antimicrobial stewardship committees. However, only 1 of these committees was functional.

4.2.2 THE THERAPEUTIC COMPONENT

1. Understanding the current reserve antibiotic supply, use cases, and gaps in the selected counties in Kenya.

   (a) Only 21% of reserve or last-resort therapeutics drugs on the WHO AWaRe list are available.

2. Identification of access pathways for new reserve antibiotics.

   (a) The study established and documented the access pathways for new reserve antibiotics.

3. Mapping potential early adoption sites, capacities, and barriers.

   (a) 12 of the HFs assessed qualified to be considered as early adoption sites as their staff had the relevant AMS training and the facilities had antimicrobial stewardship committees.

   (b) The following were identified as barriers to potential early adoption of early adoption sites were found, low number of relevant staff members, staff members with no AMR training, lack of Antimicrobial Stewardship Committees, antimicrobial stewardship guidelines, and policies.

4. Developing relationships with early adoption partners.

   (a) The relationships between identified potential early adoption partners and other stakeholders can be explored and formalized immediately after the adoption of this report.

4.3 RECOMMENDATIONS

1. Enhance resource mobilization and increased budgetary allocation at national and county levels for medical diagnostic services to increase medical diagnostic capacities of HFs.

2. Entrench AMR-associated activities in County annual development plans, County integrated development plans, County Strategic plans, County annual workplans among others.

3. Develop roadmaps that facilitate the establishment of Antimicrobial Stewardship Committees in all health facilities.

4. Strengthening and promote the oversight capacity of Antimicrobial Stewardship Committees by increasing resource allocation and capacity building.
5. Mainstream the oversight role of Antimicrobial Stewardship Committees in HF annual work plans and performance contract.
6. Develop roadmaps for the certification of medical diagnostic laboratories in HFs.
7. Strengthen and enhance the technical capacity of laboratory and medical staff through training and sensitization on AMR policies and guidelines.
8. Create calendars on the sensitization of medical personnel on AMR and antibiotic use.
9. Increase investment in automation of diagnostic equipment. This will minimize data loss and improve data storage and accuracy.
10. Develop an AMR training module for Community Health Promoters (CHPs) since the effects of AMR start at community health level.
11. Foster partnerships between the private, faith-based, and public health facilities to better address AMR issues.
12. Develop health financing models that reduce out of pocket expenditure of clients for medical diagnostic services.

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A PHARMACEUTICAL STAFF AND SATELLITE PHARMACIES

TABLE 39: PHARMACEUTICAL STAFF AND SATELLITE PHARMACIES

KEPH Level/Ownership	Pharmacists in HF	Pharmaceutical technologists in HF	Medical unit	Surgical department	ICU	HDU	Nearby 24hr pharmacies
Level 4	47	110	6	2	0	0	19
Faith Based Organisation	8	24	2	0	0	0	5
Coptic Hospital	8	5	1	0	0	0	1
MaterCare Maternity Hospital	0	1	0	0	0	0	0
Mt Kenya (ACK) Hospital	0	4	0	0	0	0	1
Pope Benedict XVI Hospital	0	7	0	0	0	0	2
Tawfiq Hospital	0	7	1	0	0	0	1
Private	0	11	0	0	0	0	2
Afya Link Medical Centre	0	2	0	0	0	0	1
Anka Hospital Isiolo	0	1	0	0	0	0	0
Kapsabet Health Care Centre	0	2	0	0	0	0	0
Kitengela Medical Services	0	6			0	0	1
Public	39	75	4	2	0	0	12
Chepterwai Sub-County Hospital	0	2	0	0	0	0	1
Emuhaya Sub County Referral Hospital	0	4	0	0	0	0	0
Isiolo County and Referral Hospital	3	6	0	0	0	0	1
Kajiado County Referral Hospital	3	5	0	0	0	0	1
Kapsabet County Referral Hospital	4	11	1	0	0	0	2
Kericho County Referral Hospital	6	16	0	1	0	0	2
Kilifi County Hospital	3	3	1	1	0	0	1
Mama Margaret Uhuru Hospital	1	5	1	0	0	0	1
Mariakani Sub County Hospital	2	3	0	0	0	0	1
Nanyuki teaching and Referral Hospital	12	6	0	0	0	0	1
Ngong Sub-County Hospital	2	3	0		0	0	0
Vihiga County Referral Hospital	3	11	1	0	0	0	1
Level 5	21	80	1	0	0	0	6
Faith Based Organisation	6	70	0	0	0	0	4
AIC Litein Mission Hospital	2	21	0	0	0	0	2
Jumuia Mission Hospital Kaimosi	1	4	0	0	0	0	1
The Mater Misericordiae Hospital (Mukuru)	3	45	0	0	0	0	1
Public	15	10	1	0	0	0	2
Kerugoya County Refferal Hospital	7	4	0	0	0	0	1
Mama Lucy Kibaki Hospital (Embakasi)	8	6	1	0	0	0	1
Level 6	31	31	1	1	2	1	3
Public	31	31	1	1	2	1	3
Kenyatta University Teaching Refferal and Research Hospital	22	26	0	0	1	0	2
KNH Othaya Annex	9	5	1	1	1	1	1
Total	99	221	8	3	2	1	28

B IV PUMPS AVAILABLE AT HFS

TABLE 40: **IV PUMPS AVAILABLE ACROSS THE HFS**

	Highest frequency of IV administration			No. of IV pumps available				
KEPH Level/Ownership	ICU	Medical Unit	Surgical Unit	Medical department	Surgical department	ICU department	HDU	Total
Level 4	1	14	5	22	6	79	48	155
Faith Based Organisation	1	3	1	4	4	13	13	34
Coptic Hospital	✓			3	3	9	9	24
MaterCare Maternity Hospital			✓	0	0	0	0	0
Mt Kenya (ACK) Hospital		✓		0	0	0	0	0
Pope Benedict XVI Hospital		✓		0	0	4	4	8
Tawfiq Hospital		✓		1	1	0	0	2
Private		2	2	0	0	0	0	0
Afya Link Medical Centre		✓		0	0	0	0	0
Anka Hospital Isiolo			✓	0	0	0	0	0
Kapsabet Health Care Centre			✓	0	0	0	0	0
Kitengela Medical Services		✓		0	0	0	0	0
Public		9	2	18	2	66	35	121
Chepterwai Sub-County Hospital		✓		0	0	0	0	0
Emuhaya Sub County Referral Hospital		✓		0	0	0	0	0
Isiolo County and Referral Hospital			✓	2	1	14	13	30
Kajiado County Referral Hospital		✓		0	0	1	0	1
Kapsabet County Referral Hospital		✓		0	0	4	0	4
Kericho County Referral Hospital		✓		0	0	30	0	30
Kilifi County Hospital		✓		6	1	17	11	35
Mama Margaret Uhuru Hospital		✓		10	0	0	0	10
Mariakani Sub County Hospital			✓	0	0	0	0	0
Nanyuki teaching and Referral Hospital		✓		0	0	0	6	6
Ngong Sub-County Hospital				0	0	0	0	0
Vihiga County Referral Hospital		✓		0	0	0	5	5
Level 5	1	4		6	6	41	21	74
Faith Based Organisation	1	2		6	6	38	20	70
AIC Litein Mission Hospital		✓		0	0	8	0	8
Jumuia Mission Hospital Kaimosi		✓		0	0	0	0	0
The Mater Misericordiae Hospital (Mukuru)	✓			6	6	30	20	62
Public		2		0	0	3	1	4
Kerugoya County Refferal Hospital		✓		0	0	0	0	0
Mama Lucy Kibaki Hospital (Embakasi)		✓		0	0	3	1	4
Level 6		1	1	0	0	10	0	10
Public		1	1	0	0	10	0	10
Kenyatta University Teaching Refferal and Research Hospital			✓	0	0	0	0	0
KNH Othaya Annex		✓		0	0	10	0	10
Total	2	19	6	28	12	130	69	239

C LIST OF AVAILABLE ANTIBIOTICS IN VARIOUS HFS

TABLE 41: ACCESS GROUP ANTIBIOTICS AVAILABLE IN THE HFS

Antibiotic/	Level 4	Faith Based Organisation	Private	Public	Level 5	Faith Based Organisation	Public	Level 6	Public	Total no. of HFs	Percentage of HFs
Amikacin	14	4	2	8	3	1	2	2	2	19	67.9%
Amoxicillin	21	5	4	12	5	3	2	2	2	28	100.0%
Amoxicillin/Clavulanic-acid	21	5	4	12	5	3	2	1	1	27	96.4%
Ampicillin	4	1	1	2	2	2	0	1	1	7	25.0%
Ampicillin/sulbactam	1	0	1	0	1	1	0	1	1	3	10.7%
Benzathine-Penicillin	15	4	3	8	5	3	2	1	1	21	75.0%
Penicillin	21	5	4	12	5	3	2	2	2	28	100.0%
Cefadroxil	6	2	1	3	3	3	0	1	1	10	35.7%
Cefalexin	9	5	2	2	3	3	0	0	0	12	42.9%
Cefazolin	4	1	1	2	2	2	0	2	2	8	28.6%
Cefroxadine	1	0	0	1	0	0	0	0	0	1	3.6%
Chloramphenicol	1	0	0	1	0	0	0	0	0	1	3.6%
Clindamycin	15	4	3	8	3	2	1	2	2	20	71.4%
Cloxacillin	2	1	0	1	2	2	0	0	0	4	14.3%
Doxycycline	20	5	4	11	5	3	2	2	2	27	96.4%
Flucloxacillin	21	5	4	12	5	3	2	2	2	28	100.0%
Gentamycin	20	4	4	12	5	3	2	2	2	27	96.4%
Metronidazole_IV	21	5	4	12	5	3	2	2	2	28	100.0%
Metronidazole_oral	20	5	4	11	5	3	2	2	2	27	96.4%
Nitrofurantoin	19	5	4	10	4	3	1	2	2	25	89.3%
Ornidazole_oral	6	3	1	2	2	2	0	1	1	9	32.1%
PhenoxymethylPenicillin	5	2	0	3	1	1	0	0	0	6	21.4%
Procaine-Penicillin	0	0	0	0	2	2	0	0	0	2	7.1%
Secnidazole	12	4	3	5	4	3	1	2	2	18	64.3%
Spectinomycin	1	0	1	0	1	1	0	0	0	2	7.1%
Sulbactam	1	1	0	0	0	0	0	0	0	1	3.6%
Sulfadiazine	1	1	0	0	1	0	1	0	0	2	7.1%
Sulfadiazine/trimethoprim	3	0	0	3	2	2	0	0	0	5	17.9%
Sulfamethoxazole/trimethoprim	20	4	4	12	5	3	2	2	2	27	96.4%
Tetracycline	12	4	1	7	5	3	2	0	0	17	60.7%
Tinidazole_oral	10	2	3	5	3	2	1	1	1	14	50.0%

TABLE 42: WATCH GROUP ANTIBIOTICS AVAILABLE IN THE HFS

Antibiotic	Level 4	Faith Based Organisation	Private	Public	Level 5	Faith Based Organisation	Public	Level 6	Public	Total no. of HFs	Percentage of HFs
Azithromycin	21	5	4	12	5	3	2	2	2	28	100.0%
Cefaclor	1	0	0	1	1	1	0	2	2	4	14.3%
Cefepime	2	1	0	1	2	2	0	1	1	5	17.9%
Cefixime	18	4	3	11	5	3	2	1	1	24	85.7%
Cefoperazone	1	1	0	0	0	0	0	0	0	1	3.6%
Cefotaxime	3	2	0	1	2	2	0	1	1	6	21.4%
Cefpodoxime-proxetil	2	1	1	0	2	2	0	0	0	4	14.3%
Ceftazidime	13	4	1	8	5	3	2	2	2	20	71.4%
Ceftriaxone	21	5	4	12	5	3	2	1	1	27	96.4%
Cefuroxime	16	4	4	8	4	2	2	2	2	22	78.6%
Ciprofloxacin	21	5	4	12	4	2	2	2	2	27	96.4%
Clarithromycin	18	5	3	10	3	2	1	1	1	22	78.6%
Doripenem	0	0	0	0	1	1	0	0	0	1	3.6%
Erythromycin	13	3	3	7	3	2	1	1	1	17	60.7%
Ertapenem	0	0	0	0	1	1	0	0	0	1	3.6%
Fosfomycin_oral	2	1	0	1	0	0	0	0	0	2	7.1%
Fusidic-acid	2	2	0	0	3	2	1	0	0	5	17.9%
Imipenem/cilastatin	3	2	0	1	1	1	0	1	1	5	17.9%
Kanamycin_IV	2	0	0	2	0	0	0	1	1	3	10.7%
Kanamycin_oral	2	0	0	2	0	0	0	0	0	2	7.1%
Levofloxacin	19	5	4	10	5	3	2	1	1	25	89.3%
Lincomycin	0	0	0	0	1	1	0	1	1	2	7.1%
Lymecycline	1	1	0	0	0	0	0	0	0	1	3.6%
Meropenem	11	3	1	7	5	3	2	1	1	17	60.7%
Vancomycin_oral	1	0	0	1	1	1	0	0	0	2	7.1%
Vancomycin_IV	12	3	1	8	4	2	2	2	2	18	64.3%
Tobramycin	1	1	0	0	0	0	0	0	0	1	3.6%
Teicoplanin	3	2	0	1	1	1	0	1	1	5	17.9%
Tazobactam	1	1	0	0	1	1	0	0	0	2	7.1%
Streptomycin_IV	1	0	0	1	1	1	0	0	0	2	7.1%
Rifaximin	1	1	0	0	0	0	0	1	1	2	7.1%
Rifamycin_oral	1	0	0	1	0	0	0	0	0	1	3.6%
Rifampicin	7	2	0	5	4	3	1	0	0	11	39.3%
Rifabutin	2	0	0	2	2	1	1	1	1	5	17.9%
Piperacillin	9	3	1	5	3	2	1	2	2	14	50.0%
Piperacillin/tazobactam	9	3	1	5	3	2	1	2	2	14	50.0%
Ofloxacin	5	5	0	0	2	2	0	1	1	8	28.6%
Norfloxacin	8	2	3	3	2	2	0	1	1	11	39.3%

