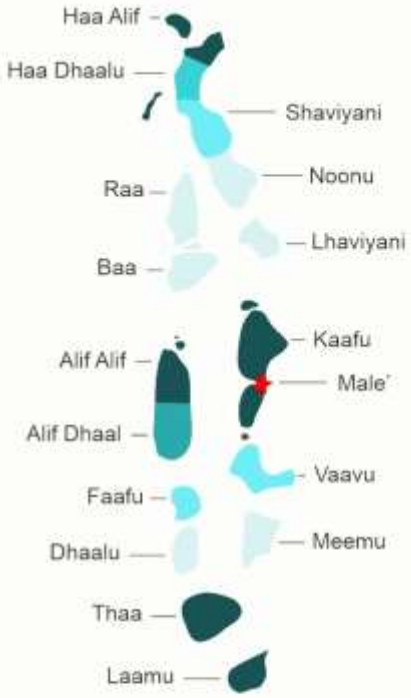
NATIONAL
AMR SURVEILLANCE
FRAMEWORK
2025-2027

Patient-based Surveillance of Antimicrobial Resistance in the Maldives



Ministry of Health
Republic of Maldives

World Health Organization
Maldives

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INTRODUCTION

Antimicrobial resistance (AMR) has become a major threat to public health worldwide, including the South-East Asian region, and the Maldives. AMR impacts on human health due to an increased length of patient hospitalization, treatment failures, and significant human suffering and deaths, and is increasing healthcare costs, as well as indirect costs. The major driver behind the occurrence and spread of AMR is the overuse, misuse and abuse of antimicrobial agents in human health, as well as in animal health. Poor implementation of infection prevention and control strategies, and low vaccination rates, are further contributing to the spread of multidrug-resistant bacteria and fungi.

For 2021, an estimated 4.71m deaths globally were associated with bacterial AMR, including an estimated 1.14m deaths attributable to bacterial AMR. According to forecasts, by the year 2050 the number of deaths associated with AMR globally could increase to 8.22m, including 1.91m deaths attributable to AMR. Regions with the highest all-age AMR mortality rate in 2050 are forecasted to be South Asia, Latin America and the Caribbean. For the South Asia region, to which the Maldives belong, the estimated number of deaths associated with AMR was 1.26m in 2021, including 335,000 deaths attributable to AMR. These numbers are expected to increase to 2.4m deaths associated with AMR, including 604,000 deaths attributable to AMR (GBD, 2024).

For the Maldives, the number of deaths associated with, or attributable to AMR is currently not known, as patient-based surveillance of AMR is yet to be established. Similarly, the epidemiology, and levels and trends of antimicrobial resistance across bacterial and fungal pathogens in the Maldives are currently unknown.

AMR surveillance includes the continuous and systematic collection, analysis, interpretation, and dissemination of AMR data, which is needed for the planning, implementation, and evaluation of AMR prevention and control strategies and activities.

The Maldives have enrolled in the Global AMR Surveillance program (GLASS) in 2018 and have in August 2024 submitted to GLASS for the first time some limited AMR data for the year 2023.

This document outlines the approach the Maldivian government is taking to establish AMR surveillance in the country. In line with the strategic objectives outlined in the National Action Plan on Antimicrobial Resistance 2024 – 2029 (NAP-AMR) (Ministry of Health, 2024) and with WHO recommendations, this **National AMR Surveillance Framework** describes the goals, implementation, objectives, methods and standards, and roles and responsibilities to establish patient-centered surveillance of AMR in the Maldives.

The National AMR surveillance system will allow, for the first time, the Maldivian government, national and local committees, healthcare and public health professionals, academia and researchers, international agencies, and other stakeholders, to:

- better understand the epidemiology of AMR in the Maldives
- generate local, regional, and national AMR data, and cumulative antibiograms
- analyze and predict trends of antimicrobial resistance
- detect and characterize emerging antimicrobial resistant organisms
- identify clusters and potential outbreaks of community- and healthcare-associated infections
- help to develop antimicrobial treatment guidelines for empiric treatment of common infections
- inform, guide, and monitor the effectiveness of antimicrobial stewardship programs, and
- contribute to the scientific body of literature on AMR in South Asia.

AMR SURVEILLANCE IN MALDIVES

Goals

The Maldives will continuously and systematically collect, analyze, interpret, and report data on patients infected with antimicrobial resistant (AMR) organisms, following the standards described in this strategic document.

The primary goal of this national AMR surveillance system is to generate evidence on the burden of antimicrobial drug resistance among priority pathogens isolated in acute care hospitals and health centers from in-patients and outpatients who have been referred to laboratory testing in the Maldives.

A further goal is to integrate this national AMR surveillance system (human health) into a comprehensive, integrated (One Health) surveillance system, for which surveillance of AMR and AMU will be established in other sectors (animal, food, environment).

Objectives

AMR surveillance goals will be achieved through the following measurable objectives:

- Conduct routine culture and standardized antimicrobial susceptibility testing (AST) to identify and isolate priority pathogens from specimens of patients with clinical infection at surveillance sites
- Establish regular and systematic communication of relevant AST results from testing laboratories to clinical providers as described in this document
- Establish regular and systematic reporting of nationally defined priority AST results and patient-level data from surveillance sites to the National AMR Surveillance Data Center (NDC-AMR) at MoH, following the reporting structure described in this document
- Provide participating surveillance sites with annual AMR surveillance reports, including site-specific cumulative antibiograms, epidemiology reports, and test practices and quality reports
- Analyze, interpret, and publicly report annual AMR surveillance data in a written national AMR surveillance report, including a national cumulative antibiogram.
- Review and update on a periodical basis the list of AMR priority pathogens to be included in the national AMR surveillance program (based on local needs and international recommendations).

SURVEILLANCE IMPLEMENTATION

Overview

The Maldives national AMR Surveillance system will be coordinated by the national **Technical Sub-Committee for AMR Surveillance (TSC-AMRS)**, as defined in the NAP AMR 2024-2029.

The system will be made up of local, national, and global components. AMR surveillance will engage public and private hospitals, health centers, and microbiology laboratories at different care levels throughout the health system to allow for more inclusive, local, regional, and nationally relevant data for informed decision-making.

Surveillance sites combine interlinked **clinical** and **laboratory** facilities where lab specimens are routinely collected and tested. Per usual procedure, clinical specimens routinely collected from patients will be submitted from the clinical departments to the diagnostic laboratory for organism identification and antibiotic susceptibility testing (AST) (a); laboratory results will be entered at the site level into the hospital information system/laboratory information system (HIMS/LIMS) and returned to clinicians as a patient report (case-by-case), as well as an annual cumulative antibiogram (b) (**Figure 1**).

On monthly basis the surveillance sites extract all AST results, along with pertinent patient data, from the local HIMS/LIMS and transmit it electronically to the **National AMR Surveillance Data Center** (NDC-AMR). The NDC-AMR receives these raw data files and conducts quality checks and analysis on at least quarterly basis and saves the data files for long-term storage (c). The NDC-AMR also collects additional AMR data and information and receives technical support from the NRL-AMR (d). The NDC-AMR, in collaboration with HIMRD, checks and analyzes the data and returns site-specific epidemiological and data quality reports to the surveillance site (e). The NDC-AMR generates the National AMR surveillance report and forwards it to the National AMR Coordination Unit **(NACU)** for review and approval (f) (**Figure 1**).

NACU reviews and approves the national AMR surveillance report and shares it with the Technical Subcommittee for AMR Surveillance (TSC-AMR Surveillance) and other partners for guiding national policy and antimicrobial stewardship programs (ASP) (g). NACU also approves sharing national aggregated data and reports with the public (MoH website: PDF report, and DHIS-2 dashboard) (h), and high-level aggregated data with international stakeholders (WHO-GLASS) (i) (**Figure 1**). WHO GLASS data file generation and upload to the WHO GLASS platform is done by the National Focal Point for GLASS at NRL-AMR once a year.

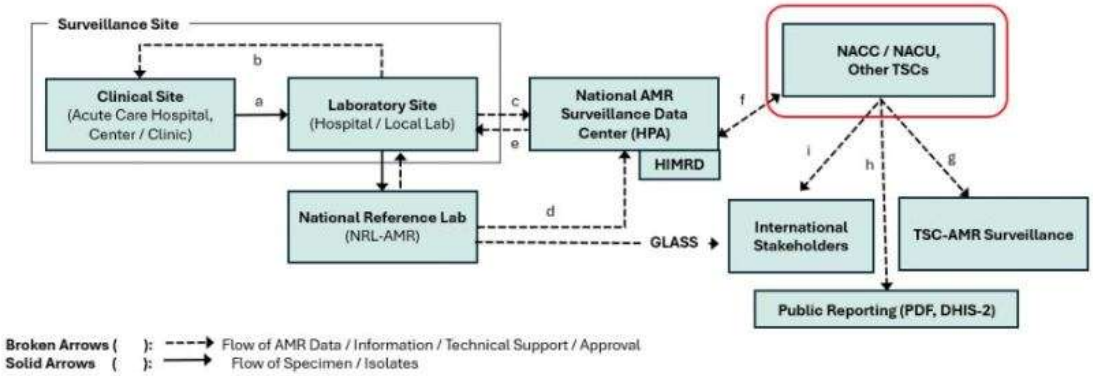


Figure 1: Simplified diagram of antimicrobial susceptibility testing data sharing and isolate/sample transmission in the Maldives Antimicrobial Resistance Surveillance System

Roadmap for Implementation

The national Technical Sub-Committee (TSC) for AMR Surveillance has been established by the NACC to oversee the development of the AMR surveillance program in the Maldives and coordinate surveillance implementation. The initial implementation period for the Maldives AMR Surveillance Program will be during 2025-2027 (phase 1), followed by phase 2 (2028-2030). Selected clinical and laboratory departments of potential surveillance sites have been assessed, including a LAARC assessment (CDC-LAARC, 2024), during October 2024 to determine capacity to participate and to identify areas for improvement to be addressed (WHO CO AMR, 2025). Minimum requirements for laboratory participation in the national AMR surveillance program are outlined in **Appendix B**. Based on the capacity identified through the baseline assessments, 27 sentinel sites have been selected for incremental roll-out of AMR surveillance (**Table 1**).

