THE REPUBLIC OF UGANDA

MINISTRY OF HEALTH

NATIONAL GUIDELINES FOR ANTIMICROBIAL CONSUMPTION AND USE SURVEILLANCE IN HUMAN HEALTH

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National Guidelines for Antimicrobial Consumption and Use Surveillance in Human Health

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Preface

The Health Sector Development Plan (HSDP 2021-2025) and the National Pharmaceutical Sector Strategic Plan (NPSSP 2021-2025) spell out the Ministry of Health's dedication to address the burden of communicable diseases in Uganda. Over the years the Ministry of Health has worked towards addressing the top three contributors to morbidity, mortality and health care costs i.e. HIV-AIDS, malaria and lower respiratory tract infections primarily pneumonia.

However, Antimicrobial Resistance poses a new threat to progress in addressing these issues mainly through reduced treatment options, increased healthcare costs and eventual increase in mortality. The Ministry of Health joined other key line ministries under the One Health Platform to develop and implement strategies towards preventing, slowing down and controlling the spread resistant pathogens. These strategies were laid out in the Antimicrobial Resistance National Action Plan (2018-2023) (AMR NAP) clustered under five key objectives including surveillance of antimicrobial consumption and use as well as ensuring antimicrobial stewardship, optimal access and use of antimicrobials.

The HSDP, PSSP and the NAP chorus the overuse and misuse of antimicrobials as the major modifiable driver of AMR and emphasise the need to preserve the effectiveness and efficacy of antimicrobial agents through controlled access and appropriate use. Pertinent to this objective is the need for systematic routine data collection, analysis of consumption and use of antibiotics at the national level down to the facility level. The information generated will describe the areas to focus stewardship interventions as well as measure the impact of these interventions against AMR at both national and facility level.

This surveillance plan outlines the multisectoral approach to generating information on antimicrobial consumption at national level as well as antimicrobial use at facility level. It provides practical guidance on management of data with emphasis on describing the extent of overuse and misuse of antimicrobials. I am therefore certain that the AMC&U surveillance plan comprehensively sets priorities and key areas on which to focus in order to optimally generate information to guide the attainment of both the health sector goals and the national goals as outlined in the HSDP 2021-2025 and the AMR NAP 2018-2023.

I commend the efforts of all who actively participated in the development of this surveillance plan and thank all the stakeholders who provided input and support under the coordination and leadership of Pharmacy Department. I encourage all health facilities and partners, in the private and public sectors to implement this intervention.

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We also thank the World Health Organization (WHO, the UN agency) and the USAID-funded programs of Uganda Health Supply Chain (UHSC) and Medicines Therapeutics and Pharmaceutical Services (MTaPS), the Centers for Disease Prevention and Control (CDC) through the Global Health Security initiatives, the National Medical Stores, National Drug Authority, and the Joint Medical Stores for their technical input.

Utmost appreciation is extended to the Medicines Procurement and Management Technical Working Group of the Ministry of Health Pharmacy Department, the Antimicrobial Stewardship and Optimal Use Technical Working Committee of the National AMR Sub-committee under the stewardship of the One Health Platform for supporting the review process of the guidelines.

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Contents

Abbreviations

AMC	Antimicrobial consumption
AMC&U	Antimicrobial Consumption and Use
AMEG	Antimicrobial Expert Group
AMR	Antimicrobial Resistance
AMU	Antimicrobial Use
ATC	Anatomical Therapeutic Chemical
CC	Collaborating Centre
DDD	Defined Daily Dose
DID	Defined Daily Doses/1000 inhabitants/day
DIS	Drug Indicator Survey
EMA	European Medicines Agency
EphMRA	European Pharmaceutical Market Research Association
GAP	Global Action Plan against AMR
GDP	Gross Domestic Product
GPPS	Global Point Prevalence Survey
INN	International Nonproprietary Name
INRUD	International Network for Rational Drug Use
IP	In-patient Department
JMS	Joint Medical Stores
M&E	Monitoring and Evaluation
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
MAUL	Medical Access Uganda Limited
MoH	Ministry of Health Uganda
MPM TWG	Medicines Procurement and Management Technical Working Group
MTC	Medicine and Therapeutics Committee
NAMRSC	National Antimicrobial Resistance Subcommittee
NAP	National Action Plan against AMR
NDA	National Drug Authority
NDAMIS	National Drug Authority Management Information System
NMS	National Medical Stores
OPD	Outpatient Department
OTC	Over-the-counter
PDD	Prescribed Daily Dose
PFP	Private-for-Profit
PIP	Pharmaceutical Information Portal
PIY	Packages/1000 inhabitants/year
PNFP	Private-not for-Profit
UHMG	Uganda Health Marketing Group
VC	Verification Certificate
WHA	World Health Assembly
WHO	World Health Organization

Operational definitions

For the purpose of the protocol presented:

Admissions (ADM): Sum of the patients admitted in a defined period of time.

Antimicrobial Resistance: A phenomenon in which bacteria fails to respond to antibiotic treatment that they were previously susceptible to.

Antimicrobial Agent: A naturally occurring, semi-synthetic or synthetic substance that exhibits antimicrobial activity (kill or inhibit the growth of micro-organisms) at concentrations attainable in vivo. Anthelminthics and substances classed as disinfectants or antiseptics are excluded from this definition.

Antimicrobial Consumption (AMC) data refer to estimates of volumes of antimicrobials derived from aggregated data sources such as import, local manufacturer, distributor, wholesaler, retailer or stockist data, where there is no information available on the individual patients given the medicines or why the antimicrobials are being used. The assumption at this level is that all that is imported is consumed locally, all that is distributed or sold is consumed locally, thus serves as a *proxy* estimate of use of antimicrobials. Consumption data may be presented as total consumption for a country or may be disaggregated by setting (community or hospital; public or private sectors).

Antimicrobial Use (AMU) data refer to estimates derived from individual patient-level data. These data may allow disaggregation of data based on patient characteristics (age, gender, signs & symptoms, indication or diagnosis for which the medicine is being used), or route of administration and type of use - (to treat, control or prevent infectious disease). Depending on the source of information, it may be possible to determine the medications ordered. This can facilitate assessment of clinical practice against agreed protocols and standard treatment guidelines.

Discharges (DIS): Sum of the patients discharged in a defined period of time.

Granular data is defined as data encompassing patient level use but also include usage measured as volumes moving through the final level providers (e.g. hospitals, retailers including private pharmacies and drug shops etc.).

A **medicine use evaluation (MUE)** involves assessing the use of a certain medication according to an established set of criteria. Criteria may relate to prescription (indication, dosages, frequency etc) or even administration/dispensing criteria (adherence to administration schedule, correct preparation and administration procedure etc).

Occupied bed days (OBD): Sum of occupied bed days in a defined period of time (number of bed days minus number of bed days without occupation by a patient).

Patient days (PD): Sum of patient days for a defined period of time (e.g. year 2017 or 1st quarter of 2017).

A **prescription audit** is a similar process but the focus is to assess if a certain disease is treated according to set standard guidelines. It can be considered a partial "clinical audit", which also involves a much wider assessment including structures, processes, competencies, skills and outcome in the management of certain conditions.

Sales data: For the purpose of surveillance data collection, sales data refers to the "amount (volumes) of antimicrobial agent(s) sold within the country for use in humans". Sales data can be used as an approximation of actual use.

Surveillance: Ongoing, systematic collection, analysis and interpretation of health-related data essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of these data to those responsible for prevention and control.

Usage data is defined as estimates derived from patient level data and may include disaggregation to the level of specific patient characteristics (age, gender, or diagnosis).

Chapter 1: Introduction and Background

1.0 Background

1.1 The burden of AMR

Antimicrobial resistance (AMR) is a major threat to global health, as it makes common infections such as pneumonia, urinary tract infections and gonorrhoea more difficult and expensive to treat due to resistance to the commonly available antimicrobial agents, leading to high mortality and morbidity rates. Resistance to antimalarials, antiretrovirals and anti-tuberculosis agents will lead to declines in the progress made in reducing the burden of those killer diseases (WHO, 2017). In addition, the increased economic burden of AMR will be predominantly felt in low and middle-income countries (LMIC) due to the high cost of treating resistant infections, need for longer hospital admissions, additional laboratory tests and expensive antibiotics, coupled with inadequate infrastructure and limited human and financial resources to deal with AMR. AMR, if left uncontrolled, is projected to lead to about 10 million deaths by 2050, majority occurring in Africa and Asia (O'Neill, 2014).

Antimicrobial resistance is a naturally occurring phenomenon, but the way antimicrobials are used in the human health, animal health and agricultural sectors has been shown to be the strongest driver that accelerates the emergence and spread of AMR (Holmes, 2016). Irrational use of antimicrobials is common in the country, with antibiotics prescribed for up to 70% of patients in outpatient settings, including for non-bacterial infections (MOH Uganda, 2018). Reports have already shown presence of resistance to common antimicrobials such as cotrimoxazole, ampicillin and ceftriaxone, along with high prevalence of multi-drug resistant bacteria such as methicillin-resistant *Staphylococcus aureus* and extended-spectrum beta-lactamase (ESBL) - producers (UNAS, 2015).

In response to the growing threat of AMR, the World Health Organization (WHO) member states adopted the Global Action Plan (GAP) on AMR in 2015. In line with the global resolutions, Uganda launched a five-year national action plan (NAP) to tackle AMR. The plan outlines the actions to be taken to fight AMR through five strategic objectives that are: 1) promote public awareness, training and education, 2) improve infection prevention and control, 3) optimize access to and use of antimicrobials in human and animals, 4) surveillance and 5) invest in research and innovation.

1.2 Surveillance of Antimicrobial Consumption and Use

Antimicrobial use is the major modifiable factor contributing to AMR. The WHO GAP and Uganda AMR NAP consider antimicrobial stewardship and optimal use as one of the five main pillars to prevent AMR. The goal is to preserve the effectiveness and efficacy of antimicrobial agents for human and animal health through controlled access, effective antimicrobial stewardship and appropriate use. Stewardship interventions improve patient outcomes and safety, and reduce resistance, so that patients get the best treatment they need while at the same time preserving the therapeutic effectiveness of antimicrobial agents. Therefore, collecting and analysing data

about the consumption and use of antimicrobials is an important action in guiding AMS activities, to measure existing practices, identify and prioritize and investigate problems, and monitor effects of interventions.

The surveillance of antimicrobial consumption and use (AMC&U) needs to be done in a systematic and standardised manner in order to produce good quality data that can be used to guide targeted interventions at both national and health facility level. There are well-established programs at the Uganda Ministry of Health Uganda that monitor the consumption and use of antimalarials, anti-tuberculosis drugs, HIV/AIDS commodities through the respective vertical programs and the Quantification, Procurement Planning Unit (QPPU), however, there is no such system for antibiotics.

In 2016, WHO released a methodology for surveillance of antimicrobial consumption at national, regional and global level using standardized population-based metrics of Defined Daily Dose (DDD) per 1000 inhabitants (WHO, 2016). The methodology has been adapted to provide guidance for AMC&U in hospitals (WHO, 2019). In addition, WHO Essential Medicine List (2017) classified antibiotics into the Access, Watch and Reserve (AWaRe) groups, as a measure to promote prudent use of antibiotics, expand availability to antibiotics where needed and preserve the effectiveness of last-resort antibiotics. The first WHO Report on surveillance of antibiotic consumption showed data from 65 countries worldwide (WHO, 2018).