TABLE 43: RESERVE GROUP ANTIBIOTICS AVAILABLE IN THE HFS

Antibiotic	Level 4	Faith Based Organisation	Private	Public	Level 5	Faith Based Organisation	Public	Level 6	Public	Total no. of HFs	Percentage of HFs
Linezolid	5	2		3	2	1	1	2	2	9	32.1%
Tigecycline	1	1		0	1	0	1	1	1	3	10.7%
Polymyxin-B_IV	1	1		0	0	0	0	1	1	2	7.1%
Daptomycin	1	0		1	0	0	0	0	0	1	3.6%
Fosfomycin_IV	1	0		1	1	1	0	1	1	3	10.7%
Colistin_IV	2	1		1	1	1	0	1	1	4	14.3%

TABLE 44: EMPIRICALLY PRESCRIBED ANTIBIOTICS BY WHO AWARE CLASSIFICATION

Access	Watch	Reserve
Flucloxacillin	Ceftriaxone	Linezolid
Metronidazole_IV	Ciprofloxacin	
Amoxicillin	Meropenem	
Clindamycin	Azithromycin	
Gentamycin	Levofloxacin	
Phenoxymethylpenicillin	Ceftazidime	
Nitrofurantoin	Cefuroxime	
Doxycycline	Piperacillin/tazobactam	
Amikacin	Vancomycin_IV	
Ampicillin	Cefixime	
Cefazolin	Erythromycin	
Cloxacillin	Clarithromycin	
Cefalexin	Cefepime	
Ornidazole_oral	Ofloxacin	
Flagyl	Fluoroquinolone	
BenzylPhenoxymethylpenicillin	Fosfomycin	
Ampiclox	Imipenem	
Cefazoline	Macrolide	
Fluconazole	Amphotericin-B	

TABLE 45: **EMPIRICALLY PRESCRIBED ANTIBIOTICS BY WHO AWARE CLASSIFICATION**

Empiric Abx	Abx Prescription rate
Ceftriaxone	18.98%
Flucloxacillin	15.65%
Metronidazole_IV	13.99%
Amoxicillin	9.28%
Clindamycin	6.93%
Ciprofloxacin	3.19%
Meropenem	3.19%
Gentamycin	3.19%
Phenoxymethylpenicillin	2.63%
Azithromycin	2.49%
Levofloxacin	2.35%
Ceftazidime	2.08%
Cefuroxime	2.08%
Piperacillin/tazobactam	2.08%
Vancomycin_IV	1.39%
Nitrofurantoin	1.39%
Doxycycline	1.11%
Cefixime	0.83%
Amikacin	0.83%
Erythromycin	0.69%
Clarithromycin	0.55%
Ampicillin	0.55%
Cefazolin	0.55%
Cloxacillin	0.55%
Ampiclox	0.42%
Linezolid	0.42%
Cefazoline	0.28%
Flagyl	0.28%
Fluconazole	0.28%
Fluoroquinolone	0.28%
Fosfomycin	0.28%
Cefepime	0.28%
Amphotericin-B	0.14%
BenzylPhenoxymethylpenicillin	0.14%
Imipenem	0.14%
Macrolide	0.14%
Ofloxacin	0.14%
Cefalexin	0.14%
Ornidazole_oral	0.14%

For Table 45, the green labels represent Access antibiotics, the amber coloured are Watch, and the red are Reserve antibiotics.

D ANTIMICROBIAL STEWARDSHIP

TABLE 46: **AMS TRAINING AND STEWARDSHIP GUIDELINES**

	Availability of stewardship guidelines/policies			Existence of AMS committee		Date AMS committee formed
KEPH Level/Ownership	No	Yes		No	Yes	
Level 4	18	3		13	8	
Faith Based Organisation	5			4	1	
Coptic Hospital	1			1		
MaterCare Maternity Hospital	1			1		
Mt Kenya (ACK) Hospital	1				1	2023-05-15
Pope Benedict XVI Hospital	1			1		
Tawfiq Hospital	1			1		
Private	4			4		
Afya Link Medical Centre	1			1		
Anka Hospital Isiolo	1			1		
Kapsabet Health Care Centre	1			1		
Kitengela Medical Services	1			1		
Public	9	3		5	7	
Chepterwai Sub-County Hospital	1			1		
Emuhaya Sub County Referral Hospital	1			1		
Isiolo County and Referral Hospital	1			1		
Kajiado County Referral Hospital	1			1		
Kapsabet County Referral Hospital		1			1	2023-02-01
Kericho County Referral Hospital	1				1	2023-08-04
Kilifi County Hospital		1			1	2021-08-03
Mama Margaret Uhuru Hospital	1			1		
Mariakani Sub County Hospital	1				1	2021-03-25
Nanyuki teaching and Referral Hospital	1				1	2023-08-01
Ngong Sub-County Hospital	1				1	2023-09-20
Vihiga County Referral Hospital		1			1	2018-01-01
Level 5	3	2		2	3	
Faith Based Organisation	2	1		1	2	
AIC Litein Mission Hospital	1			1		
Jumuia Mission Hospital Kaimosi	1				1	2023-03-01
The Mater Misericordiae Hospital (Mukuru)		1			1	2016-06-01
Public	1	1		1	1	

E ADDITIONAL USE-CASES FOR AMR DX AND ABX USE

Use Case 1: Level 4, Kilifi County Hospital, Sokoni Ward, Kilifi North Sub county, Kilifi County (Public)

	Community acquired Sepsis	**Hospital acquired sepsis**
Empiric antibiotics prescribed for:-	Azithromycin	Phenoxymethylpenicillin, Ceftriaxone
Percentage of time samples sent to microbiology for:-	100%	100%
When during the course of infection are samples sent to microbiology for:-	During consultation. If symptoms persist 48 to 72 hours later	At first contact with patient 48 to 72 hours after initiation of treatment when there is no improvement
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired Pneumonia	**Hospital acquired Pneumonia**
Empiric antibiotics prescribed for:-	Amoxicillin as first line in paediatrics Amoxicillin Clavulanic acid or Azithromycin for adults	Phenoxymethylpenicillin Or Ceftriaxone if the patient has a concomitant infection
Percentage of time samples sent to microbiology for:-	0%	8%
When during the course of infection are samples sent to microbiology for:-	When there is recurrence	When there is no clinical improvement at 48 to 72 hours
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired cUTI	**Hospital acquired cUTI**
Empiric antibiotics prescribed for:-	Nitrofurantoin or Ciprofloxacin	Ceftriaxone or Amoxicillin Clavulanic acid I.v
Percentage of time samples sent to microbiology for:-	10%	90%
When during the course of infection are samples sent to microbiology for:-	After urinalysis if suggestive of uti or if there is recurrence	After urinalysis if suggestive of UTI
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired IAI	**Hospital acquired IAI**
Empiric antibiotics prescribed for:-	Amoxicillin Clavulanic acid or doxycyline	Ceftriaxone
Percentage of time samples sent to microbiology for:-	0%	55%
When during the course of infection are samples sent to microbiology for:-	No samples collected	When symptoms persist
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired surgical site infection	**Hospital acquired surgical site infection**
Empiric antibiotics prescribed for:-	Doxycycline, Metronidazole, Azithromycin	Ceftriaxone, Metronidazole
Percentage of time samples sent to microbiology for:-	0%	55%
When during the course of infection are samples sent to microbiology for:-	Samples not collected	24 hours after initiation of treatment
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired skin and soft tissue infection	**Hospital acquired skin and soft tissue infection**
Empiric antibiotics prescribed for:-	Flucloxacillin, Doxycycline, Clindamycin	Flucloxacillin, Doxycycline, Clindamycin, Ceftriaxone, Metronidazole
Percentage of time samples sent to microbiology for:-	0%	45%
When during the course of infection are samples sent to microbiology for:-	Samples not collected	Before initiation of treatment or 72hours after initiation of treatment depending on the patients presentation in maternity No samples collected for surgical patients in other wards
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Hospital acquired bone and joint infection
Empiric antibiotics prescribed for:-	Clindamycin
Percentage of time samples sent to microbiology for:-	40%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist
Percentage of the time micro results are received within 48hours for:-	0%

For patients not improving on empiric antibiotics within 24 hours what do you do?	Continue with treatment till 48 hours, Review patient and collect sample for AST and change the treatment
How would you manage a patient improving from sepsis on broad spectrum abx, and microbiology results show BSI with pan-sensitive E coli?	Continue with the current antibiotic till the course is comp

Use Case 2: Level 5, The Mater Misericordiae Hospital (Mukuru), Nairobi South Ward, Starehe Sub county, Nairobi County (FBO)

	Community acquired Sepsis	**Hospital acquired sepsis**
Empiric antibiotics prescribed for:-	**Cefazoline**	**Amoxicillin, Clavulanic**
Percentage of time samples sent to microbiology for:-	**70%**	**100%**
When during the course of infection are samples sent to microbiology for:-	**Day 2**	**Day 1**
Percentage of the time micro results are received within 48hours for:-	**0%**	**0%**

	Community acquired Pneumonia	**Hospital acquired Pneumonia**
Empiric antibiotics prescribed for:-	Amoxicillin Clavulanic	Cefazolin, Meropenem
Percentage of time samples sent to microbiology for:-	70%	100%
When during the course of infection are samples sent to microbiology for:-	Day 2	Day 1
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired cUTI	**Hospital acquired cUTI**
Empiric antibiotics prescribed for:-	Nitrofurantoin	Ciprofloxacin
Percentage of time samples sent to microbiology for:-	50%	100%
When during the course of infection are samples sent to microbiology for:-	Day 3	Day 1
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired IAI	**Hospital acquired IAI**
Empiric antibiotics prescribed for:-	Meropenem	Meropenem
Percentage of time samples sent to microbiology for:-	100%	100%
When during the course of infection are samples sent to microbiology for:-	Day 1	Day 1
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired surgical site infection	**Hospital acquired surgical site infection**
Empiric antibiotics prescribed for:-	Meropenem, Flucloxacillin	Meropenem, Flucloxacillin
Percentage of time samples sent to microbiology for:-	100%	100%
When during the course of infection are samples sent to microbiology for:-	Day 1	Day 1
Percentage of the time micro results are received within 48hours for:-	100%	100%

	Community acquired skin and soft tissue infection	Hospital acquired skin and soft tissue infection
Empiric antibiotics prescribed for:-	Amoxicillin, Clavulanic	Flucloxacillin, Amoxicillin,
Percentage of time samples sent to microbiology for:-	50%	100%
When during the course of infection are samples sent to microbiology for:-	Day 3	Day 1
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Hospital acquired bone and joint infection
Empiric antibiotics prescribed for:-	Meropenem, Clindamycin
Percentage of time samples sent to microbiology for:-	100%
When during the course of infection are samples sent to microbiology for:-	Day 1
Percentage of the time micro results are received within 48hours for:-	0%

For patients not improving on empiric antibiotics within 24 hours what do you do?	Send for culture, escalate to specialist or team of medics, review medication
How would you manage a patient improving from sepsis on broad spectrum abx, and microbiology results show BSI with pan-sensitive E coli?	De-escalate treatment to narrow spectrum gram negative sensitive antibiotics

Use Case 3: Level 5, AIC Litein Mission Hospital, Litein Ward, Bureti Sub county, Kericho County (FBO)