Table 1: Antimicrobial Resistant Surveillance Sites and Proposed Date for Roll-out during 2025

Nr.	Proposed AMR Surveillance Roll-out Sites	Location	Ownership	Category	Roll-Out
1	Indhira Gandhi Memorial Hospital (IGMH)	Malé	Government	National	2025
2	Dharumavantha Hospital	Male'	Government	National	2025
3	Kulhudhuffushi Regional Hospital	Kulhudhuffushi/ H. Dh. Atoll	Government	Regional	2025
4	Ungoofaaru Regional Hospital	Ungoofaaru / R. Atoll	Government	Regional	2025
5	Meemu Mulee Regional Hospital	Muli / M. Atoll	Government	Regional	2025
6	Laamu Gan Regional Hospital	Gan / L. Atoll	Government	Regional	2025
7	Addu Equatorial Hospital	Hithadhoo / Addu City	Government	Regional	2025
8	Dr. Abdul Samad Memorial Hospital	Thinadhoo/G.Dh. Atoll	Government	Regional	2025
9	Haa Alifu Atoll Hospital	Dhidhdhoo/HA. Atoll	Government	Atoll	2025
10	Shaviyani Atoll Hospital	Fonadhoo/ Sh. Atoll	Government	Atoll	2025
11	Noonu Atoll Hospital	Manadhoo / N. Atoll	Government	Atoll	2025
12	Lhaviyani Atoll Hospital	Naifaru / Lh. Atoll	Government	Atoll	2025
13	Baa Atoll Hospital	Eydhafushi / B. Atoll	Government	Atoll	2025
14	Alifu Alifu Atoll Hospital	Rasdhoo / AA. Atoll	Government	Atoll	2025
15	Alif Dhaal Atoll Hospital	Mahibadhoo / A. Dh. Atoll	Government	Atoll	2025
16	Vaavu Atoll Hospital	Felidhoo / V. Atoll	Government	Atoll	2025
17	Faafu Atoll Hospital	Nilandhoo / F. Atoll	Government	Atoll	2025
18	Dhaalu Atoll Hospital	Kudahuvadhoo / Dh. Atoll	Government	Atoll	2025
19	Thaa Atoll Hospital	Veymandoo / Th. Atoll	Government	Atoll	2025
20	Gaafu Alifu Hospital	Villigili / GA. Atoll	Government	Atoll	2025
21	Fuvamulah Atoll Hospital	Fuvamulah / GN. Atoll	Government	Atoll	2025
22	Hulhumale Hospital	Hulhumalé	Government	Other	2025
23	ADK Hospital	Malé	Private	Private	2025
24	Tree Top Hospital	Hulhumalé	Private	Private	2025
25	Medica Hospital	Malé	Private	Private	2025
26	Medlab Diagnostics Pvt Ltd.	Malé	Private	Private	2025
27	Mediflex Laboratories	Malé	Private	Private	2025
28	Senahiya Military Hospital	Malé	Government	Military	2025

Starting in 2025, AMR surveillance will be conducted in the above-mentioned facilities (**Table 1**). During the initial implementation period (2025 – 2027) potential additional sites will be formally assessed and evaluated for potential inclusion in the second period (2028 – 2030). The addition of sites will depend on the results of the evaluation, epidemiological needs, and availability of resources and funds. In the first quarter of each year an AMR Surveillance Program evaluation will be completed to assist planning for continuation of the program.

During December 2024, and in preparation for the initiation of surveillance, sensitization and training of trainers (TOT) on the AMR surveillance strategy and technical procedures (data collection, data analysis)

were conducted for hospital administration and relevant clinical and laboratory personnel from the selected sentinel sites, as well as the central team. The hospitals and clinical microbiology laboratories selected for the AMR surveillance and WHONET[1] TOT training were chosen in consultation with the Maldives Quality Assurance and Regulation Division (QARD) and MFDA. Hospital administrators will be requested by the Ministry of Health to designate AMR surveillance focal point persons from both the clinical and laboratory departments at each sentinel site and ensure that the program can be actively promoted (as per the *Form for Site Enrollment and Nomination of Focal Points for AMR Surveillance*, **Appendix C**). Laboratories will be trained on surveillance and reporting requirements and procedures, culture, identification, and AST, quality control, external quality assurance, data reporting, data analysis, and all relevant standard operating procedures (SOPs) as needed (see **Appendix H** for a list of SOPs).

Additional meetings or trainings will be held to familiarize clinicians with good specimen collection practices, increase awareness of the national AMR surveillance program, allow laboratorians to review the format and implications of AST results provided to clinicians, alert clinicians to the availability of hospital AMR data, and foster clinician-laboratory communication for discussion of AMR organisms in individual patients, the hospital system, and the region. Ongoing mentorship and technical support will be provided by the National AMR Surveillance Data Center (NDC-AMR) and the National Reference Laboratory for AMR Surveillance (NRL-AMR).

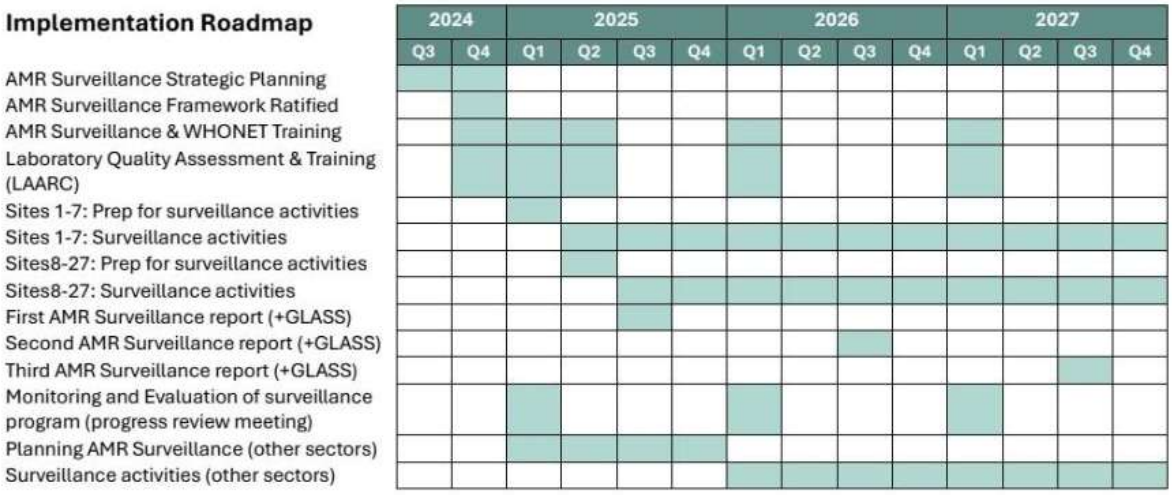


Figure 2: Road map for roll-out of the Maldives Antimicrobial Resistance Surveillance System

Priority Specimens and Organisms for National AMR Surveillance

The Maldives National AMR surveillance system collects microbiology data and clinical information from all participating surveillance sites on all bacterial and fungal pathogens isolated by culture methods from all specimen types as part of routine patient care. For all inpatient and outpatient specimens positive for such organisms, patient and laboratory data should be reported to the AMR surveillance system database.

For routine data analysis and standardized public health reporting, it focuses then on the following bacterial and fungal AMR priority pathogens of public health and national importance (enhanced surveillance):

- *Escherichia coli (E. coli)*
- *Klebsiella pneumoniae (K. pneumoniae)*

[1] WHONET Microbiology Laboratory Database Software, https://whonet.org

- *Salmonella* spp. (non-typhoid)
- *Pseudomonas aeruginosa (P. aeruginosa)*
- *Acinetobacter* spp.
- *Neisseria gonorrhoeae (N. gonorrhoeae)*
- *Staphylococcus aureus (S. aureus)*
- *Streptococcus pneumoniae (S. pneumoniae)*
- *Enterococcus faecalis (E. faecalis)*
- *Enterococcus faecium (E. faecium)*
- *Candida* spp.
- *Mycobacterium tuberculosis.*

The decision for inclusion of these pathogens was made based on the clinical significance of the pathogen, public health impact, amount of data available, current knowledge gaps, and ease of testing.

In 2018 the Maldives enrolled in the global AMR surveillance system (GLASS). For GLASS, WHO requests data on the following bug-drug combinations (**Table 2**):

Table 2: Priority Specimens and Organisms for submission to GLASS

Specimen	AMR Priority Pathogen (GLASS)
Blood	• *E. coli* • *K. pneumoniae* • *A. baumannii* • *S. aureus* • *S. pneumoniae* • *Salmonella* spp.
Urine	• *E. coli** • *K. pneumoniae** *Must have significant growth of ≥10^5 CFU/mL
Stool	• *Salmonella* spp. • *Shigella* spp.
Urethra and Cervical Swabs	• *N. gonorrhoeae*

The drug-bug combinations for which the WHO has requested data, if available, are listed in **Table 3**. In addition to these antibiotics, other antibiotics that are commonly prescribed or available for treating infections may be tested after consultation with referring hospitals or subject experts.