This document therefore aims to provide guidance for the country to conduct AMC&U surveillance programs in human health at both the national and subnational health facility level, with oversight from the Antimicrobial Stewardship and Optimal Access and Use (ASO) Technical Working Committee of the national One-Health AMR committee. The approach integrates the methods proposed in the WHO guidance, existing national policies and programmes on promoting appropriate medicines use in general as well innovative approaches tailored to the Ugandan local context. The AMC&U surveillance in humans will have strong linkages with the laboratory, animal health and environmental surveillance programs, in line with the One Health approach of implementing the NAP.

Chapter 2: The Uganda National Program on Antimicrobial Consumption and Use Surveillance in Human Health

2.1 Aims and Objectives of AMC&U Surveillance

2.1.1 Aim

The overall aim of antimicrobial use and consumption surveillance program is to generate evidence needed to identify trends in antimicrobial consumption and antimicrobial use. This evidence will guide clinical decisions regarding appropriate treatment and guide policy using the One Health approach.

A common protocol will be used for standardized collection, analysis and reporting of consumption and use data at national and subnational levels.

2.1.2 Objectives

The primary objectives of surveillance of AMC&U are to:

i) Provide reliable and comparable information on national consumption and use of antimicrobials in health facilities.
ii) Promote implementation of antimicrobial stewardship in health facilities.

2.2 Use of AMC&U Surveillance Data

Data on the consumption and use of antimicrobials have a number of uses, including to:

- Relate exposure to antimicrobials to the development of antimicrobial resistance.
- Identify and provide early warning signs of problems relating to changes in exposure to antimicrobials and to develop interventions to address problems identified.
- Assess quality of prescribing against practice guidelines.
- Raise awareness of health professionals, consumers and policy-makers about the issue of antimicrobial resistance and the contribution of inappropriate use of antimicrobials in humans.
- Detect trends and perform intra- and inter-facility comparisons.
- Plan, focus, monitor and evaluate interventions aimed at changing exposure.
- Support antimicrobial stewardship activities and to provide the basis for setting targets for improving antimicrobial use.

2.3 Governance and Operational Framework for the National AMC&U Surveillance Program in Human Health

2.3.1 National Coordination

At national level, oversight and overall coordination of the national AMC&U surveillance will be provided by the Ministry of Health. The secretariat will be at the Department of Pharmaceuticals and Natural Medicines.

The Department of Pharmaceuticals and Natural Medicines will be responsible for:

1. Defining the objectives of the surveillance program

2. Identifying, analyzing the data sources to be used in the surveillance program, developing guidelines and protocols for data collection to ensure good quality data and reporting to inform the national strategy and publish the data at national level.
3. Communicating and organizing meetings with the data providers to inform them on purpose of the surveillance program and on the requested data.
4. Provide technical support to sub-national teams and train health workers on how to carry out the AMC&U surveys
5. Developing data quality assurance policies to be implemented at both national and subnational levels.
6. Developing recommendations to inform stewardship interventions on the use of antimicrobial medicines in the country.
7. Promoting use of surveillance data to identify and monitor areas of misuse and overuse of antibiotics, and to monitor and evaluate intervention programs against the set indicators.
8. Disseminating findings to the national level, data providers and other AMR stakeholders
9. Developing systems to support electronic data integration across sectors.
10. Securing resources and capacity to collect the data and to interpret them for use in public policy
11. Monitoring and evaluating the implementation of the strategy and feed into the general M&E plan of the NAP.
12. Continuously reviewing the surveillance program to incorporate lessons learnt from previous activities so as to improve timeliness, efficiency and quality of AMC&U data.
13. Liaising with other AMR surveillance teams in the animal health, laboratory, agricultural and environmental sectors to implement the NAP.
14. Providing the report to WHO through the global AMC&U surveillance program

2.3.2 Health Facility AMC&U Team

At the health facility level, the Medicines and Therapeutic Committees (MTC) through the Antimicrobial Stewardship (AMS) sub-committee is responsible for performing AMC&U activities. The MTC is composed of clinicians, pharmacists, nurses, midwives, laboratory and administrative staff and a representative from the IPC committee. The goal is to ensure that safe, effective, cost-effective antimicrobials are made available to the facility, antimicrobials are used appropriately by both health facility staff and patients.

The duties of the AMS subcommittee of the MTC include:

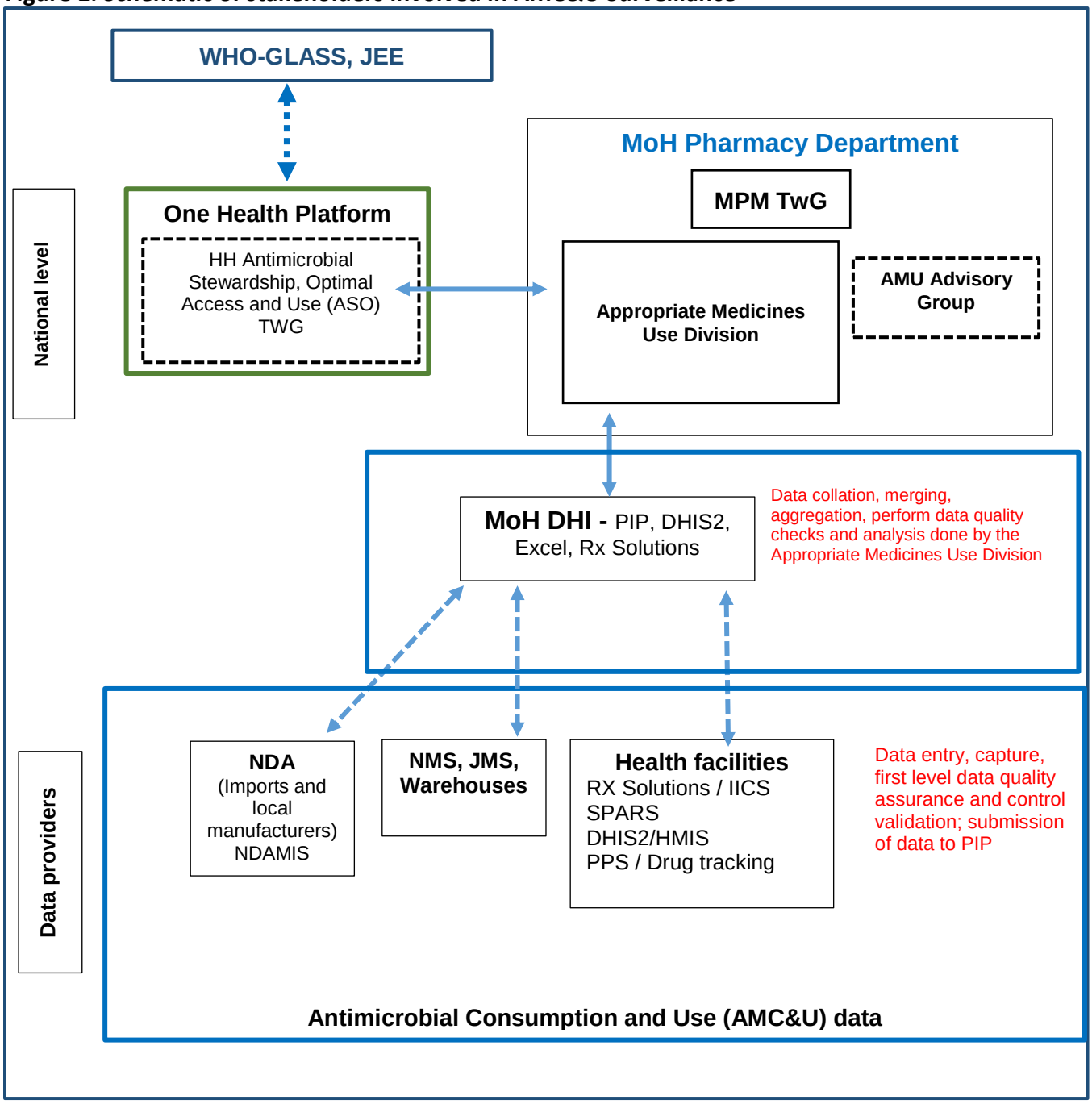
- On behalf of the MTC, lead on all on all aspects of antimicrobial use and misuse and provide feedback to all staff at the health facility.
- Assist in evaluating and selecting antimicrobials for the formulary and standard treatment guidelines.
- Develop policies concerning use of antimicrobials within the health facility, including clauses that limit and restrict use of antimicrobials in the hospitals and primary care clinics.

- Carry out Antimicrobial consumption and use surveys and disseminate to the health facility staff
- Draft reports and forward them to the national level at the Ministry of Health
- Monitor and assess consumption and use through prescribing quality assurance programs and medicine use evaluations to ensure use of antimicrobials only when clinically indicated, in the correct dose, route and for the appropriate duration.
- Participate in the educational programs for health-care staff.
- Collaborate with the Infection Prevention and Control (IPC) committee and laboratory departments to monitor and prevent/limit emergence and spread of resistant microorganism.

2.4 Stakeholders involved

The schematic diagram below shows the stakeholders involved in AMC&U surveillance and the flow of information between the different actors.

Figure 1: Schematic of stakeholders involved in AMC&U Surveillance

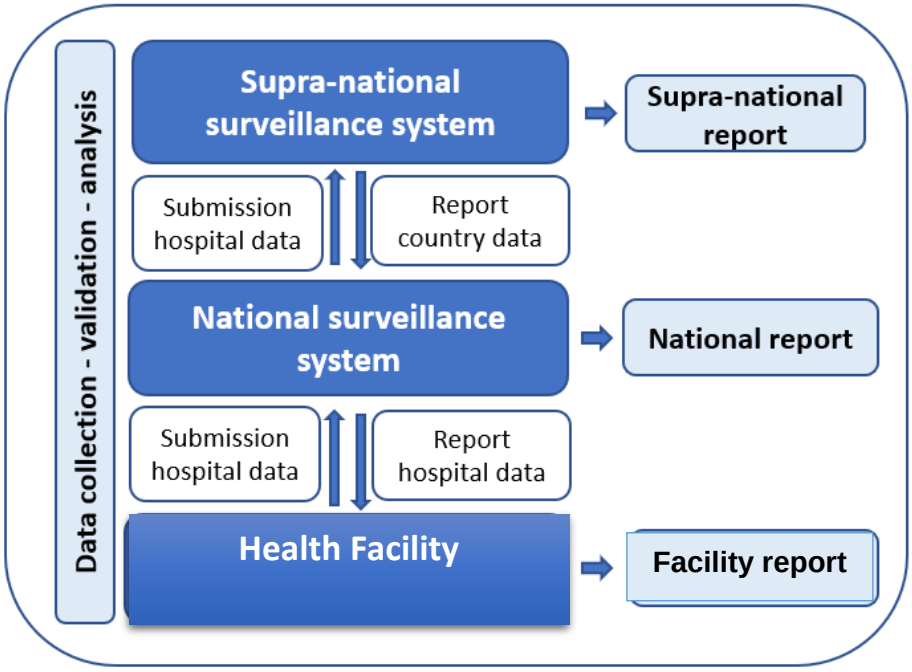


NMS-National Medical Stores, JMS- Joint Medical Stores, NDA-National Drug Authority, SPARS-Supervision, Performance Assessment and Recognition Strategy, DHIS-District Health Information System, PPS-Point Prevalence Survey, PIP-Pharmaceutical Information Portal, HH-Human Health, MPM TWG- Medicines and Pharmaceutical Management Technical Working Group, JEE- Joint Evaluation Committee

Chapter 3: Methods for Antimicrobial Consumption and Use Surveillance in Human Health at National and Sub-national Levels

3.1 Surveillance Systems

Surveillance for antimicrobial consumption and use shall occur at two levels; national level and health facility level. National level surveillance entails data collected from imports, local manufactured drugs, and distribution data from central level warehouse. Health facility level surveillance will entail data collected on consumption and use at individual health facilities.