	Community acquired Sepsis	Hospital acquired sepsis
Empiric antibiotics prescribed for:-		Piperacillin/Tazobactam, Vancomycin
Percentage of time samples sent to microbiology for:-	90%	90%
When during the course of infection are samples sent to microbiology for:-	Point of diagnosis, unless critical	As soon as an infection is suspected/ recognised
Percentage of the time micro results are received within 48hours for:-	10%	10%

	Community acquired Pneumonia	Hospital acquired Pneumonia
Empiric antibiotics prescribed for:-	Azithromycin Amoxicillin	Ceftriaxone, piperacillin/Tazobactam and Vancomycin
Percentage of time samples sent to microbiology for:-	5%	5%
When during the course of infection are samples sent to microbiology for:-	Unless it's tuberculosis, they are not sent to microbiology	
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired cUTI	Hospital acquired cUTI
Empiric antibiotics prescribed for:-	Ceuroxime, Nitrofurantoin	Ceftriaxone, piperacillin/Tazobactam, Levofloxacin
Percentage of time samples sent to microbiology for:-	30%	30%
When during the course of infection are samples sent to microbiology for:-	If there is a suspected drug resistance	If there is a suspected drug resistance
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired IAI	Hospital acquired IAI
Empiric antibiotics prescribed for:-	Ceftriaxone, Metronidazole	Ceftriaxone, Meteonidazole, Piperacillin/Tazobactam
Percentage of time samples sent to microbiology for:-	70%	100%
When during the course of infection are samples sent to microbiology for:-	At diagnosis	At diagnosis or when there is a suspected recurrence
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired surgical site infection	Hospital acquired surgical site infection
Empiric antibiotics prescribed for:-	Flucloxacillin	Flucloxacillin, Amoxicillin/Clavulate, Metronidazole
Percentage of time samples sent to microbiology for:-	50%	100%
When during the course of infection are samples sent to microbiology for:-	If not responding to initial management	At diagnosis
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired skin and soft tissue infection	Hospital acquired skin and soft tissue infection
Empiric antibiotics prescribed for:-	Flucloxacillin	Flucloxacillin, Piperacillin/tazobactam, Clindamycin
Percentage of time samples sent to microbiology for:-	30%	100%
When during the course of infection are samples sent to microbiology for:-	Persistence of symptoms	At diagnosis of the skin and/ soft tissue infection
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Hospital acquired bone and joint infection
Empiric antibiotics prescribed for:-	Amoxicillin, Clindamycin
Percentage of time samples sent to microbiology for:-	100%
When during the course of infection are samples sent to microbiology for:-	At diagnosis of the bone or joint Infection
Percentage of the time micro results are received within 48hours for:-	0%

For patients not improving on empiric antibiotics within 24 hours what do you do?	Advice the patient to continue with medications
How would you manage a patient improving from sepsis on broad spectrum abx, and microbiology results show BSI with pan-sensitive E coli?	De escalate to a lower class and less costly antibiotic

Use Case 4: Level 4, Afya Link Medical Centre, Tebere Ward, Kirinyaga South Sub county, Kirinyaga County (Private)

	Community acquired Sepsis	Hospital acquired sepsis
Empiric antibiotics prescribed for:-	Flucloxacillin, Ampiclox	Phenoxymethylpenicillin, Ceftriaxone, Gentamycin
Percentage of time samples sent to microbiology for:-	5%	5%
When during the course of infection are samples sent to microbiology for:-	Immediately	After 5 days if the patient doesn't improve
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired Pneumonia	Hospital acquired Pneumonia
Empiric antibiotics prescribed for:-	Phenoxymethylpenicillin and Gentamycin	Ceftriaxone and /or Gentamycin
Percentage of time samples sent to microbiology for:-	0%	5%
When during the course of infection are samples sent to microbiology for:-	Immediately	When there is recurrence
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired Pneumonia	Hospital acquired Pneumonia
Empiric antibiotics prescribed for:-	Phenoxymethylpenicillin and Gentamycin	Ceftriaxone and /or Gentamycin
Percentage of time samples sent to microbiology for:-	0%	5%
When during the course of infection are samples sent to microbiology for:-	Immediately	When there is recurrence
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired cUTI	Hospital acquired cUTI
Empiric antibiotics prescribed for:-	Amoxicillin-Clavulanic potassium	Ceftriaxone
Percentage of time samples sent to microbiology for:-	0%	10%
When during the course of infection are samples sent to microbiology for:-	Hardly send samples	When symptoms persist
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired IAI	Hospital acquired IAI
Empiric antibiotics prescribed for:-	Flucloxacillin	I.v Flucloxacillin or Ceftriaxone and/or Gentamycin
Percentage of time samples sent to microbiology for:-	5%	5%
When during the course of infection are samples sent to microbiology for:-	When symptoms persist	When symptoms persist
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired surgical site infection	Hospital acquired surgical site infection
Empiric antibiotics prescribed for:-	Flucloxacillin	Ceftriaxone
Percentage of time samples sent to microbiology for:-	5%	5%
When during the course of infection are samples sent to microbiology for:-	When symptoms persist	When symptoms persist
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired skin and soft tissue infection	Hospital acquired skin and soft tissue infection
Empiric antibiotics prescribed for:-	Ampiclox, Flucloxacillin	Ceftriaxone, Gentamycin
Percentage of time samples sent to microbiology for:-	5%	5%
When during the course of infection are samples sent to microbiology for:-	When there is persistence	When symptoms persist
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Hospital acquired bone and joint infection
Empiric antibiotics prescribed for:-	Ceftriaxone, Gentamycin, Flucloxacillin, Clindamycin
Percentage of time samples sent to microbiology for:-	5%
When during the course of infection are samples sent to microbiology for:-	When symptoms persist
Percentage of the time micro results are received within 48hours for:-	0%

For patients not improving on empiric antibiotics within 24 hours what do you do?	Continue with treatment till 48 to 72 hours then change the treatment
How would you manage a patient improving from sepsis on broad spectrum abx, and microbiology results show BSI with pan-sensitive E coli?	Change to Ciprofloxacin

Use Case 5: Level 4, Anka Hospital Isiolo, Bulla Pesa Ward, Isiolo Sub county, Isiolo County (Private)

	Community acquired Sepsis	**Hospital acquired sepsis**
Empiric antibiotics prescribed for:-	Amoxicillin, Levofloxacin, Azithromycin	Ceftriaxone, Flucloxacillin
Percentage of time samples sent to microbiology for:-	50%	80%
When during the course of infection are samples sent to microbiology for:-		If patient deteriorates or there are signs of a new infection.
Percentage of the time micro results are received within 48hours for:-	40%	60%

	Community acquired Pneumonia	**Hospital acquired Pneumonia**
Empiric antibiotics prescribed for:-	Amoxicillin, Azithromycin	Ceftriaxone, IV Azithromycin
Percentage of time samples sent to microbiology for:-	30%	50%
When during the course of infection are samples sent to microbiology for:-		If no response to empirical treatment or if there's worsening of infection
Percentage of the time micro results are received within 48hours for:-	40%	60%

	Community acquired cUTI	**Hospital acquired cUTI**
Empiric antibiotics prescribed for:-	Oral Ciprofloxacin with oral Metronidazole	IV Ciprofloxacin and IV Metronidazole
Percentage of time samples sent to microbiology for:-	30%	40%
When during the course of infection are samples sent to microbiology for:-	When there's no response to antibiotics given. Or recurrence	When there's no response to antibiotics
Percentage of the time micro results are received within 48hours for:-	20%	40%
	Community acquired IAI	**Hospital acquired IAI**
Empiric antibiotics prescribed for:-	Depends on presentation e.g Flucloxacillin or Clindamycin for skin abcess Amoxicillin and Metronidazole for dental abscess	IV Flucloxacillin, IV Metronidazole
Percentage of time samples sent to microbiology for:-	10%	25%
When during the course of infection are samples sent to microbiology for:-	On failure to improve or patient worsening	On failure to improve or patient worsening
Percentage of the time micro results are received within 48hours for:-	20%	40%

	Community acquired surgical site infection	**Hospital acquired surgical site infection**
Empiric antibiotics prescribed for:-	Flucloxacillin	Flucloxacillin oral or I.V.
Percentage of time samples sent to microbiology for:-	10%	30%
When during the course of infection are samples sent to microbiology for:-	When there's no response or condition is worsening	When there's no response or condition worsening
Percentage of the time micro results are received within 48hours for:-	20%	50%

	Community acquired skin and soft tissue infection	**Hospital acquired skin and soft tissue infection**
Empiric antibiotics prescribed for:-	Amoxicillin, Metronidazole, Flucloxacillin	Amoxicillin, Metronidazole, Flucloxacillin
Percentage of time samples sent to microbiology for:-	30%	30%
When during the course of infection are samples sent to microbiology for:-	50% of the time samples taken before of treatment, for the rest if there's no response to antibiotics or there's worsening of infection	50% of the time samples taken before of treatment, for the rest if there's no response to antibiotics or there's worsening of infection
Percentage of the time micro results are received within 48hours for:-	40%	50%

	Hospital acquired bone and joint infection

Empiric antibiotics prescribed for:-	Flucloxacillin , Metronidazole
Percentage of time samples sent to microbiology for:-	50%
When during the course of infection are samples sent to microbiology for:-	50% before initiating antibiotics, 50% if there's no response to antibiotics
Percentage of the time micro results are received within 48hours for:-	50%

For patients not improving on empiric antibiotics within 24 hours what do you do?	If patient is not worsening within 24 hours treatment is continued, if worsening samples are taken and antibiotics changed.
How would you manage a patient improving from sepsis on broad spectrum abx, and microbiology results show BSI with pan-sensitive E coli?	Continue with initiated drug to completion.

Use Case 6: Level 4, Chepterwai Sub-County Hospital, Chepterwai Ward, Mosop Sub county, Nandi County (Public)

	Community acquired Sepsis	**Hospital acquired sepsis**
Empiric antibiotics prescribed for:-	Ceftriaxone, Metronidazole, Amoxicillin, Clavulunic	Ceftriaxone, Metronidazole
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-		When clinical symptoms persist refer patients to Kapsabet county hospital or Moi referral hospital for management
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired Pneumonia	**Hospital acquired Pneumonia**
Empiric antibiotics prescribed for:-	Phenoxymethylpenicillin, Gentamycin, Amoxicillin, Clavulanic	Ceftriaxone, Amoxicillin, Clavulanic
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-		When clinical symptoms persist then referred to kapsabet county hospital or moi teaching and referral hospital for management
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired cUTI	**Hospital acquired cUTI**
Empiric antibiotics prescribed for:-	Ciprofloxacin, nitrofuratoin, cefixime or Cefuroxime	Ceftriaxone
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-	Never done culture and sensitivity however upon recurrence they referred to Kapsabet county hospital or moi teaching and referral hospital	When clinical symptoms persist the patients referred to Kapsabet referral hospital or Moi teaching and referral hospital
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired IAI	**Hospital acquired IAI**
Empiric antibiotics prescribed for:-	Ceftriaxone, Metronidazole	Ceftriaxone, Metronidazole
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist, patients are referred to Kapsabet county hospital or Moi teaching and referral hospital	When clinical symptoms persist, patients will be referred to Kapsabet county hospital or Moi teaching referral hospital
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired surgical site infection	**Hospital acquired surgical site infection**
Empiric antibiotics prescribed for:-	Flucloxacillin, Metronidazole	Flucloxacillin
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist the patients is referred to Kapsabet county hospital or Moi teaching and referral hospital	When clinical symptoms persist the patients is referred to Kapsabet county hospital or Moi teaching and referral hospital
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired skin and soft tissue infection	**Hospital acquired skin and soft tissue infection**
Empiric antibiotics prescribed for:-	Flucloxacillin	Flucloxacillin
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist the patients is referred to Kapsabet county hospital or Moi teaching and referral hospital	When clinical symptoms persist the patients is referred to Kapsabet county hospital or Moi teaching and referral hospital
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Hospital acquired bone and joint infection
Empiric antibiotics prescribed for:-	Flucloxacillin
Percentage of time samples sent to microbiology for:-	0%
When during the course of infection are samples sent to microbiology for:-	The patients is referred almost immediately
Percentage of the time micro results are received within 48hours for:-	0%

For patients not improving on empiric antibiotics within 24 hours what do you do?	If the patients is on Phenoxymethylpenicillin iv Switch to Ceftriaxone if no improvement then Refer to Kapsabet county hospital or Moi teaching and referral hospital
How would you manage a patient improving from sepsis on broad spectrum Abx, and microbiology results show BSI with pan-sensitive E coli?	Switch from Ceftriaxone to oral antibiotics like cefixime or Cefuroxime