Table 3: Priority Pathogens and Antimicrobial Test Combinations. Based on WHO Global Antimicrobial Resistance Surveillance System (GLASS) and national priorities.

Pathogen	Antimicrobial Class	Agents recommended for AST Testing
Escherichia coli	• Sulfonamides and trimethoprim • Fluoroquinolones • Third-generation cephalosporins • Fourth-generation cephalosporins • Carbapenems • Polymyxins • Penicillins	• Co-trimoxazole • Ciprofloxacin or levofloxacin • Ceftriaxone or cefotaxime and ceftazidime • Cefepime • Imipenem, meropenem, ertapenem, or doripenem • Colistin • Ampicillin
Klebsiella pneumoniae	• Sulfonamides and trimethoprim • Fluoroquinolones • Third-generation cephalosporins • Fourth-generation cephalosporins • Carbapenems • Polymyxins	• Co-trimoxazole • Ciprofloxacin or levofloxacin • Ceftriaxone or cefotaxime and ceftazidime • Cefepime • Imipenem, meropenem, ertapenem, or doripenem • Colistin
Acinetobacter baumannii	• Tetracyclines • Aminoglycosides • Carbapenems • Polymyxins	• Tigecycline or minocycline • Gentamicin and amikacin • Imipenem, meropenem, or doripenem • Colistin

Staphylococcus aureus	• Penicillinase-stable beta-lactams	• Cefoxitin
Streptococcus pneumoniae	• Penicillins • Sulfonamides and trimethoprim • Third-generation cephalosporins	• Oxacillin, Penicillin G • Co-trimoxazole • Ceftriaxone or cefotaxime
Salmonella spp.	• Fluoroquinolones • Third-generation cephalosporins • Carbapenems	• Ciprofloxacin or levofloxacin • Ceftriaxone or cefotaxime and ceftazidime • Imipenem, meropenem, ertapenem or doripenem
Shigella spp.	• Fluoroquinolones • Third-generation cephalosporins • Macrolides	• Ciprofloxacin or levofloxacin • Ceftriaxone or cefotaxime and ceftazidime • Azithromycin
Neisseria gonorrhoeae	• Third-generation cephalosporins • Macrolides • Aminocyclitols • Fluoroquinolones • Aminoglycosides	• Cefixime, Ceftriaxone • Azithromycin • Spectinomycin • Ciprofloxacin • Gentamicin

Monitoring and Evaluation

Monitoring and evaluation of the Maldives National AMR Surveillance System will begin already during the first year of surveillance (Q1 2025, see **Figure 2**). Prior to that time, a monitoring and evaluation team will be identified with representation from the NACC, TSC-AMR Surveillance, NDC-AMR, NRL-AMR, QARD, HPA and selected surveillance site laboratories, and surveillance site clinical departments. The monitoring and evaluation team will collaboratively design a program monitoring and evaluation strategy that will be used to describe performance and determine the overall effectiveness of the program.

The AMR surveillance monitoring and evaluation strategy will use a PDCA-approach (Plan, Do, Check, Act, also known as Deming cycle), and may include e.g. the following components:

- PLAN:
  - Restate the overall AMR surveillance goals and objectives (see above, page 5)
  - Implementation Roadmap (for milestones and timelines (see above, Figure 2)
  - For each program objective: to identify one or more key performance indicators (KPIs) to measure success (e.g., "Quarterly data file submitted for Q1 2025 from .. out of .. sites (..%)", or: "First AMR Surveillance report available as a draft").
- DO:
  - Assign responsibility for collecting baseline data on KPIs and milestones to one or more member(s) of the M&E team.
  - M&E team to establish baseline data on all KPIs.
- CHECK:
  - M&E team to conduct a review meeting to analyze and interpret the M&E baseline data to identify obstacles and challenges, and areas for improvement for the AMR surveillance program.
  - M&E team to use data visualization tools (e.g. PowerPoint slides, or a dashboard) to present the findings in an easily understandable format.
  - M&E team to prepare a report to share findings with stakeholders
- ACT:
  - Use the insights gained from monitoring to make informed decisions
  - Implement changes to enhance the effectiveness of the Maldives AMR Surveillance program
  - Periodically review and adjust the monitoring strategy to ensure it remains relevant

A formal surveillance system evaluation using an established framework will be included as one part of this program evaluation (CDC, 2001). Results of surveillance evaluations will be published annually to assist

decision makers in making adjustment to the Maldives AMR surveillance system for the next year. This monitoring and evaluation process will be repeated annually (**Figure 2**).

Surveillance System Sustainability and Resource Dedication

The Maldives Ministry of Health (MoH) has made a commitment to fund and support the Maldives AMR Surveillance System during and after the initial 2025–2027 implementation period. This commitment is mandated at policy level. In review of the final AMR Surveillance System evaluation and in light of national priorities, MoH will determine the extent this commitment will be maintained into the future.

METHODOLOGY AND STANDARDS

Clinical Specimens

Specimen Submission Methods

As part of routine clinical care, clinicians at surveillance hospitals and health centers will send specimens for culture and AST from patients with suspected infection to the laboratory. The AMR surveillance laboratory director will ensure that clinicians have the appropriate containers and materials for specimen collection and that an adequate supply of these materials is maintained at all times. The AMR surveillance laboratory director will provide clinicians and other healthcare workers with the SOP *Specimen Collection* and the laboratory requisition form (example in **Appendix D**). The laboratory requisition form will collect patient-level clinical data that will then be submitted with each clinical specimen to the corresponding diagnostic laboratory:

- Hospital / Health Center Name
- Referring / Ordering Clinician
- Patient Name
- Unique Patient Identifier (e.g. Patient Medical Record Number)
- Date of Birth (DoB)
- Sex
- Patient Location Type (inpatient / outpatient)
- Patient Ward / Location
- Patient Admission Date / Visit Date
- Specimen Type
- Date of Specimen Collection

Specimen Quality Standards

In keeping with standard laboratory practice, specimens that do not meet laboratory acceptance criteria should be rejected by the laboratory. The laboratory manager of the testing laboratory should engage the hospital clinical team, laboratory team, hospital quality assurance team, and the antimicrobial stewardship/IPC committee to review and agree upon measures to improve collection procedures as stipulated in the SOP *Specimen Collection*.

Laboratory Methods and Standards

Pathogen Isolation, Identification, and AST

Laboratories participating in AMR surveillance, conducting patient sampling, specimen culturing, isolate identification, and AST, should operate in accordance with current CLSI guidelines (CLSI, 2024). Where CLSI guidelines are not available, laboratories should use EUCAST guidelines (EUCAST, 2024). Standard operating procedures (SOPs) adhering to current CLSI guidelines (or EUCAST guidelines, where applicable) will be provided by the National Reference Lab for AMR (NRL-AMR).

For routine AST, preferably a semi-automated method should be used, resulting in a minimum inhibitory concentration (MIC) test result. Alternatively, or where recommended or required, a manual AST testing method (disc diffusion/Kirby Bauer)) is also acceptable, resulting in an inhibition zone diameter (IZD). Gradient diffusion tests (e.g. E-Test) may also be used.

The NRL-AMR will ensure that laboratory staff are trained on culture and AST methods and able to recognize unusual or unexpected findings in routine samples. When a new drug is introduced into clinical practice, laboratories should routinely test susceptibility to the drug in order to identify emerging resistance. In

addition to susceptible (S), intermediate (I), and resistant (R) classifications, minimum inhibitory concentration and inhibition zone diameter test results will be recorded by participating laboratories.

Quality Control and External Quality Assurance

As per the National Standards for Clinical Laboratories (MoH-Lab, 2022), AMR Surveillance laboratories are required to perform routine quality control of all bacteriology and mycology practices. All aspects of laboratory testing required to isolate and identify an infectious agent and to detect resistance must be quality controlled according to appropriate WHO manuals and CLSI/EUCAST guidelines, including but not limited to specimen collection, culture technique, species identification, and AST. Records must be maintained, including but not limited to temperature monitoring, media QC, reagent QC, and AST QC.

AMR Surveillance laboratories will review the components of their QC system with the NRL-AMR in their initial assessment. The NRL-AMR will coordinate procurement and supply of all American Type Control Culture (ATCC) Strains required for routine media, reagent, and AST QC. QC data records (e.g., testing of batch/lot of media, reagents, discs) should be kept and available for review with the AMR Surveillance Coordinators as requested.

The NRL-AMR will work to facilitate AMR surveillance laboratory participation in EQA, review EQA performance of participating laboratories, and provide feedback on EQA results to laboratories. The NRL-AMR, as well as all AMR surveillance site laboratories, are required to participate in an EQA program approved by the TSC-AMR Surveillance. The following EQA programs are considered as pre-approved by the TSC-AMR Surveillance: PPTC[2], UK NEQAS[3], CAP-Pt[4], and ACP-MLE[5]. A score of above 80% on each round is considered acceptable. At least annually, EQA results for each participating surveillance site will be reviewed by the TSC-AMR Surveillance to determine continued consideration of the site's AMR data for AMR surveillance.

EQA panels will be provided twice a year, and sites must score above 80% on each round in order to remain within the surveillance network.