3.2 Antimicrobials included in the surveillance

The monitoring of antimicrobial consumption is confined to antimicrobials intended for systemic use. A list of the respective antimicrobial groups is presented in Table 3.

Table 3: List of antimicrobial groups

Antimicrobial group	ATC-Code
Antibacterials for systemic use	J01
Antimycotics for systemic use	J02
Antimycobacterials	J04
Antivirals for systemic use	J05
Intestinal antiinfectives	A07A
Antifungals for systemic use	D01B
Antiprotozoals	P01

The surveillance at health facility level should at least include a basic set of antibacterials comprising the following groups:

Antimicrobial group	ATC-Code
Intestinal antiinfectives/antibiotics	A07AA
Antibacterials for systemic use	J01
Rifampicin	J04AB02
Nitroimidazol derivatives	P01AB

Topical antimicrobial substances, such as skin ointments, eye, ear, nose and vaginal preparations are not included in the protocol.

3.4 Information needed to calculate consumption for a given period

There are three elements to the data collection; namely, antimicrobial consumption data, denominator data and descriptive or contextual information that is relevant for interpreting the consumption estimates calculated.

Element	Variables
Antimicrobial consumption data • Product level data • May be stratified by health care sector	For each antimicrobial included in the consumption analysis, the following variables are required: • The product (i.e. as it appears when packaged) • Unique identifier of the medicine product package • Medicinal product package label (Brand Name) • WHO ATC category 5th Level Code (WHO 2019 version) • WHO ATC category 3rd Level Code (WHO 2019 version) • DDD per antibiotic as assigned by WHO-CC 2019 • International Non-proprietary Name (INN) • Route of administration (Oral, parental, inhalation) • Is it a pediatric medicine product • Pharmaceutical formulation type • Strength of the active ingredient (e.g. tablet) • Unit of strength of the active ingredient (gm/mg/iu/mu) • Strength of volume and unit, if syrup • Package size of the product (e.g. 10 tablets) • Pack size unit of measure • Basic ingredient quantity and unit • Salt of the active substance • Total packages of the product consumed in a given period
Denominator data • Used to calculate	Population under surveillance to which the data applies, e.g. May be stratified by health care sectors

consumption density	
Contextual information related to antimicrobial consumption	Data source information Which antimicrobials are included in surveillance? Specific exclusions, e.g. psychiatric facilities, private sectors

A detailed explanation of variables is given in **Annex 1**.

3.5 National Level AMC&U Surveillance

3.5.1. Imports and Local Manufacture Data

Import and local manufacture data provide aggregated volume estimates of antimicrobial consumption in Uganda. This consumption data is useful for comparisons between Uganda and other countries or regions, evaluating trends of use over time, and assessing the impact of high-level policy. Surveillance at this level aims to quantify the extent of exposure to antimicrobials at population level with a broad assumption that all that is imported or locally manufactured is consumed within the country, and therefore serves as a proxy for use in the community. However, such high-level data cannot be used to accurately assess how antibiotics are actually used, or where to target interventions.

Times of surveillance

Consumption surveillance should be done for each calendar year, in line with the WHO guidelines.

Data sources

The source of data is the National Drug Authority (NDA), which regulates and keeps records of all pharmaceutical products imported into and manufactured locally in the country (exclude any exports of products). The data is in form of electronic records in NDA Management Information System (NDAMIS) and customs records at NDA. A table listing the different data sources and their strengths and weakness is provided in **Annex 2.** Population estimates can be obtained from the Uganda Bureau of Statistics for the period under analysis.

Measurement of consumption

Antimicrobial consumption is measured using aggregate data of all antimicrobials consumed in a given period using a common system of nomenclature and standardised methodology. The most commonly used system is the **Anatomical Therapeutic Chemical (ATC)** classification system, and the most commonly used measurement metric is the number of **Defined Daily Doses (DDDs),** explained below.

The **Anatomical Therapeutic Chemical (ATC)** system categorizes medicinal substances into different groups according to the organ or system on which they act and therapeutic, pharmacological and chemical properties. Each medicine is classified at five different levels as in the table below. More information on the ATC system is **Annex 3.**

LEVEL	Example	
1st level, anatomical main group Consists of 1 letter	J A	Antiinfectives for systemic use Alimentary tract and metabolism
2nd level, pharmacological/ therapeutic subgroup	J01 J02 J04	Antibacterials for systemic use Antimycotics Antimycobacterials
3rd level, chemical/ pharmacological sub group	J01C	Beta-lactam antibacterials, penicillins
4th level, chemical subgroup	J01CA	Penicillins with extended spectrum
5th level chemical substance	J01CA04 J01CA01	Amoxicillin Ampicillin

Unit of measurement - Defined Daily Dose

The DDD is a measure used to quantify antimicrobial consumption and is assigned to each medicinal substance taking into account the route of administration. DDD stands for the average maintenance dose per day for a medicine used for its main indication in adults. It should be considered that the DDD is a purely technical unit, which serves as a standard measure for quantification, but which does not necessarily reflect the recommended or factual use of the substance in the individual patient. The DDD is assigned for drugs that have an ATC code by the WHO Collaborating Centre for Drug Statistics Methodology, Norway. A list of antimicrobials for human use with their assigned DDDs (version 2019) is provided in **Annex 3**, and accessed at **http://www.whocc.no/atc_ddd_index/.**

Consumption volume

The consumption volume is expressed as the number of DDDs consumed and is calculated by dividing the amount of the antimicrobial substance measured in grams by the DDD-value in grams, which has been assigned to the respective antimicrobial substance by the WHO Collaborating Centre for Drug Statistics Methodology.

The number of DDDs is calculated as follows:

$$\text{Number of DDD} = \frac{\text{Total number of grams of the substance consumed in a defined period of time}}{\text{DDD value of the substance in grams assigned by WHO}}$$

Where the total grams of the medicine used is determined by summing the amounts of active ingredient across the various formulations (different strengths of tablets or capsules, syrup formulations, injections etc.) and pack sizes.

The total number of DDDs can then be aggregated by the desired ATC code Level for reporting purposes.

Examples are given in **Annex 4.**

Consumption density

For standardization purposes, the volume of antimicrobial consumption (number of DDD, numerator) should be adjusted by measures representing population (denominator) to get the consumption density.

$$\text{Consumption density} = \frac{\text{Number of DDD for time period P multiplied by 100 (1000)}}{\text{Quantity (number) of hospital activity indicator for time period P}}$$

An Excel worksheet and guidance on steps for entering data calculating antimicrobial consumption, volumes and density using population can be found in **WHO guidance on surveillance of antimicrobial consumption in hospitals; V0.1-20190619.**

Analysis by AwaRe Categories

The antimicrobials consumed should also be analysed by the AWARE classification. To improve access and at the same time preserve the effectiveness of existing antibiotics, particularly those needed for second-line and "last resort" care, WHO has categorized antibiotics into three categories as AWaRe - Access, Watch and Reserve antibiotics. The Access category includes antibiotics needed for common infections and should be widely available and accessible in all countries. The Watch category include broad spectrum antibiotics that should be used with caution because of their high potential to develop AMR while the Reserve category is restricted as "last resort" antibiotics for multi-drug resistant infections. Details are provided in **Annex 6.**

Reporting consumption estimates

The antimicrobial consumption will be reported as:

- total **DDD/1000 inhabitants per day** for the year X
- DDDs disaggregated by ATC Level 3 Code, which is the antimicrobial chemical or pharmacological group for the year X
- DDDs, stratified by ATC Code and AwaRe Classification for the year X
- Proportion of antimicrobials in the UCG or Essential Medicines List
- Discussion of results "in context"

3.5.2 Surveillance at National Centralized Distributors

Centralized level warehouse distribution records can also provide aggregated data of antimicrobial consumption that act as proxy for use to the facilities or institutions which they serve. The consumption can then be disaggregated or stratified by region/geographical location, by health facility level of care, by public or private sectors and again by population level metrics using the population estimates of the regions supplied.

The main centralized level warehouse distributing antimicrobials nationwide include:

- National Medical Stores, the sole supplier to all government health facilities countrywide
- Joint Medical Stores
- MAUL, mainly HIV/AIDS products

Efforts will be made to include private warehouses and distributors with national and regional scope.

The methodology and data collection tools used at this level are similar to those used for imports and local manufacture AMC surveys described in the sections above.

Similarly, volume data on antimicrobials distributed will be expressed as the total DDDs per 1000 inhabitants. The denominator for consumption data will be the population of the geographical location to which the medicines have been distributed. The data may also be disaggregated by antibiotic class, level of care, geographical location and the WHO AwaRe classification

3.6 Surveillance at the health facility level

Facility level data provides a more accurate granular assessment on how antimicrobials are actually used. Client specific data can provide information on volume and type of antibiotics dispensed across provider types, and across end user types (public/PNFP facilities and private facilities). AMU data at the granular level can be used for surveillance, for target setting, for monitoring interventions or for behavior change and communication of risks.

3.6.1 Routine reports on antimicrobial use at facility level

Supervision, Performance Assessment and Recognition Strategy (SPARS)[1]: aims to increase health workers' ability to manage medicines through on- the-job training and support from Medicines Management Supervisors (MMS).
Data from SPARS over time have described a trend of inappropriate medicine use.

3.6.2 Other activities for AMC&U surveillance at health facility

- Antimicrobial consumption surveys using WHO ATC/DDD methodology.
- WHO/INRUD drug indicator surveys for Out-patient department assessment of Use.
- Point Prevalence surveys for in-patient use assessments.
- Medicines use evaluations for selected antimicrobials.
- Drug cost studies for selected antimicrobials.

3.6.3 Facility antimicrobial consumption surveys

Consumption data at the health facility described as the quantity of a particular antimicrobial issued from the main store for a defined period in time. The data may be aggregated at the stores level to represent the total consumption for the facility, or disaggregated by antimicrobial

[1] Birna Trap, Denis Okidi Ladwar, Martin Olowo Oteba, Martha Embrey, Mohammed Khalid, Anita Katharina Wagner; *Supervision, Performance Assessment, and Recognition Strategy (SPARS): a multipronged intervention strategy for strengthening medicines management in Uganda:* method presentation and facility performance at baseline. Journal of Pharmaceutical Policy and Practice, May 2016; 9 (21). DOI: 10.1186/s40545-016-0070-x.

consumed per ward. Data can be collected at "whole hospital level", only in-patient or outpatient, at ward level, at departmental level and specialty level.