Use Case 7: Level 4, Emuhaya Sub County Referral Hospital, Emabungo Ward, Luanda Sub county, Vihiga County (Public)

	Community acquired Sepsis	Hospital acquired sepsis
Empiric antibiotics prescribed for:-	Ceftriaxone, Metronidazole	Ceftriaxone, Metronidazole
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist, there is no response to any antibiotics in the facility, affordability of the patients since the service is outsourced in private facility	When clinical symptoms persist, there is no response to any antibiotics in the facility, affordability of the patients since the service is outsourced in private facility
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired Pneumonia	Hospital acquired Pneumonia
Empiric antibiotics prescribed for:-	Amoxicillin, Phenoxymethylpenicillin, Gentamycin	Phenoxymethylpenicillin, Gentamycin
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-	The health care provider has never requested for microbiology in pneumonia however they would request if clinical symptoms persist	The health care provider has never requested for microbiology in pneumonia however they would request if clinical symptoms persist
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired cUTI	Hospital acquired cUTI
Empiric antibiotics prescribed for:-	Nitrofuratoin, Levofloxacin, Erythromycin	Ceftriaxone
Percentage of time samples sent to microbiology for:-	40%	0%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist or recurrence of infection with no response	When clinical symptoms persist or recurrence of infection
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired IAI	Hospital acquired IAI
Empiric antibiotics prescribed for:-	Ceftriaxone, Metronidazole	Ceftriaxone
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-	The facility has not sent for microbiology test in IAI, they refer patients to Vihiga county hospital for specialist medical care	The facility has not sent for microbiology test in IAI ,they refer patients to Vihiga county hospital for specialist medical care
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired surgical site infection	Hospital acquired surgical site infection
Empiric antibiotics prescribed for:-	Metronidazole, Ceftriaxone	Ceftriaxone, Metronidazole
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist the patients is referred to Vihiga county hospital for specialist medical care	When clinical symptoms persist the patient's referred to Vihiga county hospital for specialist medical care
Percentage of the time micro results are received within 48hours for:-	0%	0%
	Community acquired skin and soft tissue infection	**Hospital acquired skin and soft tissue infection**
Empiric antibiotics prescribed for:-	Flucloxacillin oral, Metronidazole oral	Flucloxacillin, Clindamycin
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist the patient is referred to Vihiga county hospital for specialist medical care	When clinical symptoms persist the patient is referred to Vihiga county hospital for specialist medical care
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Hospital acquired bone and joint infection
Empiric antibiotics prescribed for:-	Metronidazole, Clindamycin
Percentage of time samples sent to microbiology for:-	0%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist refer patients to Vihiga county hospital for specialist medical care
Percentage of the time micro results are received within 48hours for:-	0%

For patients not improving on empiric antibiotics within 24 hours what do you do?	Upscale treatment to broad spectrum incase of clinical symptoms persist refer
How would you manage a patient improving from sepsis on broad spectrum abx, and microbiology results show BSI with pan-sensitive E coli?	Make sure complete dosage

Use Case 8: Level 4, Isiolo County and Referral Hospital, Wabera Ward, Isiolo Sub county, Isiolo County (Public)

	Community acquired Sepsis	Hospital acquired sepsis
Empiric antibiotics prescribed for:-	Ceftriaxone, Metronidazole	Ceftrixaone, Metronidazole
Percentage of time samples sent to microbiology for:-	50%	30%
When during the course of infection are samples sent to microbiology for:-		If recurrent
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired Pneumonia	Hospital acquired Pneumonia
Empiric antibiotics prescribed for:-	Amoxicillin	Ceftriaxone and Metronidazole
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-	0	N/A
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired cUTI	Hospital acquired cUTI
Empiric antibiotics prescribed for:-	Ciprofloxacin	Ceftriaxone and Metronidazole
Percentage of time samples sent to microbiology for:-	30%	40%
When during the course of infection are samples sent to microbiology for:-		If recurrent
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired IAI	Hospital acquired IAI
Empiric antibiotics prescribed for:-	CoAmoxicillin or Cefuroxime	Ceftriaxone and Metronidazole
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-	Immediately	On recurrence
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired surgical site infection	Hospital acquired surgical site infection
Empiric antibiotics prescribed for:-	Flucloxacillin	Ceftriaxone, Metronidazole
Percentage of time samples sent to microbiology for:-	30%	30%
When during the course of infection are samples sent to microbiology for:-	Immediately	After trying a course of antibiotics; first Metronidazole and Ceftriaxone, then Clindamycin. Samples sent if there's no response
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired skin and soft tissue infection	Hospital acquired skin and soft tissue infection
Empiric antibiotics prescribed for:-	Flucloxacillin	Ceftriaxone, Metronidazole
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-		If recurrent and not improving on empirical antibiotics
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Hospital acquired bone and joint infection
Empiric antibiotics prescribed for:-	Ceftriaxone, Metronidazole
Percentage of time samples sent to microbiology for:-	80%
When during the course of infection are samples sent to microbiology for:-	If no response to antibiotics
Percentage of the time micro results are received within 48hours for:-	0%

For patients not improving on empiric antibiotics within 24 hours what do you do?	Continue with antibiotic. Cut off of 1 week to determine if it's working
How would you manage a patient improving from sepsis on broad spectrum Abx, and microbiology results show BSI with pan-sensitive E coli?	Continue with broad spectrum antibiotic

Use Case 9: Level 5, Jumuia Mission Hospital Kaimosi, Shiru Ward, Hamisi Sub county, Vihiga County (FBO)

	Community acquired Sepsis	**Hospital acquired sepsis**
Empiric antibiotics prescribed for:-	Ceftriaxone	Ceftriaxone, Metronidazole, Ciprofloxacin
Percentage of time samples sent to microbiology for:-	30%	5%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist, recurrence and affordability of the patients since some can't afford opting for broad spectrum antibiotics	When clinical symptoms persist ,recurrences Affordability of the patients since some can't afford hence settle for empirical treatment of broad spectrum antibiotics
Percentage of the time micro results are received within 48hours for:-	100%	100%
	Community acquired Pneumonia	**Hospital acquired Pneumonia**
Empiric antibiotics prescribed for:-	Amoxicillin, Ceftriaxone, Azithromycin, Phenoxymethylpenicillin, Gentamycin	
Percentage of time samples sent to microbiology for:-	20%	5%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist, affordability of the patients since the service might not be affordable to the patients so opting for empirical broad spectrum antibiotics	Rarely do they get HAI infections ,no sample sent for that so far for hospital acquired pneumonia
Percentage of the time micro results are received within 48hours for:-	100%	100%

	Community acquired cUTI	**Hospital acquired cUTI**
Empiric antibiotics prescribed for:-	Ciprofloxacin, Metronidazole, nitrofuratoin	
Percentage of time samples sent to microbiology for:-	30%	5%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist, recurrence, affordability of the patients for the service hence opting for empirical management by broad spectrum antibiotics	Rarely do they get HAI however when clinical symptoms persist, recurrence
Percentage of the time micro results are received within 48hours for:-	100%	100%

	Community acquired IAI	Hospital acquired IAI
Empiric antibiotics prescribed for:-	Ceftriaxone, Metronidazole	Ceftriaxone, Metronidazole
Percentage of time samples sent to microbiology for:-	100%	100%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist, affordability of the patients since the service is quite expensive opting for empirical treatment by broad spectrum antibiotics	When clinical symptoms persist, affordability of the patients since the service is pricy opting for empirical treatment by broad spectrum antibiotics
Percentage of the time micro results are received within 48hours for:-	100%	100%

	Community acquired surgical site infection	Hospital acquired surgical site infection
Empiric antibiotics prescribed for:-	Flucloxacillin, Metronidazole	Flucloxacillin
Percentage of time samples sent to microbiology for:-	100%	100%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist. However Christian Hospital Association of Kenya support culture and sensitivity for Surgical site infection hence affordability due to subsidy	When clinical symptoms persist or recurrence However Christian Health Association of Kenya supports culture and sensitivity for Surgical site infection hence affordability due to subsidy
Percentage of the time micro results are received within 48hours for:-	100%	100%

	Community acquired skin and soft tissue infection	Hospital acquired skin and soft tissue infection
Empiric antibiotics prescribed for:-	Flucloxacillin, Metronidazole	Flucloxacillin, Metronidazole
Percentage of time samples sent to microbiology for:-	100%	100%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist, recurrence However CHAK support culture and sensitivity of soft skin infections hence affordability due to subsidy	When clinical symptoms persist CHAK support Culture sensitivity of Skin and soft infection hence affordability due to subsidy.
Percentage of the time micro results are received within 48hours for:-	100%	100%

	Hospital acquired bone and joint infection
Empiric antibiotics prescribed for:-	Flucloxacillin, Clindamycin
Percentage of time samples sent to microbiology for:-	100%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist or recurrence Affordability is not a issue because for bone infection culture and sensitivity is subsided by CHAK.
Percentage of the time micro results are received within 48hours for:-	100%

For patients not improving on empiric antibiotics within 24 hours what do you do?	Opt for second line antibiotics; Ceftazidime iv,
How would you manage a patient improving from sepsis on broad spectrum abx, and microbiology results show BSI with pan-sensitive E coli?	Switch to oral antibiotics Eg move from Ceftriaxone iv to cefalexin oral

Use Case 10: Level 4, Kajiado County Referral Hospital, Ildamat Ward, Kajiado Central Sub county, Kajiado County (Public)

	Community acquired Sepsis	Hospital acquired sepsis
Empiric antibiotics prescribed for:-		Flucloxacillin, Ceftazidime
Percentage of time samples sent to microbiology for:-		50%
When during the course of infection are samples sent to microbiology for:-		On diagnosis
Percentage of the time micro results are received within 48hours for:-		90%

	Community acquired Pneumonia	Hospital acquired Pneumonia
Empiric antibiotics prescribed for:-	Amoxicillin/Clavulate,Ampicillin	Ceftriaxone, Metronidazole
Percentage of time samples sent to microbiology for:-	0%	10%
When during the course of infection are samples sent to microbiology for:-	Rarely sent	Rarely sent
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired cUTI	Hospital acquired cUTI
Empiric antibiotics prescribed for:-	Ceftriaxone	Ceftriaxone
Percentage of time samples sent to microbiology for:-	80%	80%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms re-occur	On non response to empiric treatment
Percentage of the time micro results are received within 48hours for:-	20%	20%

	Community acquired IAI	Hospital acquired IAI
Empiric antibiotics prescribed for:-		Ceftriaxone as first line, escalate to Meropenem if not improving
Percentage of time samples sent to microbiology for:-	10%	10%
When during the course of infection are samples sent to microbiology for:-	On encounter	After 48 hours if patient is not responding
Percentage of the time micro results are received within 48hours for:-	20%	20%

	Community acquired surgical site infection	Hospital acquired surgical site infection
Empiric antibiotics prescribed for:-	Ceftriaxone, Flucloxacillin	Ceftriaxone, Meropenem
Percentage of time samples sent to microbiology for:-	20%	60%
When during the course of infection are samples sent to microbiology for:-	On encounter	After 48 hours of non response to empiric treatment
Percentage of the time micro results are received within 48hours for:-	20%	60%

	Community acquired skin and soft tissue infection	Hospital acquired skin and soft tissue infection
Empiric antibiotics prescribed for:-	Flucloxacillin	Flucloxacillin, Meropenem
Percentage of time samples sent to microbiology for:-	20%	60%
When during the course of infection are samples sent to microbiology for:-	During a recurrence	Non response to treatment, on recurrence
Percentage of the time micro results are received within 48hours for:-	20%	20%

	Hospital acquired bone and joint infection
Empiric antibiotics prescribed for:-	Ceftriaxone
Percentage of time samples sent to microbiology for:-	20%
When during the course of infection are samples sent to microbiology for:-	Recurrence of an infection , non response to treatment
Percentage of the time micro results are received within 48hours for:-	10%

For patients not improving on empiric antibiotics within 24 hours what do you do?	Check on the dose and frequency and consider escalation of antibiotics and sample to culture and sensitivity
How would you manage a patient improving from sepsis on broad spectrum abx, and microbiology results show BSI with pan-sensitive E coli?	Give an access antibiotic that is available

Use Case 11: Level 4, Kapsabet County Referral Hospital, Kapsabet Ward, Emgwen Sub county, Nandi County (Public)