Isolate Repository and Confirmatory Testing

The NRL-AMR at IGMH will serve as the national repository for priority AMR isolates from all participating laboratories. Once a month, sites will send all AMR priority isolates to the NRL-AMR for isolate repository. Prior to and during transport, isolates will be stored, in accordance with SOP *Isolate Repository and Confirmatory Testing*, at -70°C, and -20°C, respectively. The repository will be equipped with ultra-low freezers (-80°C), generator and a robust electronic specimen tracking system with bar-coding to allow for retrieval of bacterial isolates overseen by a freezer manager. This resource will be a key asset in promoting nationally relevant research as it will house isolates from all participating laboratories and sources in the AMR surveillance network. Twice a year, 10% of the AMR priority isolates sent for repository will undergo confirmatory testing (reverse EQA). The NRL-AMR will investigate any discrepant results for correction.

Laboratory Supply Procurement and Equipment Maintenance

The AMR surveillance laboratory director at each surveillance site will be responsible for procuring necessary supplies, media, and reagents needed for AMR surveillance. The NRL-AMR will maintain a list of quality supplies and suppliers. Where purchase of prepared media and reagents is required, surveillance laboratories should coordinate with the NRL-AMR to identify and obtain good commercially prepared

[2] Pacific Pathology Training Center EQA program (PPTC)
[3] United Kingdom National External Quality Assessment Service (UK NEQAS)
[4] College of American Pathologists Proficiency Testing program (CAP-Pt)
[5] American College of Physicians – Medical Laboratory Evaluation program (ACP-MLE)

options. Shelf-life and consistency of supply should be considered when assessing commercial media purchases. In-house production of culture media is acceptable, as long as all applicable QC measures are implemented.

Laboratories participating in the Maldives AMR Surveillance System are responsible for ensuring appropriate inventory management of all necessary reagents and supplies such that isolation, identification, and AST of priority pathogens can be conducted at all times. Surveillance laboratories are also responsible for adhering to and keeping records of proper equipment maintenance and repairing or replacing equipment when needed. The NRL-AMR will provide training support for inventory management, supply purchasing, and equipment maintenance to the surveillance laboratories, as needed.

All laboratories participating the Maldives AMR Surveillance System are strongly encouraged to assess the capacity of the laboratory to identify AMR priority pathogens and to conduct antimicrobial susceptibility testing in a systematic way. Such an assessment should ideally happen before AMR surveillance activities are initiated and be repeated/updated e.g. on an annual basis. The CDC LAARC tool (Laboratory Assessment of Antibiotic Resistance Testing Capacity) is recommended to be used (CDC-LAARC, 2024).

Data Reporting

An overview of AMR surveillance data flow is provided in **Figure 3:**

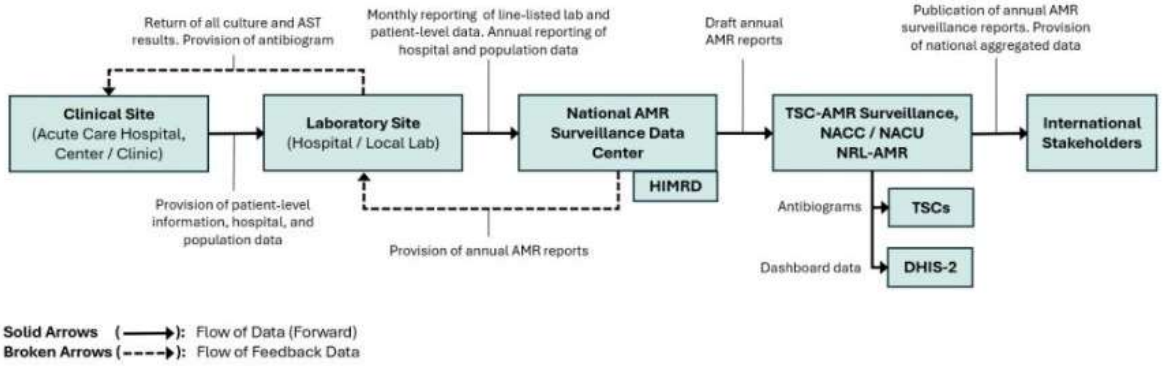


Figure 3: Diagram of antimicrobial resistance (AMR) surveillance data flow within the Maldives AMR Surveillance System

Surveillance Site Reporting

To allow for efficient AMR data collection, AMR surveillance sites are required to use a laboratory information management system (LIMS) to capture clinical bacterial and fungal culture and AST results.

- The LIMS is either a stand-alone IT system, or a module of the HIMS (Hospital Information Management System).
- The LIMS should be electronically interfaced (bi-directional) with the HIMS (if LIMS is separate system than HIMS)
- The LIMS should be electronically interfaced with all semi-automated ID/AST machines (e.g., VITEK® 2, BACT/ALERT®) in the microbiology lab.

Laboratories will enter patient-level laboratory results into the LIMS and return the relevant laboratory culture ID and AST results to the clinical teams for routine patient care.

Although laboratory data alone (e.g. organism and AST of all isolates) could be reported to the AMR surveillance system in what is referred to as laboratory-based or isolate-based surveillance, it is more

informative to include some clinical data which is specifically linked to a patient's infection. This is referred to here as **patient-based surveillance**, and this is the approach chosen for the Maldives.

At defined intervals (e.g., monthly), AMR surveillance sites will export AMR surveillance data from the HIMS/LIMS to a data file.

- The exported data file should include final/validated AMR data for all isolates, all patients (including inpatients and outpatients), all specimen types, and all antibiotics tested.
- The data file should include the data fields (as available) listed in **Appendix E**.
- If technically possible to exclude, the extracted data file should not include the patient's name.
- If technically possible to exclude, the extracted data file should not include non-clinical data (e.g., screening isolates, quality control isolates (ATCC), outbreak analysis data, environmental IPC isolates).
- The HIMS/LIMS extracted data file should be generated by the IT-Department at the site, as a line-listed data file. The file should be in vertical format, i.e., the antibiotics of one isolate require more than one row of data; and appear in variable antibiotic sequence (see sample data file in **Appendix F**).
- The preferred data file format is Microsoft Excel® (*.xlxs), but other data formats are also acceptable, including text files (*.txt), comma-separated-value data files (*.csv), and WHONET SQLite data files (*.sqlite).
- A data extraction from semi-automated AST machines (e.g., VITEK® 2, BD Phoenix®) is also acceptable, but only in case an extraction from the HIMS/LIMS is technically not possible.
- Per the SOP *AMR Data Management*, AMR data files should be submitted using a uniform filename format that includes the three- or four-character laboratory code that has been designated for each year, laboratory, and month. For example, "2025-IGMH-01.xlsx" would be the name of the January 2025 AMR data file for IGMH laboratory, whereas "2025-HMH-Q1.xlsx" would be the name of the 2025 quarter 1 (Jan-Mar) AMR data file for Hulhumalé Hospital.
- Each laboratory must also save all electronic files on a local computer or data server as a back-up.

The AMR data file will be forwarded/uploaded by the AMR Surveillance Focal Point to the National AMR Surveillance Data Center (NDC-AMR) at HPA.

- Data file upload should be through the DHIS-2 platform for all Surveillance Sites having access to the DHIS-2 platform.
- For other AMR surveillance sites, not participating in DHIS-2, the AMR data files should be forwarded by E-Mail attachment, or by data file upload to NDC-AMR server, using a secure file transfer protocol (SFTP).
- Submission of paper-based reporting forms (hard copies) is not accepted.

Surveillance site laboratories may either convert their local AMR data files themselves to WHONET SQLite data files (using the BacLink tool) or can request the National AMR Surveillance Data Center to share the final WHONET SQLite data file for their facility with them.

The data manager at the National AMR Surveillance Data Center (NDC-AMR) and the NRL-AMR will assist laboratories in data management setup and training. Procedures for data entry, storage, and export/transfer, and import to WHONET (BacLink Tool) are provided in the SOP *AMR Data Management*.

The following should also be reported annually, in order to calculate denominators:

- Total number of specimens processed for each priority specimen type
- Total number of culture-negative specimens for each priority specimen type

Once a year, surveillance laboratories will be asked to provide meta data such as updated estimates of hospital and population data, including:

- Number and demographics of patients seeking care (separately for inpatient and outpatient)
- Size and demographics of population served by hospital / lab
- Lab accreditation status

Data Quality Standards

Data validity: The validity and efficiency of data collection, transmission, and analysis is a principal concern of any surveillance program. Prior to transmitting the AMR raw data files to the NDC-AMR, the AMR data files will be reviewed by the AMR surveillance focal point person at the surveillance site to ensure that data is clean, complete, plausible, valid, and in line with AMR surveillance system reporting requirements.

In addition, at the NDC-AMR level, the submitted AMR data files are also reviewed by the central team to ensure the data is clean, complete, plausible, valid, and in line with AMR surveillance system reporting requirements. Data files not meeting the requirements are rejected and resubmitted, until an acceptable submission is achieved.

Deduplication: Patient-based surveillance strives to count the AST profiles of each individual infection only once. For example, if a patient with sepsis had blood cultures drawn at two separate times throughout the course of their infection, and *E. coli* was isolated from both of their blood cultures, the results of both the first and second *E.coli*-positive blood cultures would be returned to the clinicians, but only the results of the first *E. coli*-positive blood culture would be reported into the AMR surveillance system. If the same patient has a subsequent blood culture positive for a different organism (e.g., *K. pneumoniae*), or if the original organism is later found in another specimen type (e.g., *E. coli* in urine), both these incidents would be counted as separate infections and each reported to the AMR surveillance system. Repeat culture and AST results from a duplicate or subsequent specimen should still be included in the data file submission to the NDC-AMR and are then excluded from data analysis and are not considered for generation of AMR surveillance reports. De-duplication of non-unique infections will be routinely and dynamically performed by the data manager at the NDC-AMR during data analysis, using the WHONET "One-Isolate-per-Patient" option, either with the "first isolate" option, or the "first isolate, with antibiotic results" option, as applicable (see SOP *AMR Data Analysis and Reporting*).