Antimicrobials monitored

These include all antimicrobials described in section 3.2, but specifically antimicrobials in the ATC group J01, antimicrobials for systemic use must be included in the surveillance.

Variables collected for the antimicrobial product

These are similar to those in section 3.4. In addition, the following information must be collected.

- Description of the facility including name of facility and the level of care
- Period under consideration: month, quarter, year etc.
- Unit of issue for each individual drug
- Description of the antimicrobial i.e. ATC classification, AWaRe classification
- Total volume issued out of the store within the period of consideration, as DDD
- Volumes issued out of the store disaggregated by user department, as DDD

Data collection

The data collection methodology is based on the WHO Methodology for AMC surveillance in hospitals (version 2019). It uses the ATC/DDD methodology to calculate consumption, and an Excel template is available. Instructions for filling the excel template are provided in **WHO guidance on surveillance of antimicrobial consumption in hospitals; V0.1-20190619.**

Variables for denominator data to measure consumption density (in patient department)

In order to calculate the consumption density, the volume of the antimicrobials (number of DDD) is adjusted by measures representing the hospital activity indicators for the period of surveillance. A list of different hospital activity indicators, which can be used for normalizing the number of DDD consumed is presented in table below. A detailed description of the different denominators including examples for calculation is provided in **the table below**.

Hospital activity measure	Description
Patient days (PD)	The sum of patient days for a defined period of time (e.g. year 2017 or 1st quarter of 2017)
Occupied bed days (OBD)	Sum of occupied bed days in a defined period of time (number of bed days minus number of bed days without occupation by a patient)
Admissions (ADM)	Sum of the patients admitted in a defined period of time
Discharges (DIS)	Sum of the patients discharged in a defined period of time

The consumption is then expressed as number of DDD per quantity of hospital activity (e.g. DDD per 100 patient days or 100 admissions) for the specified time period, and calculated as in the formula below.

$$\text{Consumption density} = \frac{\text{Number of DDD for time period P multiplied by 100 (1000)}}{\text{Quantity (number)of hospital activity indicator for time period P}}$$

Note: It must be considered that the use data of the hospital activity MUST correspond strictly to the consumption data! For example, if the consumption data have been collected for a **whole year**, the hospital activity data have to be collected for the **same whole year**.

Sources of data

Sources of the data at health facility level may be:

- Purchase/procurement data of the hospital administration or pharmacy. These may be in the form of Electronic Management Information System such as Rx Solution, Stock cards and stock books, Invoices from the drug suppliers,
- Unit-based dispensing data: data on antimicrobials dispensed to departments/wards by stores, e.g. from issue and requisition vouchers
- Patient-based dispensing/billing data: data on antimicrobials sold or dispensed to individual patients e.g. from dispensing logs
- Prescription data: data on prescription of antimicrobials e.g. OPD register, in-patient register, electronic health records
- Patient registers: to obtain total number of patients on the ward on a given time or period of time
- Health facility HMIS records

Data analysis and reporting

- The data will be analysed as total volumes of DDDs consumed per hospital/department/ward, then as proportions of ATC Level 3 categories (antimicrobial class), and proportions by AwaRe categories.
- Data will be interpreted contextually, that is, knowledge about the wider framework of surveillance e.g. hospital type, -size and –structure.
- The used data sources and the coverage of hospital consumption data is helpful for sensible data interpretation.
- The respective information characterizing the hospital-specific context can be collected in form of a questionnaire.
- Monitoring of the respective contextual information is useful in order to document changes over time (e.g. in hospital structure, data sources used etc), which might facilitate the interpretation of longitudinal consumption data.

Time period of surveillance

Data collection shall be performed at least once a year with at least a yearly aggregated data. In order to validate the effect of intervention measures or for other antimicrobial stewardship purposes it can be meaningful to gather and analyse data in shorter time intervals e.g. quarterly or monthly.

3.6.3 WHO/INRUD drug indicator surveys for Out-patient

Data on antimicrobial use at the OPD shall be collected using the WHO/INRUD drug indicator survey (DIS) and the OPD antibiotic survey adapted from the Ministry of Health's Medicines and Therapeutics Committee manual 2018.

The DIS is a standardized method of assessing prescribing patterns at the facility. It answers the question, "how are medicines being used in primary care practice?" and provides a broad overview of the prevalence of antibiotic use at OPD.

The OPD antibiotic survey narrows down to specifics of the use of individual antibiotics. It answers the question, "for what diagnosis is an individual antibiotic being used?" or "what antibiotics are being used for a particular diagnosis?" The number, route, type of antibiotics, type of diagnosis, need of antibiotics (based on a recorded diagnosis of infectious disease or not) and adherence to treatment guidelines can be analyzed.

The data sources are usually the OPD prescription register (HMIS 031), in hard copy or electronic form. The methodology for conducting the DIS is provided in **Annex 10**.

The suggested indicators of interest from the Drug Indicator Survey (the pool of 200 patients) include:

- Average number of medicines per prescription/per patient
- Percentage of patients receiving one or more antibiotics
- Percentage of patients receiving one or more injections
- Percentage of medicines prescribed by generic name
- Percentage of medicines being antibiotics
- Percentage of medicines being injections
- Percentage of injections being antibiotics
- Percentage of medicines not in the Uganda Clinical Guideline and the Essential Medicines List (the latest versions)

With regard, to patients for whom antibiotics were prescribed, the indicators of interest are:

- The most common diagnoses for which antibiotics are prescribed
- Most commonly prescribed antibiotics
- Diagnoses for which the most common antibiotic is prescribed (medicine use evaluation)
- Most prescribed antibiotics for the most common condition at OPD at the time
- Percentage of prescriptions that are in accordance with local guidelines (UCG)
- Number of antibiotics per prescription

The results of the DIS can be used as a first pointer to indicate which antibiotics need further analysis. For example, the most common antibiotic used or the most common diagnosis can then be subjected to a prescription audit or drug use evaluation.

3.6.4 Point Prevalence Surveys

Point prevalence surveys are used to assess use of antibiotics in-patient level: the parameters of interest are collected for all the patients admitted in a certain ward at a certain moment. Different standardized surveys have been developed:

- Global PPS of Consumption and Resistance (University of Antwerp, Biomeraux-fund)
- PPS of Healthcare Associated Infection and Antimicrobial Use (E CDC), and,
- British Society of Antimicrobial Chemotherapy (BSAC)
- WHO Methodology for Point Prevalence Survey on Antibiotic Use in Hospitals, version 1.1 (available at https://www.who.int/medicines/access/antimicrobial_resistance/WHO-EMP-IAU-2018_01/en/, accessed on December 5th 2019)

The general purpose of PPS is to provide a standardized assessment tool to be used by hospitals in inpatient departments to assess prescription practices, identify targets for quality improvement, and assess the effectiveness of Antimicrobial Stewardship interventions. The Global PPS also aimed to establish a global surveillance tool through voluntary internet-based reporting.

The PPS normally includes ***all patients present at 8 am in the morning in the ward under consideration and having received antibiotics in the previous 24 hours***. Parameters assessed are usually:

- Antimicrobial name (generic and branded)
- Route of administration (parenteral, oral, rectal),
- Indication of antimicrobial use (Community Acquired infection, Hospital Acquired Infection, Surgical prophylaxis, Medical prophylaxis)
- Diagnosis (if present in notes, and site and type of infection)
- Presence of a stop/review date
- Type of treatment: empiric vs targeted.
- Is treatment in compliance with standard treatment guidelines
- Type of biological fluid sample: blood, urine etc.
- Is the treatment based on a biomarker? Which one?
- Which group of resistant organisms were found?

A simplified data collection tool is presented below. Links to more information and material are provided in the references.

Patient ID	**Ward**
Name of antimicrobial	Route
Unit dose	Number doses in the 24 hours
Is the reason for antimicrobial documented? (Yes or No)	Diagnosis (site of infection)
Indication • Community Acquired Infection	Complies with (local) guidance (Yes or No)

• Hospital Acquired Infection • Surgical Prophylaxis • Medical Prophylaxis*	
Is a stop or review date documented (Yes or No)	Number of prescribed doses documented as administered in the last 24 hours**

Source: BSAC UK PPS Tool

*Antimicrobials given to prevent infections, used in specific circumstances e.g. cotrimoxazole prophylaxis in HIV positive patients, penicillin prophylaxis in rheumatic heart disease.

** Added in consideration of the common gaps in administration and documentation in Uganda

Data source

The source of data for PPS is the in-patient files.

Data analysis

The PPS results can be summarised and reported as:

- The most common diagnoses for which antibiotics are prescribed
- Most commonly prescribed antibiotics
- Diagnoses for which the most common antibiotic is prescribed (medicine use evaluation)
- Most prescribed antibiotics for the most common condition at OPD at the time (prescription audit)
- Percentage of prescriptions that are in accordance with local guidelines (UCG)
- Percentage of patients receiving more than 1 antibiotic per prescription, disaggregated by the actual number of antibiotics prescribed.

3.6.5 Medicine Use Evaluations and Prescription Audits

The purpose is to identify a performance gap by comparing the current practice and the standard, followed by further investigations of the possible reasons for it, with the aim of developing appropriate interventions to address the problems encountered.

The practical instructions for carrying out a prescription audit or MUE, along with sample tools are found in **Annex 11**.

Chapter 4: Monitoring and Evaluation plan for AMC&U in Human Health

4.0 Monitoring and Evaluation

There is need for an M&E system that provides timely and accurate information to the Ministry of Health and its implementing partners in order to inform performance reviews, policy discussions and periodic revisions to the overall AMC&U surveillance plan.

4.1 Goals and Objectives of M&E

4.1.1 Goal

The goal for M&E is to assess progress towards establishing a system that is robust, comprehensive, fully integrated, harmonized and well-coordinated, and generate reliable and comparable data to inform AMC&U surveillance interventions.

4.1.2 Objectives

The specific objectives for M&E of the AMC&U surveillance plan are:

- To provide a framework for tracking progress and demonstrating results of the AMC&U Surveillance plan over the medium term.
- To build capacity within the relevant structures i.e. Appropriate Medicines Use unit and the AMC&U subcommittee, to regularly and systematically track progress of implementation of the AMC&U surveillance plan.
- To support the Appropriate Medicines, use unit within MoH Pharmacy Department and other stakeholders and assess the performance in accordance with the agreed-upon objectives and performance indicators to support management of results (evidence-based decision making),
- To improve compliance with broader government policies including the Pharmaceutical Sector Strategic Plan and the National Action Plan.
- To facilitate continuous learning (document and share the challenges and lessons learnt) by stakeholders during implementation of the surveillance plan.

4.1.3 Key M&E outcomes

The expected key outputs of the M&E framework are:

1. Performance reports (baseline survey reports, periodic progress reports, annual performance reports, financial audit reports etc.)
2. Basic statistical data on health service delivery, resources, outputs and beneficiaries.
3. Regular updates on core performance indicators.