	Community acquired Sepsis	**Hospital acquired sepsis**
Empiric antibiotics prescribed for:-	Ceftriaxone, Metronidazole	Ceftazidime, Amikacin
Percentage of time samples sent to microbiology for:-	5%	15%
When during the course of infection are samples sent to microbiology for:-		Clinical symptoms persistent after 10 days, resistance to 2nd line antibiotics ie Ceftazidime and Amikacin,
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired Pneumonia	**Hospital acquired Pneumonia**
Empiric antibiotics prescribed for:-	Amoxicillin, Azithromycin, Ceftriaxone, Amoxicillin, Clavulanic	Ceftriaxone, Ceftazidime, Amikacin
Percentage of time samples sent to microbiology for:-	5%	15%
When during the course of infection are samples sent to microbiology for:-		Immediately upon admission to ICU ,CLINICAL Symptom persist
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired cUTI	**Hospital acquired cUTI**
Empiric antibiotics prescribed for:-	Cefuroxime, cefixime	Ceftriaxone, ciprofloxacillin
Percentage of time samples sent to microbiology for:-	5%	15%
When during the course of infection are samples sent to microbiology for:-	Not routine, however when Clinical symptoms persist or recurrence of infection	When clinical symptoms persist, upon resistance of second line ie Ceftazidime and Amikacin
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired IAI	**Hospital acquired IAI**
Empiric antibiotics prescribed for:-	Ceftriaxone, metronidazole	Ceftazidime, Amikacin
Percentage of time samples sent to microbiology for:-	5%	15%
When during the course of infection are samples sent to microbiology for:-	Rarely does community acquired infections are sent for microbiology however if clinical symptoms persist or recurrence	Clinical symptoms persist, 2nd line antibiotics are resistance ie Ceftazidime and Amikacin
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired surgical site infection	**Hospital acquired surgical site infection**
Empiric antibiotics prescribed for:-	Flucloxacillin, Metronidazole	Ceftriaxone, Clindamycin
Percentage of time samples sent to microbiology for:-	5%	15%
When during the course of infection are samples sent to microbiology for:-	Rarely do we send culture and sensitivity in community acquired however if clinical symptoms persist	Clinical symptoms persist or resistance to 2nd line antibiotics Amikacin, Ceftazidime
Percentage of the time micro results are received within 48hours for:-	0%	0%
	Community acquired skin and soft tissue infection	**Hospital acquired skin and soft tissue infection**
Empiric antibiotics prescribed for:-	Flucloxacillin, Metronidazole	Flucloxacillin, Metronidazole
Percentage of time samples sent to microbiology for:-	5%	15%
When during the course of infection are samples sent to microbiology for:-	Rarely do we send community acquired for culture and sensitivity however upon recurrence of infection or clinical symptoms persist	When clinical symptoms persist , when second line antibiotics resist
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Hospital acquired bone and joint infection
Empiric antibiotics prescribed for:-	Clindamycin, Levofloxacin
Percentage of time samples sent to microbiology for:-	15%
When during the course of infection are samples sent to microbiology for:-	Rarely the department inclines to empirical treatment unless clinical symptoms persist
Percentage of the time micro results are received within 48hours for:-	0%

For patients not improving on empiric antibiotics within 24 hours what do you do?	To switch antibiotics to 2nd line ie Ceftazidime and Amikacin
How would you manage a patient improving from sepsis on broad spectrum abx, and microbiology results show BSI with pan-sensitive E coli?	Down grade to specific antibiotics or switch to orals .However its a multi discplinary decision to switch to oral Ce

Use Case 12: Level 4, Kapsabet Health Care Centre, Chemundu/Kapng'etunyi Ward, Chesumei Sub county, Nandi County (Private)

	Community acquired Sepsis	**Hospital acquired sepsis**
Empiric antibiotics prescribed for:-	Ceftriaxone, Metronidazole, Ceftriaxone, Gentamycin	Ceftazidime, Meropenem
Percentage of time samples sent to microbiology for:-	25%	70%
When during the course of infection are samples sent to microbiology for:-		When clinical symptoms persist
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired Pneumonia	**Hospital acquired Pneumonia**
Empiric antibiotics prescribed for:-	Amoxicillin, Clavulanic, Azithromycin	Ceftriaxone
Percentage of time samples sent to microbiology for:-	0%	10%
When during the course of infection are samples sent to microbiology for:-		When clinical symptoms persist or recurrence of infection
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired cUTI	**Hospital acquired cUTI**
Empiric antibiotics prescribed for:-	Nitrofuratoin, Doxycycline, cefixime/Cefuroxime	Gentamycin ,Ceftriaxone, fluconazole
Percentage of time samples sent to microbiology for:-	5%	20%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist or recurrence of infection	When clinical symptoms persist or recurrence of infection
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired IAI	**Hospital acquired IAI**
Empiric antibiotics prescribed for:-	Metronidazole, Levofloxacin,	Metronidazole, Ceftriaxone, Piperacillin/Tazobactam, Ceftazidime
Percentage of time samples sent to microbiology for:-	5%	40%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist or recurrence of infection	When clinical symptoms persist or recurrence of infection
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired surgical site infection	**Hospital acquired surgical site infection**
Empiric antibiotics prescribed for:-	Flucloxacillin, Ampicillin/Cloxacillin, Metronidazole	Flucloxacillin, Ceftriaxone, Metronidazole
Percentage of time samples sent to microbiology for:-	10%	40%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persistent, recurrence of the infection	When clinical symptoms persist or recurrence of infection
Percentage of the time micro results are received within 48hours for:-	0%	0%
	Community acquired skin and soft tissue infection	**Hospital acquired skin and soft tissue infection**
Empiric antibiotics prescribed for:-	Flucloxacillin, Metronidazole, Ciprofloxacin	Metronidazole, Ceftriaxone, Flucloxacillin, Clindamycin
Percentage of time samples sent to microbiology for:-	10%	40%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist or recurrence of infection	When clinical symptoms persist or recurrence of infection
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Hospital acquired bone and joint infection
Empiric antibiotics prescribed for:-	Gentamycin, Ceftriaxone, Clindamycin, Flucloxacillin
Percentage of time samples sent to microbiology for:-	20%
When during the course of infection are samples sent to microbiology for:-	When clinical symptoms persist or recurrence of infection
Percentage of the time micro results are received within 48hours for:-	0%

For patients not improving on empiric antibiotics within 24 hours what do you do?	Proceed to second line in the facility ie Ceftriaxone ,Metronidazole iv ,Gentamycin targeting synergizing from single antibiotic used in first line
How would you manage a patient improving from sepsis on broad spectrum abx, and microbiology results show BSI with pan-sensitive E coli?	Downgrade from iv to oral antibiotics like Levofloxacin or Amoxicillin -Clavulunic

Use Case 13: Level 4, Kericho County Referral Hospital, Kipchebor Ward, Ainamoi Sub county, Kericho County (Public)

	Community acquired Sepsis	Hospital acquired sepsis
Empiric antibiotics prescribed for:-		Meropenem, Piperacillin/Tazobactam, Imipenem, Clindamycin, Fosfomycin
Percentage of time samples sent to microbiology for:-		100%
When during the course of infection are samples sent to microbiology for:-		On diagnosis and response to treatment
Percentage of the time micro results are received within 48hours for:-		100%

	Community acquired Pneumonia	Hospital acquired Pneumonia
Empiric antibiotics prescribed for:-	Amoxicillin, Azithromycin, Amoxyclav, Cefuroxime Erythromycin	Ceftriaxone, Meropenem, Ceftazidime
Percentage of time samples sent to microbiology for:-	0%	100%
When during the course of infection are samples sent to microbiology for:-	At diagnosis	At diagnosis, on poor response to response
Percentage of the time micro results are received within 48hours for:-	0%	100%

	Community acquired cUTI	Hospital acquired cUTI
Empiric antibiotics prescribed for:-	Ceftriaxone, Flucloxacillin/Amoxicillin, Vancomycin	Vancomycin, Clindamycin,
Percentage of time samples sent to microbiology for:-	10%	100%
When during the course of infection are samples sent to microbiology for:-	During a recurrence	When clinical symptoms persist, within 24 hours
Percentage of the time micro results are received within 48hours for:-	100%	100%

	Community acquired IAI	Hospital acquired IAI
Empiric antibiotics prescribed for:-		Ceftriaxone, Metronidazole and Clindamycin and Cefazoline
Percentage of time samples sent to microbiology for:-		100%
When during the course of infection are samples sent to microbiology for:-		On diagnosis
Percentage of the time micro results are received within 48hours for:-		100%

	Community acquired surgical site infection	**Hospital acquired surgical site infection**
Empiric antibiotics prescribed for:-	Ceftriaxone, Cefazolin, Flucloxacillin, Metronidazole, Gentamycin	Ceftriaxone, Cefazolin, Flucloxacillin, Metronidazole, Gentamycin
Percentage of time samples sent to microbiology for:-	0%	100%
When during the course of infection are samples sent to microbiology for:-	When the patient conditions deteriorates	When the patient conditions deteriorates
Percentage of the time micro results are received within 48hours for:-	100%	100%

	Community acquired skin and soft tissue infection	**Hospital acquired skin and soft tissue infection**
Empiric antibiotics prescribed for:-	Flucloxacillin, Amoxicillin	Ceftriaxone, Vancomycin, Ciprofloxin, Levofloxacin, Fluconazole, Amphotericin-B
Percentage of time samples sent to microbiology for:-	100%	100%
When during the course of infection are samples sent to microbiology for:-	Not commonly observed so not articulated	When type patients condition deteriorates
Percentage of the time micro results are received within 48hours for:-	0%	100%

	Hospital acquired bone and joint infection
Empiric antibiotics prescribed for:-	Flucloxacillin, Clindamycin, Cefazolin
Percentage of time samples sent to microbiology for:-	100%
When during the course of infection are samples sent to microbiology for:-	When the patient condition deteriorates
Percentage of the time micro results are received within 48hours for:-	100%

For patients not improving on empiric antibiotics within 24 hours what do you do?	Take a sample and escalate the antibiotic,(ICU physician), Releases the patient and do other investigations for other comorbid conditions, confirm the dose (paediatrician)
How would you manage a patient improving from sepsis on broad spectrum abx, and microbiology results show BSI with pan-sensitive E coli?	Will continue with the broad-spectrum antibiotic to completion

Use Case 14: Level 4, Kitengela Medical Services, Kitengela Ward, Kajiado East Sub county, Kajiado County (Private)

	Community acquired Sepsis	Hospital acquired sepsis
Empiric antibiotics prescribed for:-		Phenoxymethylpenicillin, Ceftriaxone
Percentage of time samples sent to microbiology for:-		10%
When during the course of infection are samples sent to microbiology for:-		On diagnosis
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired Pneumonia	Hospital acquired Pneumonia
Empiric antibiotics prescribed for:-	Amoxicillin, Erythromycin, Azithromycin	Phenoxymethylpenicillin, Gentamycin, Ceftriaxone
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-	Rarely sent	Rarely sent
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired cUTI	Hospital acquired cUTI
Empiric antibiotics prescribed for:-	Ciprofloxcin, Nitrofurantoin, Erythromycin	Ceftriaxone, Levofloxacin
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-	Rarely sent..	On recurrence
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired IAI	Hospital acquired IAI
Empiric antibiotics prescribed for:-	Ciprofloxacin, Levofloxacin, Metronidazole, ornidazole/oflocaxin	Metronidazole, Levofloxacin, Ceftriaxone
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-	Rarely sent	Rarely sent
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired surgical site infection	Hospital acquired surgical site infection
Empiric antibiotics prescribed for:-	Clindamycin, Metronidazole, Flucloxacillin	Clindamycin, Metronidazole, Flucloxacillin
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-	Rare sent	On diagnosis
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Community acquired skin and soft tissue infection	Hospital acquired skin and soft tissue infection
Empiric antibiotics prescribed for:-	Flucloxacillin, Ampicillin, Cloxacillin, Flucloxacillin, Amoxicillin	Flucloxacillin, Clindamycin, Metronidazole, Amoxicillin
Percentage of time samples sent to microbiology for:-	0%	0%
When during the course of infection are samples sent to microbiology for:-	Rarely sent	Rarely sent
Percentage of the time micro results are received within 48hours for:-	0%	0%

	Hospital acquired bone and joint infection
Empiric antibiotics prescribed for:-	Cloxacillin, Ceftriaxone, Metronidazole, Clindamycin
Percentage of time samples sent to microbiology for:-	0%
When during the course of infection are samples sent to microbiology for:-	Rarely sent
Percentage of the time micro results are received within 48hours for:-	0%

For patients not improving on empiric antibiotics within 24 hours what do you do?	Wait for response after 48 hours
How would you manage a patient improving from sepsis on broad spectrum Abx, and microbiology results show BSI with pan-sensitive E coli?	Maintain the dosage as it is and continue to reassess

F AMR DX CAPACITY ASSESSMENT IN COUNTIES

AMR Dx Capacity assessment in counties

The Ministry of Health, in collaboration with JKUAT, FIND, the global alliance for diagnostics, and GARDP is carrying out an activity to assess AMR diagnostic capacity, antibiotic use and existing antimicrobial stewardship practices in preparation for the introduction of cefiderocol (and other antibiotics) and new low blood culture and molecular Point of care testing (POCT) platforms in Kenya. The activity is taking place at selected levels 4,5 and 6 of health facilities in Isiolo, Laikipia, Vihiga, Nyeri, Nairobi, Kirinyaga, Kericho, Kajiado, Nandi and Kilifi counties.