Antibiogram Creation

On an annual basis, for each calendar year (1 Jan to 31 Dec), all surveillance hospitals will generate their hospital's cumulative antibiogram (CA), using their own local AMR data. If requested by the local Antimicrobial Stewardship (ASP) and/or Infection Prevention and Control (IPC) Committee, the CA could also be generated more frequently, e.g. semi-annually. Alternatively, a "rotating" antibiogram is also possible, reflecting the AMR data of the past 12 months (requires monthly AMR data extraction, with the CA being updated on monthly basis).

- Cumulative antibiograms may be easily generated using the WHONET software (Data analysis → Quick analysis → Epidemiology report), to be amended by manual analysis as applicable (see SOP *AMR Data Analysis*).
- The cumulative antibiogram is presented as a routine antibiogram (all isolates (non-duplicated)/all specimen types).
- In addition, the CA may be presented as an enhanced antibiogram, i.e. stratified by e.g., location type (inpatient/outpatient), functional unit (e.g. ICU), clinical specialty, infection site, resistance phenotype, etc.
- The cumulative antibiogram is separated into Gram-negative and Gram-positive organisms.

- The cumulative antibiogram is presented in line with CLSI guideline M39-A5 (5th edition, 2022) (CLSI-M39, 2022).
- A template for a cumulative antibiogram is provided in **Appendix G**.

The cumulative antibiogram should be shared with the relevant clinical departments and hospital committees at the hospital in order to increase understanding of AMR organisms prevalent in that hospital and community, to impact treatment policies at the health facility, and to encourage continued participation in the surveillance system. Guidance on how to create hospital antibiograms will be provided to each laboratory by the data manager at the NDC-AMR. The CLSI M39-A5 guideline should also be referenced for antibiogram creation.

National and Global Reporting

AMR data from surveillance sites will be centrally stored and managed at the NDC-AMR, which will be responsible for conducting data quality checks and data analysis, generating official AMR surveillance reports, and providing long-term data storage. Data files received from surveillance laboratories will be reviewed for data quality, completeness, plausibility, and validity and will undergo any necessary cleaning, but not deduplication prior to importation into the nationwide database. The nationwide database will be backed-up monthly by the data manager at the NDC-AMR.

The NDC-AMR will aggregate and analyze AMR surveillance data annually and when indicated (e.g. special interim reports, focused analyses). The following reports will be generated and distributed to surveillance hospitals, NACC/NACU, and national/international stakeholders (as applicable) to inform them of the status of AMR in their respective regions and hospitals:

Table 4: AMR Surveillance Reports generated by the NDC-AMR

Nr.	Report	Target Audience	Frequency
1	AMR Epidemiology Report (site-specific)	Surveillance Hospitals	Annually
2	AMR Test Practices and Quality Report (site-specific)	Surveillance Hospitals	Annually
3	National AMR Surveillance Report	All Stakeholders	Annually
4	Other reports, e.g. specific reports or antibiograms to inform the development of empiric antimicrobial treatment guidelines	As applicable	Ad hoc

Reporting of aggregate national and regional AMR data may be used to efficiently prioritize resources and inform policies directed at control of antimicrobial resistance.

The following aggregated data will be included in the reports for each priority specimen type (i.e., blood, urine, stool, etc.):

- Total number of submissions of that specimen type
- Number of culture-negative submissions of that specimen type
- Number of submissions positive for each priority pathogen, by:
  - Pathogen type
  - Patient age group
  - Patient sex
  - Time in hospital at time of specimen collection (≤ 2 days OR > 2 days)
- All AST results for each priority organism-specimen combination, by:
  - Patient age group
  - Patient sex
  - Time in hospital at time of specimen collection (≤ 2 days OR > 2 days)

Every 12 months, data from all AMR surveillance sites will be aggregated and reported to the WHO, in accordance with the WHO Global Antimicrobial Surveillance System (GLASS) protocol. Reporting of national aggregate AMR data to WHO and other international stakeholders, will help ensure that the AMR situation in the Maldives is accurately appreciated by the global health community.

ROLES AND RESPONSIBILITIES

National Technical Sub-Committee for AMR Surveillance (TSC-AMRS)

Chair and Co-Chair, TSC-AMRS

- Proactively coordinate all TSC Surveillance committee meetings
- Oversee national AMR surveillance strategies and activities in the Maldives
- Represent the national AMR surveillance program in meetings, conferences, stakeholder meetings and other relevant national and international forums
- Coordinate the selection of surveillance sites (clinical and laboratory)
- Coordinate cross-sector protocols and reporting mechanisms
- Source funding through grants and partnerships
- Liaise with the national government
- Engage with national and international stakeholders
- Set minimum requirements for inclusion in AMR surveillance
- Lead and coordinate the implementation of the AMR surveillance framework in the country
- Oversee AMR surveillance data management and reporting
- Report AMR data to key regional, national and international stakeholders
- Provide interpreted data for use in guiding policies and guidelines
- Facilitate linkages with AMR surveillance across human health, animal health, food and environmental sectors (One Health context)
- Finalize annual aggregate AMR Reports to be shared with WHO and other stakeholders as needed

National Data Center for AMR Surveillance (NDC-AMR)

AMR Surveillance Coordinator(s)

- Facilitate all surveillance activities in the surveillance network including enrollment of sites
- Maintain a Master data sheet with meta data for all participating surveillance sites and labs
- Provide standardized standard operating procedures (SOPs) to sites including guidance and information on AMR data collection and reporting
- Ensure SOPs to be used by individual laboratories for AMR surveillance, are harmonized
- Provide initial AMR trainings and mentorship to sentinel sites
- Conduct periodic mentorship/monitoring visits to ensure SOPs are being followed
- Perform annual surveillance program evaluations including evaluations of AMR sentinel site level implementation
- Provide feedback to AMR surveillance sites in collaboration with the National Reference Laboratory
- Engage in overall quality assurance of the implementation of AMR surveillance including sustainable supply chain management

AMR Data Manager / IT Specialist(s)

- Assist surveillance site laboratories in data management setup, training, and troubleshooting

    - Ensure LIMS/HIMS, WHONET, MS Office, and other tools (DB Browser for SQLite) are installed at sites
    - Train on data entry, transmission, and manipulation (e.g. how to compile AST results and antibiograms using WHONET
    - Assist sites with troubleshooting WHONET problems
- Provide sites with guidance on how to create internal hospital aggregated reports
- Maintain the national AMR surveillance database
- Ensure sites send raw, line-listed data as per agreed frequency (e.g., monthly)
- Work with AMR surveillance sites to enforce data quality standards and proper data collection policies and procedures
- Review AMR data and ensure that data reported meets AMR surveillance system requirements
- Perform data cleaning (but not de-duplication[6]) prior to compilation of national AMR data and long-term storage
- Maintain data back-ups
- Perform data analyses and prepare annual and ad hoc site-specific and national AMR reports
- Conduct periodic data verification visits which will compare source data and system data
- Conduct periodic evaluation of data from facilities
- Ensure any WHONET software updates are properly rolled out at sites

National Reference Laboratory for AMR (NRL-AMR)

- Serve as a resource and coordination point for laboratory expertise and share information and advice with relevant stakeholders
- Liaise with the National Data Center for AMR Surveillance (NDC-AMR) and the Technical Sub-Committee for AMR Surveillance (TSC-AMRS)
- Provide standardized standard operating procedures (SOPs) to sites including guidance and information on microbiology lab procedures (specimen collection, ID, AST)
- Develop, maintain, and share relevant reference materials
- Promote good laboratory practice and provide guidance and technical support for quality management, pathogen isolation and identification and antimicrobial susceptibility testing (AST) methodology
- Support capacity building of laboratories serving AMR surveillance sites through oversight and training
- Organize or facilitate participation in external quality assurance (EQA) schemes for laboratories serving AMR surveillance sites
- Review EQA performance of participating laboratories
- Provide feedback on EQA results to laboratories and assist sites to identify and address root causes for EQA error
- Perform confirmatory testing for 10% of AMR isolates collected from all sites
- Perform additional advanced tests as needed on AMR isolates from the sites
- Coordinate transport of AMR surveillance isolates from testing laboratories to NRL for repository and confirmatory testing
- Serve as the national repository of priority isolates from all participating laboratories

[6] De-duplication takes place dynamically during WHONET analysis (One-per-Patient option)

AMR Surveillance Sites (Hospitals, Health Centers, and Laboratories)

Hospital Administration

- Ensure that there are adequate staff and physical infrastructure in place to perform surveillance activities
- Assign a laboratory and/or clinical focal person, with a commitment to AMR
- Ensure clinicians have appropriate containers and specimen collection materials
- Provide staff with the SOP *Specimen Collection* and laboratory requisition forms
- Ensure frequent communication between the clinical focal personnel and laboratory
- Provide NDC-AMR *with annually* updated estimates of hospital and population data
- Review and disseminate AMR surveillance reports at the facility level
- Establish one or more hospital committees (e.g., Infection Control Committee, AMR Committee, and/or Antimicrobial Stewardship Committee), consisting of clinicians, microbiologists, laboratory technologists, pharmacists, and IPC nurses to meet quarterly.

Hospital Committee (e.g. Infection Control Committee, AMR Committee, or Antimicrobial Stewardship Committee)

NOTE.: A hospital committee could be as simple as the clinical and laboratory AMR focal points with representatives from hospital administration.