The M&E Plan should result in:

- Timely reporting on progress of implementation of the AMC&U surveillance plan;
- Timely meeting of reporting obligations to Ministry of Health;
- Objective decision making for performance improvement
- Accountability to the Ministry of Health
- Policy dialogue with stakeholders.
- Evidence-based policy development and advocacy.
- Institutional memory on AMC&U surveillance implementation

4.2 Monitoring and Evaluation Matrix

	Indicator	Indicator Definition	Indicator Level	Disaggregation	Data Source	Frequency	Responsibility
1.0 Leadership, Organization and Management							
1.1	Designation of the Human Health AMC&U National Coordination Center (NCC)	Presence of a designated Human Health AMC&U NCC	Output		AMC&U surveillance assessments	Annual	MoH/NAMRSC
1.2	Presence of a functional AMC&U Sub-committee at MoH-Pharmacy Department	Presence of a functional AMC&U Sub-committee at MoH-Pharmacy Department	Output		AMC&U surveillance assessments	Annual	MoH/NAMRSC
1.3	Presence of a multi-disciplinary team coordinating AMC&U at the facility	Presence of a multi-disciplinary team coordinating AMC&U at the facility	Output		AMC&U surveillance assessments	Annual	MoH/NAMRSC
2.0 Capacity for AMC&U Surveillance							
2.1	Proportion of human health staff trained in AMC&U surveillance	N: Number of human health staff trained	Output	By data provider level	Training reports	Quarterly	AMC&U Sub-committee
2.2	Proportion of AMC&U surveillance reports submitted to MoH	N: Number of facilities reporting AMC&U surveillance data to MoH D: Expected number of facilities reporting AMC&U surveillance data	Output	By facility level	DHIS2/PIP	Quarterly	AMC&U Sub-committee
2.4	Percentage of reports submitted on time to the MoH	N: Number of facilities reporting AMC&U surveillance data to MoH on time D: Expected number of facilities reporting AMC&U surveillance data	Output	By facility level	DHIS2/PIP	Quarterly	AMC&U Sub-committee

2.5	Number of Human Health AMC&U review meetings conducted	N: Number of human health AMC&U review meetings conducted	Process		Meeting minutes	Quarterly	AMC&U Sub-committee
3.0 Extent of exposure to antibiotics							
3.1	Proportion of imports attributed to antibiotics	N: Volume of antibiotics imported D: Volume of imports	Output	WHO AWaRe Classification	NDAMIS		
3.2	Proportion of antibiotics imported against country antibiotic needs	N: Volume of antibiotics imported D: Country needs for antibiotics	Output	WHO AWaRe Classification	Quantification, Procurement and Planning Unit (QPPU) needs assessment	Annual	NDA
3.3	Proportion of local manufactured medicines attributed to antibiotics	N: Volume of antibiotics manufactured. D: volume of local manufactured EMHS	Output	WHO AWaRe	NDAMIS QPPU needs assessment	Annual	NDA
3.4	Proportion of antibiotics locally manufactured against country antibiotic needs	N: Volume of antibiotics manufactured D: Country needs for antibiotics	Output	WHO AWaRe	QPPU needs assessment	Annual	NDA
3.5	Volumes of antibiotics distributed in public and PNFP facilities	N: Volumes of antibiotics distributed in public and PNFP facilities	Output	By Level of care	Distribution reports	Quarterly	National Warehouses (NMS, JMS)

3.6	Quantity of antibiotics consumed	N: Number of DDD's D: Total number of patients	Outcome	By department (OPD, IPD)	Rx Solution, Stock Cards, Stock Books, HMIS 105 and HMIS 108 Monthly Reports	Quarterly	Facility AMC&U Team
3.7	Percentage financial expenditure on antibiotics	N: Total cost of all antimicrobials purchased D: Total cost of all medicines purchased	Outcome		Rx Solution, Delivery Notes, Order Forms	Quarterly	Facility AMC&U Team
3.8	Percentage of encounters with an antibiotic prescribed	N: Total number of prescriptions with antibiotics D: Total number of patients sampled	Outcome	By department (OPD, IPD)	OPD register, dispensing logs, inpatient files	Quarterly	Facility AMC&U Team
3.9	Average number of antibiotics prescribed per patient encounter	N: Total number of antibiotics prescribed for all patients sampled D: Total number of medicines prescribed for all patients sampled	Outcome	By department (OPD, IPD)	OPD register, dispensing logs, inpatient files	Quarterly	Facility AMC&U Team
4.0 Prescription Quality							
4.1	Percentage of antibiotics prescribed consistent with the hospital formulary list or UCG EMHSL	N: Number of antibiotics prescribed that are on the formulary list/ UCG EMHSL D: Total number of antibiotics prescribed	Outcome	By Department (OPD, IPD)	Inpatient files, dispensing logs, formulary list (EMHSL)	Quarterly	Facility AMC&U Team
4.2	Average duration of administered antibiotics	N: Total number of days of antibiotic administration D: Total number of hospital bed days at the point of the survey	Outcome	IPD	In patient files	Quarterly	Facility AMC&U Team

4.3	Percentage of patients with Upper-Respiratory Tract Infections (URTI) who were prescribed with antibiotics	N: Total number of patients diagnosed with URTI and antibiotics prescribed D: Total number of patients diagnosed with URTI	Outcome	OPD	OPD register	Quarterly	Facility AMC&U Team
4.4	Percentage of antibiotics prescribed by generic name	N: Total number antibiotics prescribed by generic name for sampled patients D: Total number antibiotics prescribed for the sampled patients	Outcome	By department (OPD, IPD)	OPD register, dispensing logs, In-patient files	Quarterly	Facility AMC&U Team
4.5	Percentage of encounters with an injectable antibiotic prescribed at OPD	N: Number of encounters for which an injectable antibiotic was prescribed at OPD D: Total number of encounters for which an antibiotic prescribed at OPD	Outcome	OPD	OPD register, dispensing logs,	Quarterly	Facility AMC&U Team

4.3 Implementation matrix

Objective 1: Provide reliable and comparable information on national consumption and use of antimicrobials in health facilities.						
Sub-activity	**Means of Verification**	**Timeline**	**Location**	**Responsible Entity**	**Cost (UGX)**	**Source of funding**
1. Governance						
1.1 Coordination						
Designation of the Appropriate Medicines Use Unit as National Coordination Centre for AMU/C surveillance.	Functional NCC in place with staff and TORs	Year 1	National	MoH Commissioner Pharmacy		MOH
Designation of the Appropriate Medicines Use Advisory Group with clear terms of reference and appointment letters	Functional Appropriate Medicines Use Advisory Group with TORs	Year 1	National	MOH Commissioner Pharmacy		MOH
Orientation of members of Appropriate Medicines Use Advisory Group on their responsibility with regards to the overall goal of surveillance for AMR and AMU/C	Orientation report	Year 1	National	MOH Commissioner Pharmacy		MOH
Carry out stakeholder engagement meetings (National):	Meeting reports	Year 1	National	MOH Commissioner Pharmacy		MOH/Partners
Carry out stakeholder engagement meetings (Local Government)	Meeting reports	Year 1	Sub-National	MOH Commissioner Pharmacy		MOH/Partners
Sub total						
Strengthen capacity in surveillance through training, mentorship and equipment acquisition						

Disseminate, print and distribute AMU/C surveillance guideline	Copies printed,	Year 1	National	Commissioner Pharmacy		MOH/Partners
Procure equipment for the Appropriate Medicines Use unit to support data management	Equipment procured and set up at the Appropriate Medicines Use unit	Year 1	National	Commissioner Pharmacy		MOH/Partners
Train and routinely mentor staff at the Appropriate Medicines Use unit on data management.	Training reports	Year 1	National	Commissioner Pharmacy		MOH/Partners
Train and routinely mentor stakeholders involved in AMU/C surveillance on data management and reporting	Training reports	Year 1	National Sub-National	Commissioner Pharmacy		MOH/Partners
Provide support supervision of stakeholders involved in AMU/C surveillance.	Support supervision reports	Year 2-5	Sub-National	Commissioner Pharmacy		MOH/Partners
Sub total						
2. Data management						
2.1 Collection of data on antimicrobial imports and local manufacture						
Conduct a baseline assessment data through the National Drug Authority's management information system (NDAMIS)	One annual data set/report on antimicrobials imported	Year 2	National	Commissioner Pharmacy, National Drug Authority (NDA)		NDA
Regular, routine import and local manufacture data collection through National Drug Authority's management information system (NDAMIS)	Annual reports on antimicrobials imported	Year 3-5	National	Commissioner Pharmacy, National Drug Authority (NDA)		NDA
Sub total						
2.2 Collection of data on antimicrobial distribution to public and PNFP facilities						

Conduct a baseline assessment of volumes of antimicrobials distributed	Baseline antimicrobial distribution data set submitted to the appropriate medicines use unit	Year 1	National	Commissioner Pharmacy NMS, JMS, MAUL		MOH/Partners
Regular, routine data collection of volumes of antimicrobials distributed	Annual antimicrobial distribution data set submitted to the appropriate medicines use unit	Year 2-5	National	Commissioner Pharmacy		MOH/Partners
Sub total						
2.3 Collection of data on antimicrobial consumption and use at facility level.						
Baseline survey at of antimicrobial consumption data from the store: expenditure on antibiotics, ward consumption	Baseline antimicrobial consumption data set obtained	Year 1	National	Commissioner Pharmacy Facility MTC/AMS sub-committee		MOH/Partners
Regular, routine data collection of antimicrobial consumption data from the store: expenditure on antibiotics, ward consumption	Annual antimicrobial consumption data from the store	Year 2	National	Commissioner Pharmacy Facility MTC/AMS sub-committee		MOH/Partners
Quarterly Point Prevalence survey for antimicrobial use in IPD drug indicator surveys for antimicrobial use in OPD at RRH and NRH levels of care	Quarterly PPS and DIS data sets received at the appropriate medicines use unit	Year 1-5	National	Commissioner Pharmacy Facility MTC/AMS sub-committee		MOH/Partners
Quarterly Point Prevalence survey for antimicrobial use in IPD drug indicator surveys for antimicrobial use in OPD at	Quarterly PPS and DIS data sets received at the	Year 2-5	Sub-National	Commissioner Pharmacy Facility MTC/AMS sub-committee/AMS Focal persons		MOH/Partners

district hospitals and HCIV levels of care	appropriate medicines use unit					
Quarterly Point Prevalence survey for antimicrobial use in IPD drug indicator surveys for antimicrobial use in OPD from private hospitals	Quarterly PPS and DIS data sets received at the appropriate medicines use unit	Year 3-5	Sub-National	Commissioner Pharmacy		MOH/Private sector/Partners
Sub total						
3. Data						
3.1 Data entry and storage						
Safe and secure storage on a local network in accordance with national ethical and data safety regulations	A module for AMU/C surveillance created in the Pharmaceutical Information Portal	Year 2	National	Appropriate Medicines Use Unit		MOH/Partners
Data locally stored with regular backup to national host server.		Year 2-5	National	Appropriate Medicines Use Unit		MOH/Partners
Direct entry and storage using a dedicated web-based tool on a national host server.	Web-based tool developed	Year 2-5	National	Appropriate Medicines Use Unit		MOH/Partners
Sub total						
3.2 Data analysis						
Appropriate Medicines Use Unit reviews and analyses aggregated data from different data providers	Analysed data sets, aggregate reports generated	Year 1	National	Appropriate Medicines Use Unit		MOH/Partners
Appropriate Medicines Use unit, compiles annual report and provides feedback to sites	Annual reports	Year 2-5	National	Appropriate Medicines Use Unit		MOH/Partners