Please complete this questionnaire for the facilities that you are reporting on, and where indicated, provide additional details on your selected responses.

Findings will be published by MoH, Isiolo, Laikipia, Vihiga, Nyeri, Nairobi, Kirinyaga, Kericho, Kajiado, Nandi and Kilifi Counties, as well as JKUAT, FIND and GARDP.

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A PRELIMINARY INFORMATION

County

- ◯ Isiolo
- ◯ Laikipia
- ◯ Vihiga
- ◯ Nyeri
- ◯ Nairobi
- ◯ Kirinyaga
- ◯ Kericho
- ◯ Kajiado
- ◯ Nandi
- ◯ Kilifi

Sub county

Ward

Name of health facility

Facility code

Assessor name

.....

GPS coordinates

latitude (x.y °)

longitude (x.y °)

altitude (m)

accuracy (m)

Assessment date

yyyy-mm-dd

B FACILITY CHARACTERISTICS

b1. Level of the health facility

- ◯ Level 4
- ◯ Level 5
- ◯ Level 6

b2. Ownership of health facility

- ◯ Public/Government
- ◯ Private
- ◯ NGO/Faith-based/Donors
- ◯ Other

b2.1 Other (specify)

b3. Primary laboratory affiliation

- ◯ University teaching hospital/ Medical College
- ◯ National referral hiospital
- ◯ County referral hospital
- ◯ Sub_county hospital
- ◯ Private hospital
- ◯ Faith-based hospital

b4. Number of beds in the health facility

.....

b5. What is the average bed occupancy rate

.....

b6. Approximate number of people treated in the facility over the last 12 months (Inpatient)

consider august 2022 as the reference month

.....

b7. Approximate number of people treated in the facility over the past 12 months (Outpatient)

consider august 2022 as the reference month

.....

b8. Facility Phone Number

.....

b9. Facility email address

.....

b10. Name of the lab manager

.....

b11. Phone number of the lab manager

.....

b12. Lab manager's email address

.....

C LABORATORY WORKFORCE

c1. Total number of laboratory staff

c2. Total number of laboratory staff employed by the government

c3. Total number of laboratory staff employed but paid by organizations other than government

c4. Number of staff between ages 20-35 years

c5. Number of staff between ages 36-50 years

c6. Number of staff over 50 years old

D TEST MENU AND WORKLOAD

d.1 Does the lab have capacity to perform cultures

- ◯ Yes
- ◯ No

d1.1 Does the lab have capacity to perform fungal cultures

- ◯ Yes
- ◯ No

d1.2 What is the main reason why the lab does not perform cultures

d2. Does the lab perform the following cultures

- [ ] Blood
- [ ] Urine
- [ ] Stool
- [ ] Lower Respiratory
- [ ] Upper Respiratory
- [ ] Cerebrospinal Fluid
- [ ] Sterile Body Fluid (pleural, pericardial, peritoneal, synovial)
- [ ] Genital (urethral and cervical)
- [ ] High Vaginal Swab
- [ ] Pus, aspirates and tissue
- [ ] TB

d8. Does the lab conduct manual or automated blood cultures?

- [ ] Automated
- [ ] Manual

d9. What blood culture machine is available?

- [ ] Bactec
- [ ] BacT/ALERT
- [ ] TDR automated blood culture system

d21 Does the lab use any other blood culture machine not listed above

- ( ) Yes
- ( ) No

d22 How many other Blood culture machines are available other than those mentioned above?

indicate a 0 if none

» d23 List the other blood culture machines

d39 Does the lab conduct gram staining?

- ◯ Yes
- ◯ No

d40 Does the lab conduct antimicrobial susceptibility testing (AST)?

- ◯ Yes
- ◯ No

d40.1 Does the lab refer samples for AST

- ☐ Patient to another lab
- ☐ Isolates to another lab

d40.2 Where does the lab refer for AST testing?

- ☐ National referral hospital
- ☐ County referral hospital
- ☐ National microbiology reference lab
- ☐ Private hospitals
- ☐ Private labs
- ☐ University teaching hospital/ medical college
- ☐ Government level 4 hospitals
- ☐ NGO owned hospital
- ☐ FBO owned hospital

d41 What manual AST methods are in use?

- [ ] Disk diffusion
- [ ] Gradient strip (e.g Etest/Liofilchem)
- [ ] Broth microdilution (96-well tray)
- [ ] Broth microdilution (tube method)
- [ ] Agar dilution

d42 What automated AST methods are in use?

Leave blank if none applies

- [ ] Vitek
- [ ] Phoenix
- [ ] Microscan
- [ ] SIRScan
- [ ] BIOMIC

d49 Does the lab use any other automated AST methods different from the ones listed above?

- ( ) Yes
- ( ) No

d50 How many other automated AST machines are available other than those mentioned above?

indicate a 0 if none

.....

» d51 List the other automated AST machines

d60 Does the lab use chromagar (chromogenic culture media) to detect antibiotic resistant organisms?

- ◯ Yes
- ◯ No

d61 Does the lab have a PCR (or other nucleic acid tests (NAT)) instrument/Machine used for detecting antibiotic resistance genes?

- ◯ Yes
- ◯ No

d62 What is the machine in use?

d63 What is the TaT (in hours) on this machine?

d64 Is the machine functional today?

- Yes
- No

d65 Is the user manual present?

- Yes
- No

d66 Are the routine (user) maintenance records present?

- Yes
- No

d67 Are the vendor maintenance records present?

- Yes
- No

d68 Is a service contract in place?

- Yes
- No

d69 When was the machine last callibrated?

yyyy-mm-dd

d70 Do you conduct specific testing for the detection of MRSA, VRE, carbapenem and/or 3rd gen cephalosporin resistance using phenotypic (chromogenic media, CarbaNP) or genotypic (e.g. Cepheid cartridge) methods?

- ◯ Yes
- ◯ No

d71 Mention the tests

- ☐ Phenotypic (Chromogenic media, CarbaNP)
- ☐ Genotypic (e.g. Cepheid cartridge) methods

d732Does the facility receive samples from other facilities for culture and AST?

- ◯ Yes
- ◯ No

d73 Indicate the number of samples submitted in 2021

.....

d74 Indicate the number of samples submitted in 2022

.....

d75 Name the facility which sends the highest volume of samples

.....

d76 Does the facility receive isolates from other facilities for AST?

- ◯ Yes
- ◯ No

d77 Indicate the number of samples submitted in 2021

.....

d78 Indicate the number of samples submitted in 2022

.....

d79 Name the facility which sends the highest volume of isolates

.....

d80 Who collects samples for blood culture test?

- [ ] Clinician
- [ ] Phlebotomist
- [ ] Lab Personnel
- [ ] Others

d80.1 Other (Specify)

.....

E LIS AND DATA USE

e1. What is the laboratory system for recording culture and AST results?

- ( ) Computer-based laboratory information system (LIS)a. Computer-based laboratory information system (LIS)
- ( ) Electronic but not LIS (e.g word, excel)
- ( ) Handwritten paperwork card
- ( ) Combination of electronic and handwritten

e2. Who is responsible for entering the data in the selected option above?

- [ ] Microbiologist in charge
- [ ] Data clerk
- [ ] Microbiology students/interns
- [ ] IT personnels
- [ ] IT students/interns
- [ ] Lab Personnel

e3. Does the LIS record the AST method used to obtain each individual antibiotic result?

- ( ) Yes
- ( ) No

e4. Does the LIS automatically interpret inhibition zone diameters/MICs into Susceptible, Intermediate, Resistant?

- ( ) Yes
- ( ) No

e5. Does the LIS produce a cumulative antibiogram ?

- Yes
- No

e6.1 If yes, how often is it updated?

- Quarterly
- Half_yearly
- Annually

e7. Does the LIS interface with automated AST instruments?

- Yes
- No

e8. Does the LIS interface with hospital information system (HIS)?

- Yes
- No

e9. What is the laboratory system for reporting to the clinician/client?

- Fully electronic
- Combination of paper and electronic reporting
- Fully paper based

e10. Does the LIS export isolate-based AST data (line list) to .txt or .csv?

- Yes
- No

e11. Does the facility develop cumulative antibiogram reports using the AMR data?

- Yes
- No

e11.1 How often?

- Quarterly
- Half_yearly
- Annually

e12. Is the cumulative antibiogram reviewed annually by either AMS or pharmacy and therapeutics committee?

- Yes
- No

e13. Is the cumulative antibiogram distributed to all physicians?

- Yes
- No

e13.1 How is the antibiogram distributed?

- Hardcopy
- Electronically

e14. Is the cumulative antibiogram report produced disaggregated by the hospital unit?

- Yes
- No

e15. Is the cumulative antibiogram report produced limited to a number of pathogens or only specific pathogens?

- Yes
- No

e15.1 If yes, what are the reasons?

.....

e15.2 Which are these pathogens?

.....

F DIAGNOSTIC TEST COST

f1. How does the patient pay for culture and sensitivity testing?

- [ ] Out-of-pocket
- [ ] Medical Insurance (private)
- [ ] Government health scheme (NHIF, UHC, ESIC, CGHS)
- [ ] Free
- [ ] Not Applicable/Bacteriology services not offered

f2. What is the cost to the patient for culture and sensitivity testing for a single patient sample?

f3. What is the cost of a blood culture?

f4. What is the cost to the patient on a PCR/NAT test?

G LABORATORY STAFF EDUCATION

Among laboratory leadership and technical staff in bacteriology, indicate the number that fall in each training level category

g1. Advanced degree in medical microbiology or medical laboratory sciences (PhD)

g2. Master's degree in medical microbiology or medical laboratory sciences

g3L1c. Postgraduate diploma in medical microbiology or medical laboratory sciences

g4. Bachelor's degree in medical microbiology or medical laboratory sciences

g5. Higher National Diploma in medical microbiology or medical laboratory sciences

g6. Diploma in medical laboratory sciences

.....

g7. Certificate in medical laboratory sciences

.....

g8. Indicate other trainings

.....

g9. Does the lab have a standardized process of training new employees?

- ◯ Yes
- ◯ No

g9.1 Please specify

.....

g10. Do employees receive annual competency assessment? (Review lab test menu)

- ◯ Yes
- ◯ No

H QMS MENTORING PROGRAM

h1. Has the laboratory been enrolled to any of the following mentorship programmes

- ☐ SLIPTA program
- ☐ SLMTA program
- ☐ SLIPTA program enrollment ongoing
- ☐ SLMTA program enrollment ongoing
- ☐ None

h1.1 Other (Please specify)

.....

h1.2 For eithor SLIPTA or SLMTA, when was the most recent certification awarded?

- ◯ Within the last 2 years
- ◯ More than 2 years ago

h2 What is the star level of the latest SLIPTA audit? *Check certificate*

- 0 Star
- 1 Star
- 2 Stars
- 3 Stars
- 4 Stars
- 5 Stars

h3. Has the laboratory been enrolled in the KNEQAS bacteriology program?

- Yes
- No

h3.1 If yes, which year?

.....

h4 What was the last overall percentage score?

- >90%
- 70%-89%
- 50%-69%
- <49%

h5. Has the laboratory ever been enrolled in any other mentorship program for laboratory quality management?

- Yes
- No

h5.1 Mention the program

.....

h5.2 Mention when

yyyy-mm-dd

.....

I ACCREDITATION AND CERTIFICATION

i1 Does the lab possess a valid ISO 15189 accreditation certificate?

Only select yes after confirming the certificate

- ◯ Yes
- ◯ No

i2 Which of the following cultures are covered by the accreditation certificate

- ☐ Blood Cultures
- ☐ Stool Cultures
- ☐ Urine Cultures
- ☐ Organism Identification
- ☐ Antibiotic Susceptibility Testing
- ☐ Other

Specify other.

.....

i3 Who awarded the accreditation?

- ◯ International Laboratory Accreditation Cooperation
- ◯ KENAS
- ◯ NABL
- ◯ JCI
- ◯ Other

i3.1 Other (Please specify)

.....

» J GENERAL FACILITY

j1 Are critical equipment (e.g automated blood culture) supported by a functioning backup system?

- ◯ Yes
- ◯ No
- ◯ Not Applicable

j2 Are critical equipment (e.g automated blood culture) attached to uninterrupted power supply (UPS)? (Provides temporary power until back-up is activated)

- ◯ Yes
- ◯ No
- ◯ Not Applicable

j3 In the last 6 months, has prolonged power failure disrupted the ability to provide routine bacteriology services?