- Liaise between hospital clinical and laboratory teams
- Convene quarterly to discuss how to address challenges associated with specimen collection, specimen transport, results, reporting
- Provide feedback on system and individual performance to the members of the surveillance system at the hospital
- Review reports and make recommendations to the hospital administration
- Share data and recommendations with additional committees and staff members
- Ensure specimens are collected according to the SOP *Specimen Collection*

Clinicians (doctors, clinical officers and nurses)

- Request the necessary laboratory tests based on the symptomatic and clinical diagnosis
- Submit and transport priority specimens per approved specimen collection SOP
- Complete laboratory requisition forms (**Appendix D**) consistently and correctly with the required clinical data

Laboratory Technologists

- Identify the pathogen accurately and perform the AST according to the relevant SOPs
- Return routine culture results to the requesting hospital/clinicians in a timely manner
- Track and keep records of rate of specimen rejection and rates of contamination
- Maintain proficiency testing standards and conduct root cause analysis and correction when failure occurs
- Manage inventory of all necessary reagents
- Adhere to and keep records of proper equipment maintenance

Lab Focal Person for AMR

NOTE: This individual is typically a laboratory technologist who is also trained on WHONET.

- Input data into the facility LIMS/HIMS
- Submit line-listed data to the NDC-AMR, as per agreed frequency
- Send 10% of all identified AMR priory pathogen isolates to the NRL-AMR as outlined in the SOP "Isolate Repository and Confirmatory Testing"
- With assistance from NDC-AMR data manager use WHONET to produce antibiogram for hospital
- Train new staff on AMR surveillance system, data reporting, and AMR specific SOPs when necessary

Laboratory Manager / Clinical Microbiologist

- Assign a laboratory focal person, with a commitment to AMR
- Liaise between hospital clinical and laboratory teams
- Ensure adherence to SOPs in the bacteriology and mycology laboratory
- Review all positive culture results prior to returning to hospitals/ordering clinicians
- Review and approve submissions of AMR data to NDC-AMR
- Perform supervisory review for out-of-range QC results and document corrective action that was taken on all QC failures
- Review EQA results and conduct root cause analysis and correction when failure occurs
- Share hospital antibiogram with the relevant clinical departments and hospital committees
- Ensure appropriate inventory management of all necessary reagents and supplies such that isolation, identification, and AST of priority pathogens can be conducted at all times.
- Calculate and send hospital administration and procurement department annual laboratory supply needs
- Ensure equipment are in good working order, schedule maintenance and repairs, and replace equipment when needed
- Manage major microbiology equipment service contracts for laboratory

International Stakeholders

- Support Maldives in building laboratory capacity to identifying and report AMR organisms
- Provide technical (e.g. trainings, mentorship, assessments) and material (e.g. reagents, equipment) support towards implementation of AMR surveillance in Maldives
- In consultation with the NACC/NACU (MoH), TSC-AMRS, and NDC-AMR, include Maldives AMR data in global reporting of AMR burden.

APPENDICES

Appendix A: Acronyms and Abbreviations

ACP-MLE	**American College of Physicians – Medical Laboratory Evaluation program**
AMR	**Antimicrobial resistance**
AMU	**Antimicrobial usage**
ASP	**Antimicrobial Stewardship Program**
AST	**Antimicrobial Susceptibility Testing**
ATCC	**American Type Culture Collection**
CA	**Cumulative Antibiogram**
CAP-Pt	**College of American Pathologists Proficiency Testing program**
CFU	**Colony-forming Units**
CLSI	**Clinical & Laboratory Standards Institute**
CSV	**Comma-separated value**
DoB	**Date of Birth**
EUCAST	**European Committee on Antimicrobial Susceptibility Testing**
EQA, EQAS	**External Quality Assurance (System)**
HIMRD	**Health Information Management and Research Division**
HIS, HIMS	**Hospital Information (Management) System**
HPA	**Health Protection Agency**
I	**Intermediate**
IGMH	**Indira Ghandi Memorial Hospital**
IPC	**Infection Prevention and Control**
IZD	**Inhibition zone diameter**
LAARC	**Laboratory Assessment of Antibiotic Resistance Testing Capacity**
LIS, LIMS	**Laboratory Information (Management) System**
MFDA	**Maldives Food and Drug Authority**
MIC	**Minimum inhibitory concentration**
MoH	**Ministry of Health**
MNU	**Maldives National University**
MRN	**Medical Record Number**
MRSA/MSSA	**Methicillin-resistant (-susceptible) Staphylococcus aureus**
NACC	**National AMR Coordinating Committee**
NACU	**National AMR Coordination Unit**
NDC-AMR	**National Data Center for Antimicrobial Resistance Surveillance**
NMSC	**National Multi-Sectorial Steering Committee for AMR**
PDCA	**Plan, Do, Check, Act (Deming Cycle)**
PPTC	**Pacific Pathology Training Center (PPTC) EQA program**
QARD	**Maldives Quality Assurance and Regulation Division**
QC	**Quality Control**
S	**Susceptible**
SFTP	**Secure file transfer protocol**
SOP	**Standard Operating Procedure**
R	**Resistant**
TSC	**Technical Sub-Committee**
WHONET	**Microbiology Laboratory Database Software, https://whonet.org**
TOT	**Training Trainers**

Appendix B: Laboratory Requirements for AMR Surveillance Participation

Capacity	Minimum requirements
Technical	• Capacity to identify priority organisms and perform AST in accordance with internationally recognized methods and standards, e.g., CLSI or EUCAST
Quality assurance	• All aspects of laboratory testing required to isolate and identify an infectious agent and to detect resistance must be controlled for quality according to appropriate WHO manuals and CLSI or EUCAST guidelines, including but not limited to specimen collection, culture technique, species identification, and AST • Utilize a quality management system recognized by the NRL-AMR to ensure the accuracy, reliability and timeliness of reported results • Maintain rigorous quality control records for potential review by NRL-AMR, NDC-AMR, and TSC-AMRS
Proficiency testing	• Ongoing, regular participation in an accredited bacteriology and mycology EQA program, including organism ID and AST • Ongoing, regular participation in a proficiency testing scheme that covers organism ID and AST and is recognized/endorsed by the NRL-AMR and international standards • Demonstrate consistent successful performance in the proficiency testing scheme
Data management	• Maintains records of inhibition zone diameters and/or minimum inhibitory concentrations • Make commitment to collect and report good-quality data in accordance with reporting timelines • Dedicate time for staff member(s) to regularly input, analyze, and report data

Appendix C: Form for Site Enrolment and Nomination of Focal Points for AMR Surveillance

Maldives National AMR Surveillance System Site Enrollment and Nomination of Focal Points	Ministry of Health Republic of Maldives

Document purpose	• To enroll healthcare facilities as AMR surveillance sites • Nomination of authorized focal points for AMR surveillance • To update focal point information and contact details		
Document Ref. No.	MoH/AMRS/01	**Version**	1.0 (01/01/2025)
Healthcare Facility			
Facility Name		Island	
Licensing No.		Atoll	
Focal Point(s) for AMR Surveillance			
Focal Point 1	Full name		
	Job title		
	Department		
	Tel. (direct)	Tel. (mobile)	
	E-Mail		
Focal Point 2	Full name		
	Job title		
	Department		
	Tel. (direct)	Tel. (mobile)	
	E-Mail		

Enrollment

• The above-mentioned healthcare facility is hereby enrolling/already enrolled as a surveillance site/laboratory in the Maldives National Antimicrobial Resistance (AMR) Surveillance System.

Nomination

• I am nominating and authorizing the above-mentioned staff to act as focal points of contact for the Maldives National AMR Surveillance System, representing our facility on all matters related to collecting, analyzing, sharing, and reporting of antimicrobial resistance (AMR) data from our facility.

Approved by:			
Name		Job title	
Institution		E-Mail	
Signature		Date	

Submission

Please return the completed and signed form,
Ministry of Health,
Roashanee Building,
Malé, Maldives. E-mail: amr.mdv@health.gov.mv
Telephone: +960 3304322
Note: An updated enrollment/nomination form should be submitted in case of any changes.

Appendix D: Laboratory Requisition Form (Example7)

Hospital / Facility: _____

Ordering Physician: _____ Telephone: _____

Patient Name: _____

Patient Medical Record Number: _____

Date of Birth (dd/mm/yyyy): ___/___/____

Gender: ❒ Male ❒ Female

In-Patient Ward / Department: _____ ❒ Out-Patient

Date of Admission (dd/mm/yyyy): ___/___/____ ❒ Out-Patient

Specimen Type:

❒ Blood ❒ Sputum

❒ Urine ❒ CSF

❒ Stool ❒ Other:

❒ Wound

Specimen Collection Date (dd/mm/yyyy): ___/___/____

Specimen Collected By: _____

TO BE FILLED OUT BY LABORATORY

Specimen Receive Date (dd/mm/yyyy): ___/___/____ Time: AM/PM

Specimen Received By: _____

Specimen accession number: _____

Notes:

[7] This form is an example. Sites are free to use their own local electronic or paper-based forms, as long as the relevant data elements are captured.