Sub total						
3.3 Data reporting						
Data reported to the Appropriate Medicines Use unit	Data sets received at Appropriate Medicines Use Unit	Year 1-5	National	Appropriate Medicines Use Unit		MOH/Partners
Reports discussed by the Appropriate Medicines Use Advisory Group and the MPM TwG within the ministry, to describe actionable areas	Report received for discussion by Appropriate Medicines Use Advisory Group	Year 1-5	National	Appropriate Medicines Use Unit		MOH/Partners
Reports shared with: The One Health Platform through the One Health Surveillance TwC and the antimicrobial stewardship, optimal access and use technical working group (ASO) Reports shared with international development partners (WHO) and at scientific meetings.	Reports received at the One Health secretariat through the Data Integration and sharing centre (DISC). WHO-Glass receipt	Year 2-5	National	Appropriate Medicines Use Unit		MOH/Partners
Sub total						
Objective 2: promote implementation of antimicrobial stewardship in health facilities.						
Sub-Activity	**Means of Verification**	**Timeline**	**Location**	**Responsible Entity**	**Cost**	**Source of Funding**
3.4 Data Use						
Surveillance activity baseline data used to develop data quality indicators of AMU/C	Data quality indicators developed based on baseline data	Year 1	National	Appropriate Medicines Use Unit/Advisory Group		MOH
Data used to identify targets for antimicrobial use improvement at both national and facility level	Targets for Quality improvement set	Year 2-3	National Sub-national	Appropriate Medicines Use Unit/Advisory Group		MOH

Data used to inform and design interventions (including policies) to improve antimicrobial use at National level	Interventions for stewardship developed	Year 3-5	National	Appropriate Medicines Use Unit/Advisory Group		MOH
Data used to inform and design interventions to improve antimicrobial use at Facility level	Interventions for stewardship developed	Year 2-5	Sub-national	Facility MTC/AMS sub-committee		MOH
Data used to monitor the effectiveness of antimicrobial stewardship activities	Impact assessment reports	Year 3-5	National Sub-national	Appropriate Medicines Use Unit/Advisory Group Facility MTC/AMS sub-committee		MOH
Sub total						

Annex 1: Detailed description of variables for AMC data

Table 1: Product-level data variables for the antimicrobial register

Variable Name	Content
Product ID	Unique identifier of the medicinal product package e.g. registration number
Label	Medicinal product package label (Brand Name)
Pack size unit	Pack size unit of measure
Paediatrics_Product	Is it a pediatric medicine product
Form	Pharmaceutical formulation type
Route_Admin	Route of administration
Strength	Quantity of the main ingredient of each item
Strength_Unit	Unit measurement of strength
INBASQ	Basic ingredient quantity
INBASQ_UNIT	Unit measurement of the basic ingredient quantity
ATC5	WHO ATC code at substance level (ATC-5 level)
SALT	Salt of the active substance
COMBINATION	The WHO CC has defined DDD for combined products
PRODUCT NAME	Medicinal product name
INGREDIENTS	Ingredient name: e.g. amoxicillin
PRODUCT_ORIGIN	The product could be an import, donation or locally manufactured
Manufacturer Country	The country of the manufacturer of the product
Manufacturer	Name of the manufacture
Generic	Is the product a generic?
Conv_Factor	Transform strength expressed in IU in grams
WHO_DDD	The DDD defined by the WHO CC for the ATC code
WHO_DDD_Unit	Unit measurement of the WHO DDD (mg, g, IU)
DPP	DDD per package

Source: WHO antimicrobial medicines collection protocol year 2016

Annex 2: Data Sources for AMC&U Data

There are a number of sources of information on consumption of antimicrobials, providing information with differing levels of detail on the consumption and use of antimicrobials, as discussed in the table below.

Table 2: Strengths and limitations of data sources for AMC&U surveillance

Data source	Strengths	Limitations
Import data (NDAMIS)	• Centralized records • Standardised reporting for customs declaration forms including product type (generic, branded), volume, port of origin, country of manufacture, batch number, expiry date)	• Documentation may be incomplete • Does not account for parallel imports or illegal entry of products • Volumes match import cycles, not consumption patterns. A single VC from NDA will allow for import of a product throughout the year • Administrative records are not formatted for research and analysis, therefore require further manipulation to generate meaningful information. • Currently, NDA/NDAMIS is using of EphMRA classification rather than ATC codes, so there may be limited information at the pharmacological or chemical subgroup level
Local manufacture (NDAMIS)	• Local licensed producers can be easily identified by the system • Separate product volumes for local use and for export can be separated • Data can be requested in a format suitable for analysis that doesn't require further manipulation	• There is no policy requiring local manufacturers to file returns with NDA. • There may be unwillingness to provide data • Volumes reflect production not consumption patterns
Public and PNFP procurement (NMS, JMS, MAUL, UHMG, distribution data)	• Data is likely to have accurate documentation of purchases • Disaggregation of distribution data to facility types (community and	• Only provides data for public sector and PNFPs • The data may not reflect total public sector consumption if other procurement is undertaken by hospitals, health facilities

	hospital) and geographical location is possible ● Few procurement agencies in this category ● Donations imported for use at these facilities are channeled through these agencies, including programme commodities	
Donations	May be significant proportion of antimicrobials dispensed for specific clinical programs. These may include essential medicines.	There may be a significant proportion of donations that don't go through the centralised procurement agencies and may exaggerate the facility consumption data.
Facility level consumption data (Rx Solution, Stock cards, Stock books, issue/requisition vouchers)	● Standardised data collection ● Capacity to combine data from multiple sources including manufacturer records (batch number expiry date), volumes received at the facility, demanders/ward volumes ordered	● May be limited data collection in some areas, especially those relying on manual records ● May not be able to examine data at prescriber level
Patient level consumption data (Dispensing logs)	Data may be disaggregated by patient demographic characteristics	May be difficult to trace a patient to a prescription and to the dispensing log
Prescribing records (OPD Registers and Patient files for those in admission)	This data has patient characteristics, diagnosis, dose, duration, and other prescribed medicines	● Prescribed medicines may not be dispensed ● Data in the registers and files may not be complete, and underestimate the prevalence of antibiotic use ● Samples of patients may not be representative and therefore not reflect national data

Annex 3: List of antimicrobials with ATC codes and DDD values

J	**ANTIINFECTIVES FOR SYSTEMIC USE**	**1**
J01	**ANTIBACTERIALS FOR SYSTEMIC USE**	**2**
J01A	**TETRACYCLINES**	**3**
J01AA	**Tetracyclines**	**4**
J01AA01	demeclocycline	5
J01AA02	doxycycline	5
J01AA03	chlortetracycline	5
J01AA04	lymecycline	5
J01AA05	metacycline	5
J01AA06	oxytetracycline	5
J01AA07	tetracycline	5
J01AA08	minocycline	5
J01AA09	rolitetracycline	5
J01AA10	penimepicycline	5
J01AA11	clomocycline	5
J01AA12	tigecycline	5
J01AA13	eravacycline	5
J01AA20	combinations of tetracyclines	5
J01AA56	oxytetracycline, combinations	5
J01B	**AMPHENICOLS**	**3**
J01BA	**Amphenicols**	**4**
J01BA01	chloramphenicol	5
J01BA02	thiamphenicol	5
J01BA52	thiamphenicol, combinations	5
J01C	**BETA-LACTAM ANTIBACTERIALS, PENICILLINS**	**3**
J01CA	**Penicillins with extended spectrum**	**4**
J01CA01	ampicillin	5
J01CA02	pivampicillin	5
J01CA03	carbenicillin	5
J01CA04	amoxicillin	5
J01CA05	carindacillin	5
J01CA06	bacampicillin	5
J01CA07	epicillin	5
J01CA08	pivmecillinam	5
J01CA09	azlocillin	5
J01CA10	mezlocillin	5
J01CA11	mecillinam	5
J01CA12	piperacillin	5
J01CA13	ticarcillin	5

J01CA14	metampicillin	5
J01CA15	talampicillin	5
J01CA16	sulbenicillin	5
J01CA17	temocillin	5
J01CA18	hetacillin	5
J01CA19	aspoxicillin	5
J01CA20	combinations	5
J01CA51	ampicillin, combinations	5
J01CE	**Beta-lactamase sensitive penicillins**	**4**
J01CE01	benzylpenicillin	5
J01CE02	phenoxymethylpenicillin	5
J01CE03	propicillin	5
J01CE04	azidocillin	5
J01CE05	pheneticillin	5
J01CE06	penamecillin	5
J01CE07	clometocillin	5
J01CE08	benzathine benzylpenicillin	5
J01CE09	procaine benzylpenicillin	5
J01CE10	benzathine phenoxymethylpenicillin	5
J01CE30	combinations	5
J01CF	**Beta-lactamase resistant penicillins**	**4**
J01CF01	dicloxacillin	5
J01CF02	cloxacillin	5
J01CF03	meticillin	5
J01CF04	oxacillin	5
J01CF05	flucloxacillin	5
J01CF06	nafcillin	5
J01CG	**Beta-lactamase inhibitors**	**4**
J01CG01	sulbactam	5
J01CG02	tazobactam	5
J01CR	**Combinations of penicillins, incl. beta-lactamase inhibitors**	**4**
J01CR01	ampicillin and beta-lactamase inhibitor	5
J01CR02	amoxicillin and beta-lactamase inhibitor	5
J01CR03	ticarcillin and beta-lactamase inhibitor	5
J01CR04	sultamicillin	5
J01CR05	piperacillin and beta-lactamase inhibitor	5
J01CR50	combinations of penicillins	5
J01D	**OTHER BETA-LACTAM ANTIBACTERIALS**	**3**
J01DB	**First-generation cephalosporins**	**4**
J01DB01	cefalexin	5
J01DB02	cefaloridine	5

J01DB03	cefalotin	5
J01DB04	cefazolin	5
J01DB05	cefadroxil	5
J01DB06	cefazedone	5
J01DB07	cefatrizine	5
J01DB08	cefapirin	5
J01DB09	cefradine	5
J01DB10	cefacetrile	5
J01DB11	cefroxadine	5
J01DB12	ceftezole	5
J01DC	**Second-generation cephalosporins**	**4**
J01DC01	cefoxitin	5
J01DC02	cefuroxime	5
J01DC03	cefamandole	5
J01DC04	cefaclor	5
J01DC05	cefotetan	5
J01DC06	cefonicid	5
J01DC07	cefotiam	5
J01DC08	loracarbef	5
J01DC09	cefmetazole	5
J01DC10	cefprozil	5
J01DC11	ceforanide	5
J01DC12	cefminox	5
J01DC13	cefbuperazone	5
J01DC14	flomoxef	5
J01DD	**Third-generation cephalosporins**	**4**
J01DD01	cefotaxime	5
J01DD02	ceftazidime	5
J01DD03	cefsulodin	5
J01DD04	ceftriaxone	5
J01DD05	cefmenoxime	5
J01DD06	latamoxef	5
J01DD07	ceftizoxime	5
J01DD08	cefixime	5
J01DD09	cefodizime	5
J01DD10	cefetamet	5
J01DD11	cefpiramide	5
J01DD12	cefoperazone	5
J01DD13	cefpodoxime	5
J01DD14	ceftibuten	5
J01DD15	cefdinir	5