- ◯ Yes
- ◯ No
- ◯ Not Applicable

j4 Has QA/QC been done in the last 6 months?

- ◯ Yes
- ◯ No

» K INVENTORY AND STOCK OUTS

k1. Does the lab have an inventory control system in place?

- ◯ Yes
- ◯ No
- ◯ Not Applicable

k1.1 If yes, is the inventory management system manual or using software?

- ◯ manual
- ◯ software

k2. In the last 6 months, has the lab experienced stockouts for specimen collection materials? E.g blood culture bottles

- ◯ Yes
- ◯ No
- ◯ Not Applicable

k3. In the last 6 months, has the lab experienced stockouts of consumables? E.g gloves, agar plates

- ◯ Yes
- ◯ No
- ◯ Not Applicable

k4. In the last 6 months, has the lab experienced stockouts of antibiotic disks or strips?

- ◯ Yes
- ◯ No
- ◯ Not Applicable

k5. In the last 6 months, has the lab experienced stockouts of ID or AST cards/trays for automated instruments?

- ◯ Yes
- ◯ No
- ◯ Not Applicable

k6. In the last 6 months, has any stockouts disrupted the lab's ability to provide routine bacteriology services?

- ◯ Yes
- ◯ No
- ◯ Not Applicable

k7. Apart from stock outs, what other challenges hinder you from conducting blood culture in your facility?

.....

Thank you for taking the time out of your day to participate in this assessment. We highly appreciate the information you have provided.

.....

G ABX USE ASSESSMENT IN COUNTIES

ABX Use Assessment in Counties

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.....

A PRELIMINARY INFORMATION

County *

- ◯ Isiolo
- ◯ Laikipia
- ◯ Vihiga
- ◯ Nyeri
- ◯ Nairobi
- ◯ Kirinyaga
- ◯ Kericho
- ◯ Kajiado
- ◯ Nandi
- ◯ Kilifi

Sub county *

Ward *

Name of health facility *

Facility code *

Name of assessor *

.....

GPS coordinates

latitude (x.y °)

longitude (x.y °)

altitude (m)

accuracy (m)

Assessment date *

yyyy-mm-dd

B FACILITY ASSESSMENT

Health Facility Assesment

b1 What is the ownership of the health facility

- ◯ Public
- ◯ Private
- ◯ Faith Based Organisation

b2 What is the level of the health facility

- ◯ Level 4
- ◯ Level 5
- ◯ Level 6

b3 What is the bed capacity of the health facility

b4 What is the bed occupancy rate of the health facility

Give this as a percentage

.....

b5 What guides clinicians to request for a bacteriology test?

- [ ] Patient clinical signs
- [ ] Guidelines
- [ ] Research driven
- [ ] Other

Specify other.

.....

b6 Does the health facility have antibiotic guidelines

- ◯ Yes
- ◯ No

b7 Are the guidelines global, national, county or health facility specific?

- ◯ Global
- ◯ National
- ◯ County
- ◯ Health Facility specific

Antibiogram Details

.....

b8 Does the health facility have an antibiogram?

- ◯ Yes
- ◯ No

b9 What is the level of disaggregation of the antibiogram details?

Regional could for example mean the former provinces or one from a level 6 health facility

- ◯ Country
- ◯ Regional
- ◯ County
- ◯ Health Facility

b10 Take a photograph of the antibiogram

Click here to upload file. (< 10MB)

b11 How often is the antibiogram updated

- Quarterly
- Semi-annually
- Annually
- Other

Specify other.

b12 Where is the antibiogram available

- Clinic (Consultation room)
- Hospital ward
- Hospital Pharmacy
- Available Online
- Other

Specify other.

b13 Is the antibiogram shared with any other facilities/ hospitals?

- Yes
- No

b14 Does the hospital issue an antibiogram during orientation?

- Yes
- No

b15 Who are issued with an antibiogram during orientation?

- [ ] Nurses
- [ ] Medical Officers
- [ ] Clinical Officers
- [ ] Pharmacists
- [ ] Consultants
- [ ] Interns
- [ ] Lab Personnel

b16 Is the antibiogram available to the public?

- ◯ Yes
- ◯ No

Antibiotic formulary

.....

b17 Are you aware about the WHO EML AWaRe list? (2021 AWaRe classification (who.int))

- ◯ Yes
- ◯ No

b18 Select the antibiotics available at the health facility pharmacy from the Access group antibiotics listed

- [ ] Amikacin
- [ ] Amoxicillin
- [ ] Amoxicillin/clavulanic-acid
- [ ] Ampicillin
- [ ] Ampicillin/sulbactam
- [ ] Azidocillin
- [ ] Bacampicillin
- [ ] Benzathine-benzylpenicillin
- [ ] Benzylpenicillin
- [ ] Brodimoprim
- [ ] Cefacetrile
- [ ] Cefadroxil
- [ ] Cefalexin
- [ ] Cefaloridine
- [ ] Cefalotin
- [ ] Cefapirin
- [ ] Cefatrizine
- [ ] Cefazedone
- [ ] Cefazolin
- [ ] Cefradine
- [ ] Cefroxadine
- [ ] Ceftezole
- [ ] Chloramphenicol
- [ ] Clindamycin
- [ ] Clometocillin
- [ ] Cloxacillin
- [ ] Dicloxacillin
- [ ] Doxycycline
- [ ] Epicillin
- [ ] Flucloxacillin
- [ ] Furazidin
- [ ] Gentamicin
- [ ] Hetacillin
- [ ] Mecillinam
- [ ] Metampicillin
- [ ] Meticillin
- [ ] Metronidazole_IV
- [ ] Metronidazole_oral
- [ ] Nafcillin
- [ ] Nifurtoinol
- [ ] Nitrofurantoin
- [ ] Ornidazole_IV
- [ ] Ornidazole_oral
- [ ] Oxacillin
- [ ] Penamecillin
- [ ] Phenoxymethylpenicillin
- [ ] Pivampicillin
- [ ] Pivmecillinam
- [ ] Procaine-benzylpenicillin
- [ ] Propicillin
- [ ] Secnidazole
- [ ] Spectinomycin
- [ ] Sulbactam
- [ ] Sulfadiazine
- [ ] Sulfadiazine/tetroxoprim
- [ ] Sulfadiazine/trimethoprim
- [ ] Sulfadimethoxine
- [ ] Sulfadimidine
- [ ] Sulfadimidine/trimethoprim
- [ ] Sulfafurazole
- [ ] Sulfaisodimidine
- [ ] Sulfalene
- [ ] Sulfamazone
- [ ] Sulfamerazine
- [ ] Sulfamerazine/trimethoprim
- [ ] Sulfamethizole
- [ ] Sulfamethoxazole
- [ ] Sulfamethoxazole/trimethoprim
- [ ] Sulfamethoxypyridazine
- [ ] Sulfametomidine
- [ ] Sulfametoxydiazine
- [ ] Sulfametrole/trimethoprim
- [ ] Sulfamoxole
- [ ] Sulfamoxole/trimethoprim
- [ ] Sulfanilamide
- [ ] Sulfaperin
- [ ] Sulfaphenazole
- [ ] Sulfapyridine
- [ ] Sulfathiazole
- [ ] Sulfathiourea
- [ ] Sultamicillin
- [ ] Talampicillin
- [ ] Tetracycline
- [ ] Thiamphenicol
- [ ] Tinidazole_IV
- [ ] Tinidazole_oral
- [ ] Trimethoprim

b19 Select the antibiotics available at the health facility pharmacy from the Watch group antibiotics listed

- [ ] Arbekacin
- [ ] Aspoxicillin
- [ ] Azithromycin
- [ ] Azlocillin
- [ ] Bekanamycin
- [ ] Biapenem
- [ ] Carbenicillin
- [ ] Carindacillin
- [ ] Cefaclor
- [ ] Cefamandole
- [ ] Cefbuperazone
- [ ] Cefcapene-pivoxil
- [ ] Cefdinir
- [ ] Cefditoren-pivoxil
- [ ] Cefepime
- [ ] Cefetamet-pivoxil
- [ ] Cefixime
- [ ] Cefmenoxime
- [ ] Cefmetazole
- [ ] Cefminox
- [ ] Cefodizime
- [ ] Cefonicid
- [ ] Cefoperazone
- [ ] Ceforanide
- [ ] Cefoselis
- [ ] Cefotaxime
- [ ] Cefotetan
- [ ] Cefotiam
- [ ] Cefoxitin
- [ ] Cefozopran
- [ ] Cefpiramide
- [ ] Cefpirome
- [ ] Cefpodoxime-proxetil
- [ ] Cefprozil
- [ ] Cefsulodin
- [ ] Ceftazidime
- [ ] Cefteram-pivoxil
- [ ] Ceftibuten
- [ ] Ceftizoxime
- [ ] Ceftriaxone
- [ ] Cefuroxime
- [ ] Chlortetracycline
- [ ] Cinoxacin
- [ ] Ciprofloxacin
- [ ] Clarithromycin
- [ ] Clofoctol
- [ ] Clomocycline
- [ ] Delafloxacin
- [ ] Demeclocycline
- [ ] Dibekacin
- [ ] Dirithromycin
- [ ] Doripenem
- [ ] Enoxacin
- [ ] Ertapenem
- [ ] Erythromycin
- [ ] Fidaxomicin
- [ ] Fleroxacin
- [ ] Flomoxef
- [ ] Flumequine
- [ ] Flurithromycin
- [ ] Fosfomycin_oral
- [ ] Fusidic-acid
- [ ] Garenoxacin
- [ ] Gatifloxacin
- [ ] Gemifloxacin
- [ ] Grepafloxacin
- [ ] Imipenem/cilastatin
- [ ] Isepamicin
- [ ] Josamycin
- [ ] Kanamycin_IV
- [ ] Kanamycin_oral
- [ ] Lascufloxacin
- [ ] Latamoxef
- [ ] Levofloxacin
- [ ] Levonadifloxacin
- [ ] Lincomycin
- [ ] Lomefloxacin
- [ ] Loracarbef
- [ ] Lymecycline
- [ ] Meropenem
- [ ] Metacycline
- [ ] Mezlocillin
- [ ] Micronomicin
- [ ] Midecamycin
- [ ] Minocycline_oral
- [ ] Miocamycin
- [ ] Moxifloxacin
- [ ] Nemonoxacin
- [ ] Neomycin_IV
- [ ] Neomycin_oral
- [ ] Netilmicin
- [ ] Norfloxacin
- [ ] Ofloxacin
- [ ] Oleandomycin
- [ ] Oxolinic-acid
- [ ] Oxytetracycline
- [ ] Panipenem
- [ ] Pazufloxacin
- [ ] Pefloxacin
- [ ] Penimepicycline
- [ ] Pheneticillin
- [ ] Pipemidic-acid
- [ ] Piperacillin
- [ ] Piperacillin/tazobactam
- [ ] Pirmidic-acid

- [ ] Piperacillin
- [ ] Piperacillin/tazobactam
- [ ] Piromidic-acid
- [ ] Pristinamycin
- [ ] Prulifloxacin
- [ ] Ribostamycin
- [ ] Rifabutin
- [ ] Rifampicin
- [ ] Rifamycin_IV
- [ ] Rifamycin_oral
- [ ] Rifaximin
- [ ] Rokitamycin
- [ ] Rolitetracycline
- [ ] Rosoxacin
- [ ] Roxithromycin
- [ ] Rufloxacin
- [ ] Sarecycline
- [ ] Sisomicin
- [ ] Sitafloxacin
- [ ] Solithromycin
- [ ] Sparfloxacin
- [ ] Spiramycin
- [ ] Streptoduocin
- [ ] Streptomycin_IV
- [ ] Streptomycin_oral
- [ ] Sulbenicillin
- [ ] Tazobactam
- [ ] Tebipenem
- [ ] Teicoplanin
- [ ] Telithromycin
- [ ] Temafloxacin
- [ ] Temocillin
- [ ] Ticarcillin
- [ ] Tobramycin
- [ ] Tosufloxacin
- [ ] Troleandomycin
- [ ] Trovafloxacin
- [ ] Vancomycin_IV
- [ ] Vancomycin_oral

b20 Select the antibiotics available at the health facility pharmacy from the Reserve group antibiotics listed

- [ ] Aztreonam
- [ ] Carumonam
- [ ] Cefiderocol
- [ ] Ceftaroline-fosamil
- [ ] Ceftazidime/avibactam
- [ ] Ceftobiprole-medocaril
- [ ] Ceftolozane/tazobactam
- [ ] Colistin_IV
- [ ] Colistin_oral
- [ ] Dalbavancin
- [ ] Dalfopristin/quinupristin
- [ ] Daptomycin
- [ ] Eravacycline
- [ ] Faropenem
- [ ] Fosfomycin_IV
- [ ] Iclaprim
- [ ] Imipenem/cilastatin/relebactam
- [ ] Lefamulin
- [ ] Linezolid
- [ ] Meropenem/vaborbactam
- [ ] Minocycline_IV
- [ ] Omadacycline
- [ ] Oritavancin
- [ ] Plazomicin
- [ ] Polymyxin-B_IV
- [ ] Polymyxin-B_oral
- [ ] Tedizolid
- [ ] Telavancin
- [ ] Tigecycline

b21 When was the exisitng antibiotic formulary last updated

yyyy-mm-dd

.....

b22 Do available guidelines match formulary?