Appendix E: Data Fields for Maldives National AMR Surveillance Program

Nr.	Description	Data Field Name	Category	Format	Comments
1	Patient identifier (unique)	PATIENT_ID	**Required**	STRING	This is usually the medical record number (MRN)
2	Patient date of birth (DOB)	PATIENT_DOB	**Required**	DATE	Patient date of birth in UK date format (dd/mm/yyyy)
3	Patient age	PATIENT_AGE	Desirable	STRING	Patient age; rounded up or down to full years, e.g., if age <6 months = 0 years
4	Patient gender	PATIENT_GENDER	Optional	STRING	Patient gender (male/female/diverse/unknown)
5	Patient nationality	PATIENT_NATIONALITY	Optional	STRING	Patient Nationality, in Capital letters (MALDIVIAN, INDIAN, SRILANKAN, ...)
6	Date of patient visit/admission to hospital	PATIENT_ADM_DT	**Required**	DATE	UK date format (dd/mm/yyyy), without time stamp (hh:mm).
7	Date of discharge (for inpatients only)	PATIENT_DISC_DATE	Desirable	DATE	UK date format (dd/mm/yyyy), without time stamp (hh:mm)
8	Healthcare facility name	FACILITY_NAME	**Required**	STRING	Full name of the HCF where patient was seen (e.g. 'Treetop Hospital')
9	Healthcare facility identifier	FACILITY_ID	Desirable	STRING	Abbreviated name/code of healthcare facility, e.g. 'IGMH', 'HMH', ADK', etc.
10	Healthcare facility Island name	FACILITY_ISLAND	Desirable	STRING	Name of the island on which the facility is located (where the patient was seen)
11	Healthcare facility Atoll name	FACILITY_ATOLL	Desirable	STRING	Name of the atoll where the facility is located (where the patient was seen)
12	Healthcare facility Region name	FACILITY_REGION	Desirable	STRING	Name of the region where the facility belongs to (that saw the patient)
13	Department/Clinical Specialty name	FACILITY_DEPT_NAME	Optional	STRING	Full name of department or clinical specialty caring for the patient (e.g. internal medicine, orthopedic surgery etc.)
14	Patient ward / location name	PATIENT_LOCATION_NAME	**Required**	STRING	Name of the patient ward or location at the time when specimen was taken. E.g. 'Surgical ward 5E', 'Medical Intensive Care Unit', 'Diabetes clinic'
15	Patient location type	PATIENT_LOCATION_TYPE	Desirable	STRING	E.g.: Community, Emergency, Inpatient, Inpatient (Non-ICU), Intensive care unit, Laboratory, Mixed, Nursing home, Other, Outpatient, Unknown
16	Laboratory name	LAB_NAME	Conditional	STRING	Name of microbiology lab where the culture, ID and AST was done
17	Microbiological procedure	SPECIMEN_PROC_NAME	Optional	STRING	Name of microbiological procedure ordered, e.g. urine culture, blood culture, ..
18	Specimen lab number (unique)	SPECIMEN_LAB_NR	**Required**	STRING	The unique number that is assigned to each sample by the microbiology lab
19	Specimen type	SPECIMEN_TYPE	**Required**	STRING	E.g. blood, throat swab, sputum, wound swab, urine, urine (catheter), etc.
20	Pathogen identification	ORGANISM_NAME	**Required**	STRING	Local organism name, e.g. *Staphylococcus aureus*, *E. coli*, P. aeruginosa, etc.
21	Bacterial growth quantification	ORGANISM_CFU	Conditional	STRING	For urine samples only, as CFU/mL (e.g., <10^3, 10^3, 10^4, 10^5, 10^6)
22	AST susceptibility Method	AST_METHOD	Conditional	STRING	E.g. 'MIC (VITEK)', 'MIC (Phoenix)', 'Disk diffusion/KB', 'E-Test (MIC)'. Required if the AMR data file contains more than one AST methods (MIC, KB, Etest)
23	Antimicrobial agent tested	ANTIBIOTIC_NAME	**Required**	STRING	E.g. Ampicillin, Ceftriaxone, Gentamicin, ...
24	AST result (interpretation)	AST_RESULT_SIR	**Required**	STRING	Susceptible (S), Intermediate (I), Resistant (R). For each antibiotic tested
25	AST result (numerical)	AST_RESULT_NUM	Desirable	STRING	Minimal Inhibitory Concentration/MIC (in µg/mL), or Inhibition Zone Diameter (in mm), for each antibiotic tested
26	Specimen collection date	SPECIMEN_DATE_COLLECTED	**Required**	DATE	Date when the specimen was collected at the ward or clinic
27	Specimen received date	SPECIMEN_DATE_RECEIVED	Desirable	DATE	Date when the specimen was received by the microbiology lab
28	Specimen testing date	SPECIMEN_DATE_TESTED	**Desirable**	DATE	Date when the isolate was tested for antimicrobial susceptibility
29	Patient discharge status	PATIENT_DISC_STATUS	Desirable	STRING	E.g. Treated and discharged, Expired/died, Transferred to other facility, Other, Unknown
30	Diagnosis	DIAGNOSIS	Desirable	STRING	Principal diagnosis at time of discharge (final main diagnosis)
31	ICD Code	ICD	Desirable	STRING	ICD code of patient diagnosis at time of discharge
32	Molecular resistance marker	AST_MRM	Desirable	STRING	Results of Molecular Resistance Tests (e.g., AmpC+, OXA-48 pos+, NDM-5 pos, KPC+)

Appendix F: Sample Data File for Maldives National AMR Surveillance Program (HIMS/LIMS Extraction) – Part 1

PATIENT_ID	PATIENT_DOB	PATIENT_AGE	PATIENT_GENDER	PATIENT_NATIONALITY	PATIENT_ADM_DT	PATIENT_DISC_DATE	FACILITY_NAME	FACILITY_ID	FACILITY_ISLAND	FACILITY_ATOLL	FACILITY_REGION	FACILITY_DEPT_NAME
IGMH000123	27/08/1949	75	Female	NEPALESE	13/11/2024		Hulhumale Hospital	HMH	Hulhumale	Male Atoll	Central	Internal Medicine
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH123456	22/11/1996	28	Male	MALDIVIAN	19/10/2024	23/10/2024	Indira Ghandi Memorial Hospital	IGMH	Male	Male Atoll	Central	Intensive care unit
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic
IGMH654321	07/03/1993	32	Female	INDIAN	22/11/2024		Villimalé Hospital	VMH	Villimale	Male Atoll	Central	ObGyne clinic

Appendix F (continued): Sample Data File for Maldives National AMR Surveillance Program (HIMS/LIMS Extraction) – Part 2

PATIENT_LOCATION_TYPE	LAB_NAME	SPECIMEN_PROC_NAME	SPECIMEN_LAB_NR	SPECIMEN_TYPE	ORGANISM_NAME	ORGANISM_CFU	AST_METHOD	ANTIBIOTIC_NAME	AST_RESULT_NUM	AST_RESULT_SIR
Outpatient	IGMH Lab	Sputum Culture	345698765	Sputum	S. maltophilia		Disc diffusion	Trimethoprim-Sulfamethoxazole	6	R
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Penicillin G	>=0.5	R
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Ampicillin		R
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Amoxicillin-Clavulanate		R
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Oxacillin	>=4	R
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Imipenem		R
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Ciprofloxacin		R
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Levofloxacin	4	R
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Moxifloxacin	1	R
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Gentamicin	<=0.5	S
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Vancomycin	1	S
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Clarithromycin		R
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Erythromycin	>=8	R
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Clindamycin	<=0.25	S
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Tetracyclin	<=1	S
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Tigecyclin	<=0.25	S
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Linezolid	2	S
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Mupirocin	<=2	S
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Rifampin	<=0.5	S
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Trimethoprim-Sulfamethoxazole	>=320	R
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Cefoxitin-Screen	+	+
Inpatient (ICU)	IGMH Lab	Tracheal Aspirate Culture	123456789	Tracheal Aspirate	Staphylococcus aureus		MIC (VITEK-2)	Inducible clindamycin resistance	-	-
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Ampicillin	>=32	R
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Amoxicillin-Clavulanate	>=32	R
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Piperacillin-Tazobactam	8	S
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Cefuroxime (oral)	>=64	R
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Cefoxitin	>=64	R
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Cefpodoxim	>=8	R
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Ceftazidime	16	R
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Ceftriaxone	>=64	R
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Cefepim	8	R
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Ertapenem	<=0.5	S
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Imipenem	<=0.25	S
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Ciprofloxacin	<=0.25	S
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Norfloxacin	2	R
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Gentamicin	<=1	S
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Tetracyclin	<=1	S
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Fosfomycin	<=16	S
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Nitrofurantoin	64	S
Outpatient	IGMH Lab	Urine Culture	987654321	Urine	Escherichia coli	10^6	MIC (VITEK-2)	Trimethoprim-Sulfamethoxazole	<=20	S

Appendix F (continued): Sample Data File for Maldives National AMR Surveillance Program (HIMS/LIMS Extraction) – Part 3

SPECIMEN_DATE_COLLECTED	SPECIMEN_DATE_RECEIVED	SPECIMEN_DATE_TESTED	PATIENT_DISC_STATUS	DIAGNOSIS	ICD	AST_MRM
13/11/2024	13/11/2024	15/11/2024	Treated and discharged	Acute bronchitis	J20.9	
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
19/10/2024	19/10/2024	20/10/2024	Expired	Pneumonia	J159	MLS-B, PBP2a
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M
22/11/2024	23/11/2024	24/11/2025	Treated and discharged	Urinary Tract Infection (cystitis)	N39.0	AmpC, CTX-M

Appendix G: Cumulative Antibiogram – Gram-negative bacteria (Example/Template)

National [or: XYZ Hospital] Cumulative Antibiogram (2024): Percent susceptible isolates (%S[a]) – Gram-neg. bacteria (isolates from all sources, N=...)