J01DD16	cefditoren	5
J01DD17	cefcapene	5
J01DD18	cefteram	5
J01DD51	cefotaxime and beta-lactamase inhibitor	5
J01DD52	ceftazidime and beta-lactamase inhibitor	5
J01DD54	ceftriaxone, combinations	5
J01DD62	cefoperazone and beta-lactamase inhibitor	5
J01DD63	ceftriaxone and beta-lactamase inhibitor	5
J01DD64	cefpodoxime and beta-lactamase inhibitor	5
J01DE	**Fourth-generation cephalosporins**	**4**
J01DE01	cefepime	5
J01DE02	cefpirome	5
J01DE03	cefozopran	5
J01DF	**Monobactams**	**4**
J01DF01	aztreonam	5
J01DF02	carumonam	5
J01DH	**Carbapenems**	**4**
J01DH02	meropenem	5
J01DH03	ertapenem	5
J01DH04	doripenem	5
J01DH05	biapenem	5
J01DH06	tebipenem pivoxil	5
J01DH51	imipenem and cilastatin	5
J01DH52	meropenem and vaborbactam	5
J01DH55	panipenem and betamipron	5
J01DI	**Other cephalosporins and penems**	**4**
J01DI01	ceftobiprole medocaril	5
J01DI02	ceftaroline fosamil	5
J01DI03	faropenem	5
J01DI54	ceftolozane and beta-lactamase inhibitor	5
J01E	**SULFONAMIDES AND TRIMETHOPRIM**	**3**
J01EA	**Trimethoprim and derivatives**	**4**
J01EA01	trimethoprim	5
J01EA02	brodimoprim	5
J01EA03	iclaprim	5
J01EB	**Short-acting sulfonamides**	**4**
J01EB01	sulfaisodimidine	5
J01EB02	sulfamethizole	5
J01EB03	sulfadimidine	5
J01EB04	sulfapyridine	5
J01EB05	sulfafurazole	5

J01EB06	sulfanilamide	5
J01EB07	sulfathiazole	5
J01EB08	sulfathiourea	5
J01EB20	combinations	5
J01EC	**Intermediate-acting sulfonamides**	**4**
J01EC01	sulfamethoxazole	5
J01EC02	sulfadiazine	5
J01EC03	sulfamoxole	5
J01EC20	combinations	5
J01ED	**Long-acting sulfonamides**	**4**
J01ED01	sulfadimethoxine	5
J01ED02	sulfalene	5
J01ED03	sulfametomidine	5
J01ED04	sulfametoxydiazine	5
J01ED05	sulfamethoxypyridazine	5
J01ED06	sulfaperin	5
J01ED07	sulfamerazine	5
J01ED08	sulfaphenazole	5
J01ED09	sulfamazone	5
J01ED20	combinations	5
J01EE	**Combinations of sulfonamides and trimethoprim, incl. derivatives**	**4**
J01EE01	sulfamethoxazole and trimethoprim	5
J01EE02	sulfadiazine and trimethoprim	5
J01EE03	sulfametrole and trimethoprim	5
J01EE04	sulfamoxole and trimethoprim	5
J01EE05	sulfadimidine and trimethoprim	5
J01EE06	sulfadiazine and tetroxoprim	5
J01EE07	sulfamerazine and trimethoprim	5
J01F	**MACROLIDES, LINCOSAMIDES AND STREPTOGRAMINS**	**3**
J01FA	**Macrolides**	**4**
J01FA01	erythromycin	5
J01FA02	spiramycin	5
J01FA03	midecamycin	5
J01FA05	oleandomycin	5
J01FA06	roxithromycin	5
J01FA07	josamycin	5
J01FA08	troleandomycin	5
J01FA09	clarithromycin	5
J01FA10	azithromycin	5
J01FA11	miocamycin	5
J01FA12	rokitamycin	5

J01FA13	dirithromycin	5
J01FA14	flurithromycin	5
J01FA15	telithromycin	5
J01FA16	solithromycin	5
J01FF	**Lincosamides**	**4**
J01FF01	clindamycin	5
J01FF02	lincomycin	5
J01FG	**Streptogramins**	**4**
J01FG01	pristinamycin	5
J01FG02	quinupristin/dalfopristin	5
J01G	**AMINOGLYCOSIDE ANTIBACTERIALS**	**3**
J01GA	**Streptomycins**	**4**
J01GA01	streptomycin	5
J01GA02	streptoduocin	5
J01GB	**Other aminoglycosides**	**4**
J01GB01	tobramycin	5
J01GB03	gentamicin	5
J01GB04	kanamycin	5
J01GB05	neomycin	5
J01GB06	amikacin	5
J01GB07	netilmicin	5
J01GB08	sisomicin	5
J01GB09	dibekacin	5
J01GB10	ribostamycin	5
J01GB11	isepamicin	5
J01GB12	arbekacin	5
J01GB13	bekanamycin	5
J01M	**QUINOLONE ANTIBACTERIALS**	**3**
J01MA	**Fluoroquinolones**	**4**
J01MA01	ofloxacin	5
J01MA02	ciprofloxacin	5
J01MA03	pefloxacin	5
J01MA04	enoxacin	5
J01MA05	temafloxacin	5
J01MA06	norfloxacin	5
J01MA07	lomefloxacin	5
J01MA08	fleroxacin	5
J01MA09	sparfloxacin	5
J01MA10	rufloxacin	5
J01MA11	grepafloxacin	5
J01MA12	levofloxacin	5

J01MA13	trovafloxacin	5
J01MA14	moxifloxacin	5
J01MA15	gemifloxacin	5
J01MA16	gatifloxacin	5
J01MA17	prulifloxacin	5
J01MA18	pazufloxacin	5
J01MA19	garenoxacin	5
J01MA21	sitafloxacin	5
J01MA22	tosufloxacin	5
J01MA23	delafloxacin	5
J01MB	**Other quinolones**	**4**
J01MB01	rosoxacin	5
J01MB02	nalidixic acid	5
J01MB03	piromidic acid	5
J01MB04	pipemidic acid	5
J01MB05	oxolinic acid	5
J01MB06	cinoxacin	5
J01MB07	flumequine	5
J01MB08	nemonoxacin	5
J01R	**COMBINATIONS OF ANTIBACTERIALS**	**3**
J01RA	**Combinations of antibacterials**	**4**
J01RA01	penicillins, combinations with other antibacterials	5
J01RA02	sulfonamides, combinations with other antibacterials (excl. trimethoprim)	5
J01RA03	cefuroxime and metronidazole	5
J01RA04	spiramycin and metronidazole	5
J01RA05	levofloxacin and ornidazole	5
J01RA06	cefepime and amikacin	5
J01RA07	azithromycin, fluconazole and secnidazole	5
J01RA08	tetracycline and oleandomycin	5
J01RA09	ofloxacin and ornidazole	5
J01RA10	ciprofloxacin and metronidazole	5
J01RA11	ciprofloxacin and tinidazole	5
J01RA12	ciprofloxacin and ornidazole	5
J01RA13	norfloxacin and tinidazole	5
J01X	**OTHER ANTIBACTERIALS**	**3**
J01XA	**Glycopeptide antibacterials**	**4**
J01XA01	vancomycin	5
J01XA02	teicoplanin	5
J01XA03	telavancin	5
J01XA04	dalbavancin	5

J01XA05	oritavancin	5
J01XB	**Polymyxins**	**4**
J01XB01	colistin	5
J01XB02	polymyxin b	5
J01XC	**Steroid antibacterials**	**4**
J01XC01	fusidic acid	5
J01XD	**Imidazole derivatives**	**4**
J01XD01	metronidazole	5
J01XD02	tinidazole	5
J01XD03	ornidazole	5
J01XE	**Nitrofuran derivatives**	**4**
J01XE01	nitrofurantoin	5
J01XE02	nifurtoinol	5
J01XE03	furazidin	5
J01XE51	nitrofurantoin, combinations	5
J01XX	**Other antibacterials**	**4**
J01XX01	fosfomycin	5
J01XX02	xibornol	5
J01XX03	clofoctol	5
J01XX04	spectinomycin	5
J01XX05	methenamine	5
J01XX06	mandelic acid	5
J01XX07	nitroxoline	5
J01XX08	linezolid	5
J01XX09	daptomycin	5
J01XX10	bacitracin	5
J01XX11	tedizolid	5

Annex 4: Calculation of DDDs

Consumption volume

The consumption volume is expressed as the number of DDDs consumed and is calculated by dividing the amount of the antimicrobial substance measured in grams by the DDD-value in grams, which has been assigned to the respective antimicrobial substance by the WHO Collaborating Centre for Drug Statistics Methodology.

$$\text{Number of DDD} = \frac{\text{Total number of grams of the substance consumed in a defined period of time}}{\text{DDD value of the substance in grams assigned by WHO}}$$

The total amount in grams can be obtained in two ways: 1. by multiplying the strength of each tablet or vial by the number of items per package and the number of packages consumed, 2. by multiplying the strength of each tablet or vial by the total number of items consumed. The DDD value is mostly specified in grams but can also be defined as MU (million units) for certain substances.

Example:

Calculation of the volume as number of DDD of orally administered amoxicillin (medicinal product A) consumed in a surgical ward in the year 2018:
Medicinal product A consumed in 2018: 50 packages
Size of the package: 20 tablets
Strength of the single tablet: 0.75 g Amoxicillin
ATC-Code: J01CA04
Route of administration: oral
WHO-DDD: 1.5 g
Number of items: 1000 pieces (50 packages x 20 tablets)

A. Calculation based on the number of packages

$$\text{Number of DDD} = \frac{(\text{number of packages}) \times (\text{package size}) \times (\text{strength per item})}{\text{DDD assigned by WHO Collaborating Centre}}$$

Example:

$$\text{Number of DDD} = \frac{20 \text{ tablets} \times 50 \text{ packages} \times 0.75\text{g}}{1.5\text{g}} = 500 \text{ DDD}$$

B. Calculation based on the number of items

$$\text{Number of DDD} = \frac{(\text{number of items}) \text{ x } (\text{strenght per single item})}{\text{DDD assigned bay WHO collaborating center}}$$

Example:

$$\text{Number of DDD} = \frac{1000 \text{ tablets} \times 0.75 \text{ g}}{1{,}5 \text{ g}} = 5000 \text{ DDD}$$

It is not necessary to provide data on the number and size of packages, if data on the number of items (e.g. tablets) is available.

Special cases

For combinations of antibiotics, the DDD value is specified as UD (Unit Dose). One tablet or vial of a combination product with a specific strength of each component is defined as a specific number of UD representing the DDD. To obtain the DDD consumed of a specific combination product, the total number of UDs is divided by the assigned UD value. A list of combination products with specified strengths and their assigned DDD values is provided by the WHO Collaborating Centre for Drug Statistics Methodology.

For combination products, which contain one active and one inactive ingredient the DDD is ordinarily assigned only to the active ingredient. For example, for amoxicillin/clavulanic acid the DDD is assigned to amoxicillin and neglects the clavulanic acid. In consequence, for the calculation of the number of DDD for amoxicillin/clavulanic acid, the total volume of grams consumed should refer only to amoxicillin as in the example below.

Examples for data entry of combined products

Example A - Data entry of combined products consisting of one active antimicrobial substance and one inactive substance.