- ◯ Yes
- ◯ No

» B2. Staff Strength

Physician capacity
b22 What is the number of Infectious disease specialists
b22.1 What is the number of medical officers
b23 What is the number of Interns
b24 What is the number of physicians at the ICU
Nursing staff available
b25 What is the number of nurses in the medical unit
b26 What is the bed capacity of the medical unit
The patient to nurse ratio in the medical unit is NaN
b27 What is the number of nurses in the surgical unit
b28 What is the bed capacity of the surgical unit
The patient to nurse ratio in the surgical unit is NaN
b29 What is the number of nurses in the ICU

b30 What is the bed capacity in the ICU

The patient to nurse ratio in the ICU is NaN

b31 What is the number of nurses in the HDU

b32 What is the bed capacity in the HDU

The patient to nurse ratio in the HDU is NaN

Nursing Staff Clinical capabilities

b33 Where is the highest frequency of IV administration

- ◯ Medical Unit
- ◯ Surgical Unit
- ◯ ICU
- ◯ HDU

» B3. Infrastructure available

Ward infrastructure

b34 What is the number of IV pumps available in the medial department

b35 What is the number of IV pumps available in the surgical department

b36 What is the number of IV pumps available in the ICU department

b37 What is the number of IV pumps available in the HDU

Drug dispensation
b38 How many satelite pharmacies are in the medical unit
b39 How many satelite pharmacies are in the surgical department
b40 How many satelite pharmacies are in the ICU
b41 How many satelite pharmacies are in the HDU

C Pharmacy (Questions for Pharmacists)

c1 How many pharmacies, either on site or nearby operate for 24 hours?
c2 What is the total number of pharmacists in the health facility?
c3 What is the total number of pharmaceutical technologists in the health facility?
c4 Have the staff attended any AMS training(s) in the course of their work? ◯ Yes ◯ No
c4.1 List the AMS trainings attended by the Pharmacists;
c4.2 List the AMS trainings attended by the Pharmaceutical technologists;

c5 Who does the reconstitution of antibiotics?

- [ ] Pharmacist
- [ ] Pharmaceutical technologist
- [ ] Nurses
- [ ] Clinicians
- [ ] Other

Specify other.

c6 Who provides drug information?

- [ ] Pharmacist
- [ ] Pharmaceutical technologist
- [ ] Nurses
- [ ] Clinicians
- [ ] Other

Specify other.

D Stewardship (Questions for Physicians and Microbiologists)

d1 Are stewardship guidelines or policies available

- ◯ Yes
- ◯ No

d2 Do you have an existing Antimicrobial Stewardship Committee?

- ◯ Yes
- ◯ No

d3 When was it formed?

yyyy-mm-dd

d4 Has it been functional?

- Yes
- No

d5 List out few of the key activities the Antimicrobial Stewardship Committee have been involved in;

.....

d6 Do you have stewardship interventions on the formulary restrictions?

- Yes
- No

d7 What antibiotics have the stewardship intervention on the formulary restrictions?

.....

d8 What do the restrictions state?

.....

d9 Is preauthorisation required?

- Yes
- No

d10 What antibiotics are preauthorised?

.....

d11 Who provides preauthorization?

- Medical Officers
- Clinical Officers
- Pharmacists
- Consultants
- Other

Specify other.

.....

d12 How is preauthorization provided?

- [ ] Electronically
- [ ] Verbally
- [ ] Manually (written)
- [ ] Other

Specify other.

.....

d13 Is there a prospective audit?

- ◯ Yes
- ◯ No

d14 For which antibiotics?

.....

d15 For which wards?

- [ ] Medical Unit
- [ ] Surgical Unit
- [ ] ICU
- [ ] HDU
- [ ] Other

Specify other.

.....

d16 Who performs prospective audit?

.....

d17 Do you carry out stewardship rounds?

- ◯ Yes
- ◯ No

d18 Who performs stewardship rounds?

.....

d19 What is the frequency of the stewardship rounds?

e.g monthly, quarterly, yearly...

.....

d20 Which wards have stewardship rounds?

- [ ] Medical Unit
- [ ] Surgical Unit
- [ ] ICU
- [ ] HDU
- [ ] Other

Specify other.

.....

d21 When was the last stewardship ward round conducted?

yyyy-mm-dd

.....

d22 Is there retrospective audit?

- ◯ Yes
- ◯ No

d23 For which antibiotics?

.....

d24 What is the frequency of the retrospective audits?

e.g monthly, quarterly, yearly...

.....

d25 For which wards?

- [ ] Medical Unit
- [ ] Surgical Unit
- [ ] ICU
- [ ] HDU
- [ ] Other

Specify other.

d26 Who performs retrospective audit

E Infection Prevention and Control

e1 How many handwashing stations are available outside and inside wards?

e.g 13 stations for 10 wards

e2 Do you report hospital acquired infections?

- ◯ Yes
- ◯ No

e3 Which infections per ward?

e4 How are these results communicated to clinical and nursing staff?

e5 Do you do cohorting or isolation of patients with AMR?

- ◯ Yes
- ◯ No

e6 For which resistance profiles?

e7 Describe cohorting or isolation procedures (SOPs)

e8 Are isolation procedures clearly displayed?

- ( ) Yes
- ( ) No

e9 How are payments for patients made?

- [ ] Cash
- [ ] Medical insurance (private)
- [ ] Government health scheme (NHIF, UHC, ESIC, CGHS)
- [ ] Free

F Qualitative Assessment- (Questions for Physicians)

f1 What is the field of specialization

.....

f2 Years of experience

.....

f3 Ward

.....

f4 Do you have access to the hospital antibiogram if available?

- ( ) Yes
- ( ) No

f5 How often do you use the hospital antibiogram?

.....

f6 Do you have access to antibiotic guidelines?

- ( ) Yes
- ( ) No

f7 Which guidelines do you use?

- [ ] National Guidelines
- [ ] WHO Guidelines
- [ ] County Guidelines
- [ ] Hospital Guidelines
- [ ] Other

Specify other.

f8 Do you share the Hospital antibiogram with any other nearby facility or Hospital

- Yes
- No

G Sepsis infection

g1 What empiric antibiotics (if any) do you prescribe for community acquired Sepsis?

g2 What empiric antibiotics (if any) do you prescribe for hospital acquired Sepsis?

g3 What percentage of the time do you send samples to microbiology for community acquired Sepsis?

g4 What percentage of the time do you send samples to microbiology for hospital acquired Sepsis?

g5 When during the course of infection do you send samples for community acquired Sepsis?

g6 When during the course of infection do you send samples for hospital acquired Sepsis?

g7 What percentage of the time do you receive micro results within 48hours for community acquired Sepsis?

g8 What percentage of the time do you receive micro results within 48hours for hospital acquired Sepsis?

Pneumonia infection

h1 What empiric antibiotics (if any) do you prescribe for community acquired Pneumonia?
h2 What empiric antibiotics (if any) do you prescribe for hospital acquired/ventilator associated Pneumonia?
h3 What percentage of the time do you send samples to microbiology for community acquired Pneumonia?
h4 What percentage of the time do you send samples to microbiology for hospital acquired/ventilator associated Pneumonia?
h5 When during the course of infection do you send samples for community acquired Pneumonia?
h6 When during the course of infection do you send samples for hospital acquired/ventilator associated Pneumonia?
h7 What percentage of the time do you receive micro results within 48hours for community acquired Pneumonia?
h8 What percentage of the time do you receive micro results within 48hours for hospital acquired/ventilator associated Pneumonia?

I cUTI

i1 What empiric antibiotics (if any) do you prescribe for community acquired cUTI?
i2 What empiric antibiotics (if any) do you prescribe for hospital acquired cUTI?

i3 What percentage of the time do you send samples to microbiology for community acquired cUTI?
i4 What percentage of the time do you send samples to microbiology for hospital acquired cUTI?
i5 When during the course of infection do you send samples for community acquired cUTI? *e.g. when clinical symtoms persist or during a recurrence*
i6 When during the course of infection do you send samples for hospital acquired cUTI?
i7 What percentage of the time do you receive micro results within 48hours for community acquired cUTI?
i8 What percentage of the time do you receive micro results within 48hours for hospital acquired cUTI?

IAI

j1 What empiric antibiotics (if any) do you prescribe for community acquired IAI?
j2 What empiric antibiotics (if any) do you prescribe for hospital acquired IAI?
j3 What percentage of the time do you send samples to microbiology for community acquired IAI?
j4 What percentage of the time do you send samples to microbiology for hospital acquired IAI?
j5 When during the course of infection do you send samples for community acquired IAI? *e.g. when clinical symtoms persist or during a recurrence*
j6 When during the course of infection do you send samples for hospital acquired IAI?

j7 What percentage of the time do you receive micro results within 48hours for community acquired IAI?

.....

j8 What percentage of the time do you receive micro results within 48hours for hospital acquired IAI?

.....

K Surgical site infection

k1 What empiric antibiotics (if any) do you prescribe for community acquired Surgical site infection?

.....

k2 What empiric antibiotics (if any) do you prescribe for hospital acquired Surgical site infection?

.....

k3 What percentage of the time do you send samples to microbiology for community acquired Surgical site infection?

.....

k4 What percentage of the time do you send samples to microbiology for hospital acquired Surgical site infection?

.....

k5 When during the course of infection do you send samples for community acquired Surgical site infection?

e.g. when clinical symtoms persist or during a recurrence

.....

k6 When during the course of infection do you send samples for hospital acquired Surgical site infection?

.....

k7 What percentage of the time do you receive micro results within 48hours for community acquired Surgical site infection?

.....

k8 What percentage of the time do you receive micro results within 48hours for hospital acquired Surgical site infection?

.....

L Skin and soft tissue infection

l1 What empiric antibiotics (if any) do you prescribe for community acquired Skin and soft tissue infection?
l2 What empiric antibiotics (if any) do you prescribe for hospital acquired Skin and soft tissue infection?
l3 What percentage of the time do you send samples to microbiology for community acquired Skin and soft tissue infection?
l4 What percentage of the time do you send samples to microbiology for hospital acquired Skin and soft tissue infection?
l5 When during the course of infection do you send samples for community acquired Skin and soft tissue infection? *e.g. when clinical symtoms persist or during a recurrence*
l6 When during the course of infection do you send samples for hospital acquired Skin and soft tissue infection?
l7 What percentage of the time do you receive micro results within 48hours for community acquired Skin and soft tissue infection?
l8 What percentage of the time do you receive micro results within 48hours for hospital acquired Skin and soft tissue infection?

M Bone and joint infection

m1 What empiric antibiotics (if any) do you prescribe for hospital acquired Bone and joint infection?

.....

m2 What percentage of the time do you send samples to microbiology for hospital acquired Bone and joint infection?

.....

m3 When during the course of infection do you send samples for hospital acquired Bone and joint infection?

e.g. when clinical symtoms persist or during a recurrence

.....

m4 What percentage of the time do you receive micro results within 48hours for hospital acquired Bone and joint infection?

.....

n1 If the patient is not improving on empiric antibiotics within 24 hours what do you do?

.....

n2 How would you manage a patient improving from sepsis on broad spectrum abx, and microbiology results show BSI with pan-sensitive E coli

.....

n3 Detail out the Challenges/ barriers in implementing the proper Antibiotic usage in your facility.

- [ ] Patient behavior in using antibiotics
- [ ] Lack of appropriate implementation of guidelines
- [ ] Lack of specific antibiogram for primary care
- [ ] Competition amongst clinicians
- [ ] Lack of departmental co-ordination
- [ ] Unclear clinical presentation
- [ ] Lack of diagnostic capability
- [ ] Restricted time of consultation
- [ ] Clinician knowledge and practices
- [ ] Other

Specify other.

.....

n4 What steps can be taken to improve the existing scenario (click on 'NEXT' then 'Add' to continue or 'Do not add' to end)

1

n5 Please list 3 to 5 major steps

e.g. continuous training

.....

Thank you for taking the time out of your day to participate in this assessment. We highly appreciate the information you have provided.