The substance amoxicillin/clavulanic acid includes as active antimicrobial substance amoxicillin and as an inactive additive clavulanic acid. For the quantification of antimicrobial consumption only the active substance is relevant and the DDD-value assigned by the WHO collaboration center only refers to amoxicillin.

From the product «amoxicillin/clavulanic acid, 875mg/125mg, 10 tablets » 7 packages have been dispensed to the ward « PNEU1 » in the first quarter of 2018. The consumption volume in DDD is calculated by multiplying the number of the items dispensed (number of packages x number of items per package) with the strength per single item (only amoxicillin) divided by the DDD-value assigned by WHO (1.5 g).

Calculation

$$\text{Consumption volume} = \frac{(7 \text{ packages} \times 10 \text{ tablets}) \times 0.875 \text{ g}}{1.5 \text{ g}} = 40.8 \text{ DDD}$$

Annex 5. Steps for filling in the WHO Excel Tool

Available in WHO guidance on surveillance of antimicrobial consumption in hospitals; V0.1-20190619

https://amu-tools.org/amctool/amctool.html

Annex 6: WHO AWARE Categories for Antimicrobials

The 2017 edition of the WHO Model List of Essential Medicines introduced a classification of antibiotics into three classes, with examples in the table below:

1. **Access Antibiotics:** first or second line medicines for most common clinical infective syndromes, based on comprehensive review of 21 priority infectious syndromes in children and adults, review of 5 bacterial infections in children (community acquired pneumonia, dysentery, cholera, sepsis, severe acute malnutrition), and review for antibiotics for STI (current WHO guidelines). These antibiotics should be widely available, accessible and quality-assured.
2. **Watch Antibiotics:** classes of antibiotics with a broad spectrum and a higher risk of resistance, to be used for selected indications and to be considered as a focus for stewardship. This group includes most of the highest priority agents among the Critically Important Antimicrobials for Human Medicine. Some ACCESS antibiotics, like ceftriaxone and azithromycin are also in the WATCH group.
3. **Reserve Antibiotics:** "last resort" antibiotics, which should be restricted only for multi resistant infections and for targeted treatment, and should also be focus for stewardship.

ACCESS ANTIBIOTICS	WATCH ANTIBIOTICS
Amoxicillin, Amoxicillin-clavulanic	Quinolones and fluoroquinolones *(e.g. ciprofloxacine, levofloxacin,moxifloxacine, norfloxacin)*
Ampicillin, Cloxacillin	3rd generation cephalosporins - with or without beta-lactamase inhibitors *(e.g. cefixime, ceftriaxone, cefotaxime, ceftazidime)*
Phenoxymethylpenicillin	Macrolides *(e.g. azythromicin, clarithromycin, erythromycin)*
Benzathin penicillin, Benzyl penicillin	Glycopeptides *(e.g. teicoplanin, vancomycin)*
Procain penicillin	Antipseudomonal penicillins+beta lactamase inhibitors *(e.g. piperacillin-tazobactam)*
Amikacin, Gentamicin	Carbapenems *(e.g. meropenem, imipenem-cilastatin)*
Cefalexin, Cefazolin	Penems *(e.g. faropenem)*
Chloramphenicol	**RESERVE ANTIBIOTICS**
Clindamycin	Aztreonam
Doxycycline	4th generation cephalosporins *(e.g. cefepime)*
Metronidazole	5th generation cephalosporins *(e.g. ceftarolin)*
Nitrofuraintoin	Polymyxins *(e.g. polymyxin B,colistin)*
Spectinomycin	Fosfomycin (IV)
Sulphamethoxazole+trimethoprim	Oxazolidinones *(e.g. linezolid)*
Cefixime*	Tigecyclin
Cefotaxime*, Ceftriaxone*	daptomycin
Piperacillin tazobactam*	
Meropenem*	
Azithromycin* Clarithromycin*	
Ciprofloxacin*	
Vancomycin (oral)*, Vancomycin (parenteral)*	

*antibiotics in both access and watch groups (*Access-Watch*)

Annex 7: AMC data extraction tool for NDA and central warehouses

Background information	Name of institution:			Data source:			Enumerator:		
#	Name of antimicrobial product intended for use in humans	Active ingredient(s) (Antimicrobial)	Strength or Concentration (each active ingredient)	Dosage form	*Route of administration	Antimicrobial class	Quantity	Unit of Measure	Remark

*In case of Antimicrobial Consumption data such as import, local manufacture and distributed

Annex 8: Tool for WHO Indicator surveys

How to Investigate Drug Use in Health Facilities: Selected Drug Use Indicators
https://www.who.int/medicines/publications/how-to-investigate_drug-use/en/

Annex 9: Template for Point Prevalence Surveys

- Global PPS of Consumption and Resistance (University of Antwerp, Biomeraux-fund) https://www.global-pps.com/documents/
- WHO Methodology for Point Prevalence Survey on Antibiotic Use in Hospitals, version 1.1 (available at https://www.who.int/medicines/access/antimicrobial_resistance/WHO-EMP-IAU-2018_01/en/, accessed on December 5th 2019)

Annex 10: Instructions for Drug Indicator Survey

Practical instructions for DIS

Study Setting:

These surveys will be conducted in the general OPD, excluding antenatal and specialist out-patient clinics such as diabetes, HIV, Neurology and mental health. Prescription practices in these departments will be very different.

Inclusion/Exclusion criteria:

In order to have a single sample for the DIS and more specific Antibiotic survey, the inclusion criteria will be ALL patients seen at general OPD regardless of whether they were prescribed an antibiotic or not.

OPD re-attendances and visits that result in admissions are excluded.

Sample size:

The suggested sample size is at least 200 patients/prescriptions within the period of consideration. Considering the high rate of antibiotic use in primary health care settings, this will produce a sample of more than 100 patients for which antibiotics were prescribed.

Sampling strategy

The suggested sampling strategy is systematic sampling. For the period considered (2-3 months), the total number of entries in the OPD Register, divided by the expected sample size will provide the sampling interval.

- From HMIS 031, get the number of OPD (new) visits for the 3 months you have decided to investigate: e.g. 3456 new OPD visits in the months January to March 2016.
- Divide the total number by the number of prescriptions you want to sample and round the result: e.g. 3456/100 = 34.56 rounded down to 34.
- Choose a random number from 1 to 9 (common method is to take out a banknote and take the last figure of the serial number) and sample one patient every 35 (in this example) starting from the patient number indicated by the random number. Skip re-attendances and admissions while counting.
- Decide what to do in case the prescription does not fit the definition (e.g. if it is an admission case), i.e., choose the previous prescription or the next.

Data collection:

The data source is the OPD Register (HMIS 031). The variables to be collected include:

- Serial Number/OPD Number
- Age
- Sex
- Test done*
- Diagnosis
- Drugs prescribed including dose and duration

**Data on these variables may not be captured from the OPD Register*.

Collect and analyse the data using the attached form and formulas (see next page for tables an examples). Per are no pre-set absolute thresholds or standards for the value of the indicators, since they depend on a number of factors. Further analysis will be carried out on this data set,

therefore, the most practical approach is to copy the complete prescription of the sampled patients and complete the indicator table below:

Variables for Data Collection											
1	2	3	4	5	6	7	8	9	10	11	12
No	Client Initials	OPD No	Month of visit	Age	Sex	Test done	Result	Diagnosis	Drugs Prescribed	Total mg per day	Duration

Variables for Analysis													
13	14	15	16	17	18	19	20	21	22	23	24	25	26
Antibiotic INN Name	Antibiotic Class	ATC code	WHO AWaRe 2019 Access Watch Reserve	WHO DDDs	No. of medicines per prescription	No. of Abx prescribed	Requiring Antibiotic YES or No	Abx prescribed according to UCG 1=YES, 0=NO	Medicine not in UCG/ESML	INN Used 1=Yes 0-No	Antibiotic INJ 1=Yes 0=No	Total No. of Medicines	Total No. of Medicines

Annex 11: Instructions for Medicines Use Evaluation and Prescription Audit

Practical instructions for MUE and prescription audit

Step 1: Identify a priority condition or antimicrobial of interest. (it can be a diagnosis e.g. sepsis, pneumonia, or a medicine e.g. an expensive antibiotic). Define the **scope** of the activity, which refers to the parameters you are going to assess, i.e. prescribing criteria, dispensing, and administration. The choice depends on the problem you are looking at.

- For example, if the problem pointer is a high number of treatment failures in patients using an antibiotic, you may want to investigate indication but also dosages, the way it is administered or prepared, patient characteristics and culture and sensitivity results.

Step 2: Detail the standard management criteria according to guidelines (IMCI, UCG, and PGD). To keep it simple, limit to 3-5 criteria. Create a simple data collection tool based on the established criteria.

Step 3: Set the threshold below which the adherence to standard would be considered insufficient: often 100% is unrealistic, 90%-95% is sufficient in most cases.

Step 4: Describe how the data will be collected. This is an important consideration because while some data are easy to collect retrospectively, some others can only be collected prospectively.

Step 5: Establish the number of prescriptions to be analysed: **minimum 30**, but up to 100 for common conditions/medicines, and in big facilities with multiple prescribers.

Step 6: ***For retrospective studies***

For a prescription audit, establish the period you want to investigate (usually 1-3 months). Obtain the total number of cases with the condition under investigation from the HMIS for that period, and divide it by the number of prescriptions you want to collect: the result will be your sampling interval.

> **Example:** if you are doing a prescription audit on Urinary Tract Infection (UTI), and you want 50 prescriptions from a period of 1 month: check how many UTI cases are recorded in HMIS 105 for that month (e.g. 346) and divide by 50. That is, **346/50 = 7**, so you will record every 7th case of UTI from the OPD register.

For a medicine use evaluation, establish the period you want to investigate, check how many patients have been prescribed the medicine in the period of interest, divide it by the number of prescriptions you want to collect and use the result for your sampling interval.

> **Example:** you want to do a prescription survey on ceftriaxone. You may get the number of patients dispensed ceftriaxone in a certain period from the pharmacy dispensing log, e.g. 155. Divide the number by the number of prescriptions you are targeting (30) to obtain your sampling interval. That is, **155/30 = 5**, so you will every 5th patient prescribed metformin from the OPD register.

> **NOTE:** If the condition or medicine under investigation is not common, you can simply check **all** the prescriptions you find in a certain period.

Step 6: ***For prospective studies.*** These are often based on observation, and the sample size may depend on the amount of time available, and the number of cases per day. Usually when health workers are aware to be observed, they may change their behaviour but they soon get used and revert to usual practices. So it is advisable to start collecting data after having done some

observations. Prospective methods have risks of bias since data are collected in a short period and there is a limited chance of random sampling, so they are used in case of absence of retrospective data (poor records) or to study certain practices (e.g. how nurses prepare and administer injectable medicines).

Step 7: Collect data (retrospectively or prospectively) and tabulate them for analysis. If documentation is poor, the only way to collect data is prospectively. Analyse percentage of adherence to criteria and compile a report with recommendations.

Step 8: if the problem has a straightforward solution, share the report with prescribers, then design and implement an intervention. If the reasons of the problem have to be investigated, design and conduct qualitative studies to inform the development of the intervention.

Step 9: Repeat the medicine use evaluation or the prescription audit during and after the intervention for monitoring and evaluation purposes. Remember that data collection, analysis and feedback to prescribers by itself it is an intervention because it can influence prescribers' behaviour.

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