Gram-negative Bacteria	Isolates	β-Lactams											Aminoglycosides			FQ	Other		
		Penicillins			Cephalosporins				Carbapenems										
	N	AMP	AMC	TZP	CZO	CXM[h]	CTX	CAZ	FEP	IPM	MEM	ETP	AMK	GEN	TOB	CIP	ATM	SXT	NIT[a]
Gram-negative bacteria (all)		-			-	-		-											
Haemophilus influenzae[b]				-	-		-	-	-	-	-	-	-	-	-		-		-
Moraxella (Branh.) catarrhalis[c]		-		-	-		-	-	-	-	-	-	-	-	-		-		-
Enterobacterales						-		-											-
Citrobacter koseri (diversus)		R				/		-											
Enterobacter cloacae		R	R		R	/		-											
Enterobacter aerogenes (K. aer.)		R	R		R	R		-											
Escherichia coli[d]						/		-											
Klebsiella pneumoniae		R				/		-											
Klebsiella oxytoca		R				/		-											
Morganella morganii		R	R		R	R		-											R
Proteus mirabilis						/		-											R
Proteus vulgaris		R			R	R		-							-		-		R
Providencia spp.		R	R		R	–		-									-		R
Salmonella spp. (non-typhoid)					-	-		-		-	-	-	-	-	-	[f]	-		-
Salmonella Typhi/Paratyphi					-	/		-		-	-	-	-	-	-		-		-
Serratia marcescens		R	R		R	R		-											R
Shigella spp.					-	-		-		-	-	-	-	-	-		-		-
Non-fermenting Gram-neg. rods		R	R		-	-	-					R							-
Acinetobacter baumannii		R	R		-	-	-					R					R		-
Pseudomonas aeruginosa		R	R		-	R	R					R						R	R
Stenotrophomonas maltophilia[g]		R	R	R	-	-	R		-	R	R	R	R	R	R	-	R		-

The %S for each organism/antimicrobial combination was generated by including the first isolate only of that organism encountered on a given patient during the reporting period (de-duplicated data).

[a] NIT: Nitrofurantoin data is from urine isolates only. [b] *H. influenzae*: disc diffusion data (Kirby Bauer): LVX ... %S, CRO ... %S, AZM: ... %S, ... 61%S. [c] *M. catarrhalis*: CLR: ... %S, ERY ... %S, AZM: ... %S, LVX ... %S, TCY ... %S. [d] *E. coli* (urinary tract isolates): FOS ... %S. [e] A small number of isolates were tested (N<30), and the percentage susceptible should be interpreted with caution. [f] Ciprofloxacin results for *Salmonella* spp. (non-typhoid) refer to extra-intestinal (non-stool) isolates only. [g] *S. maltophilia*: MNO ... %S, TCC ... %S. [h] Cefuroxime: oral/parenteral breakpoints.

AMC=Amoxicillin/Clavulanic acid, **AMK**=Amikacin, **AMP**=Ampicillin, **ATM**=Aztreonam, **AZM**=Azithromycin, **CAZ**=Ceftazidime, **CIP**=Ciprofloxacin, **CLR**=Clarithromycin, **CRO**=Ceftriaxone, **CTX**=Cefotaxime, **CXM**=Cefuroxime, **CZO**=Cefazolin, **ETP**=Ertapenem, **ERY**=Erythromycin, **FEP**=Cefepime, **FOS**=Fosfomycin, **GEN**=Gentamicin, **IPM**=Imipenem, **LVX**=Levofloxacin, **MEM**=Meropenem, **MNO**=Minocycline, **NIT**=Nitrofurantoin, **SXT**=Trimethoprim/Sulfamethoxazole, **TCC**=Ticarcillin/Clavulanic acid, **TCY**=Tetracycline, **TOB**=Tobramycin, **TZP**=Piperacillin/Tazobactam.

%S=Percent of isolates susceptible, FQ=Fluoroquinolones, MIC=Minimal inhibitory concentration data only, unless mentioned otherwise (usually derived by antibiotic susceptibility testing platforms), except for *H. influenzae* and *M. catarrhalis* (disc diffusion data), N=Number, spp.=species, R=intrinsically resistant, (–) =No data available, small number of isolates tested (N<30), antimicrobial agent is not indicated, or not effective clinically. Interpretation standard: CLSI M100 ED34:2024. Antibiogram presentation standard: CLSI M39-A5:2022. Data analysis: WHONET 2024.

Data source: Maldives National [or: XYZ Hospital] Antimicrobial Resistance Surveillance System. Data shown is from ... surveillance sites from public and private sector (Maldives), including ... hospitals and ... health centers. [or: Data shown is from all clinical departments (inpatient and outpatient of XYZ hospital)]. Version 1.0 (../../ 2025).

Appendix G (continued): Cumulative Antibiogram – Gram-positive bacteria (Example/Template)

National [or: XYZ Hospital] Cumulative Antibiogram (2024): Percent susceptible isolates (%S) – Gram-pos. bacteria (isolates from all sources, N=...)

Gram-positive Bacteria	Isolates	β-Lactams						Macrolides		Aminoglycosides			FQ		Glycopept.		Other					
	N	AMP	PEN	AMC	OXA	CRO	CTX	ERY	CLI	GEN	GEH	STH	LVX	MFX	VAN	TEC	SXT	NIT[a]	LNZ	TCY	RIF	QDA
Gram-positive organisms (all)		-	-	-	-	-	-			-	-	-								-	-	-
Enterococcus spp.			-	-	-	R	R	-	R	R							R			-	-	-
Enterococcus faecalis			-	-	-	R	R	-	R	R							R			-	-	R
Enterococcus faecium			-	-	-	R	R	-	R	R							R			-	-	
Staphylococcus aureus[b]		-	-	[c]		-	-				-	-										
MSSA[k]		-	-			-	-				-	-										
MRSA[k]		-	-	-	-	-	-				-	-										
Coag.-neg. staphylococci (CNS)		-	-	[c]		-	-				-	-										
Staphylococcus epidermidis		-	-	[c]		-	-				-	-										
Staphylococcus saprophyticus[g]		-	-	[c]		-	-				-	-										
Staphylococcus lugdunensis		-	-	[c]		-	-				-	-										
Streptococcus pneumoniae		-	[d]	-	-	[e]	[e]			-	-	-						-				
Streptococcus pyogenes		[f]		-	-					-	-	-		-			-	-			-	-
Streptococcus agalactiae				-	-					-	-	-		-			-				-	
Streptococcus spp. (viridans gr.)		-		-	-					-	-	-		-		-	-	-			-	-

The %S for each organism/antimicrobial combination was generated by including the first isolate only of that organism encountered on a given patient during the reporting period (de-duplicated data).

[a] NIT: Nitrofurantoin data is from testing urine isolates only. [b] *S. aureus*: excludes isolates from axilla, nose, and groin. [c] Extrapolated, based on Oxacillin. [d] Data shown is based on non-meningitis breakpoints for Pen G. Pen G (meningitis breakpoints/oral breakpoints): ... %S. [e] CRO/CTX: Data shown is based on non-meningitis breakpoints. [f] Extrapolated, based on Penicillin G. [g] A small number of isolates were tested (N<30), and the percentage susceptible should be interpreted with caution.

AMP=Ampicillin, **AMC**=Amoxicillin/Clavulanic acid, **CLI**=Clindamycin, **CRO**=Ceftriaxone, **CTX**=Cefotaxime, **ERY**=Erythromycin, **GEH**=Gentamicin (high-level), **GEN**=Gentamicin, **LNZ**=Linezolid, **LVX**=Levofloxacin, **MFX**=Moxifloxacin, **NIT**=Nitrofurantoin, **OXA**=Oxacillin, **PEN**=Penicillin G, **QDA**=Quinupristin/Dalfopristin, **RIF**=Rifampin, **STH**=Streptomycin (high-level), **SXT**=Trimethoprim/Sulfamethoxazole, **TEC**=Teicoplanin, **TCY**=Tetracycline, **VAN**=Vancomycin.

%S=Percent of isolates susceptible, FQ=Fluoroquinolones, GAS=Group A streptococci, GBS=Group B streptococci, Glycopept.=Glycopeptides, MIC=Minimal inhibitory concentration data only, unless mentioned otherwise (usually derived by antibiotic susceptibility testing platforms), MRSA=Oxacillin-resistant *S. aureus*, MSSA=Oxacillin-susceptible *S. aureus*, N=Number, spp.=species, R=intrinsically resistant, (-) =No data available, or small number of isolates tested (N<30), or antimicrobial agent is not indicated or not effective clinically. Interpretation standard: CLSI M100 ED34:2024. Antibiogram presentation standard: CLSI M39-A5:2022. Data analysis: WHONET 2024.

Data source: Maldives National [or: XYZ Hospital] Antimicrobial Resistance Surveillance System. Data shown is from ... surveillance sites from public and private sector (Maldives), including ... hospitals and ... health centers. [or: Data shown is from all clinical departments (inpatient and outpatient of XYZ hospital)]. Version 1.0 (../../ 2025).

Appendix H: List of Standard Operating Procedures (SOP) and other Documents

Note: This list is tentative and may change.

Standard Operating Procedures (SOP)

SOP *Specimen Collection*

SOP *Pathogen Isolation and Identification*

SOP *Antimicrobial Susceptibility Testing (Methods)*

SOP *Antimicrobial Susceptibility Testing (gram-positive pathogens)*

SOP *Antimicrobial Susceptibility Testing (gram-negative pathogens)*

SOP *Antimicrobial Susceptibility Testing (Yeast)*

SOP *Isolate Repository and Confirmatory Testing*

SOP *AMR Data Cleaning*

SOP *AMR Data Management*

SOP *AMR Data Analysis and Reporting*

Other Documents (MS Excel®)

AMR Surveillance Master Sheet – Surveillance Sites (Clinical Sites and Laboratories)

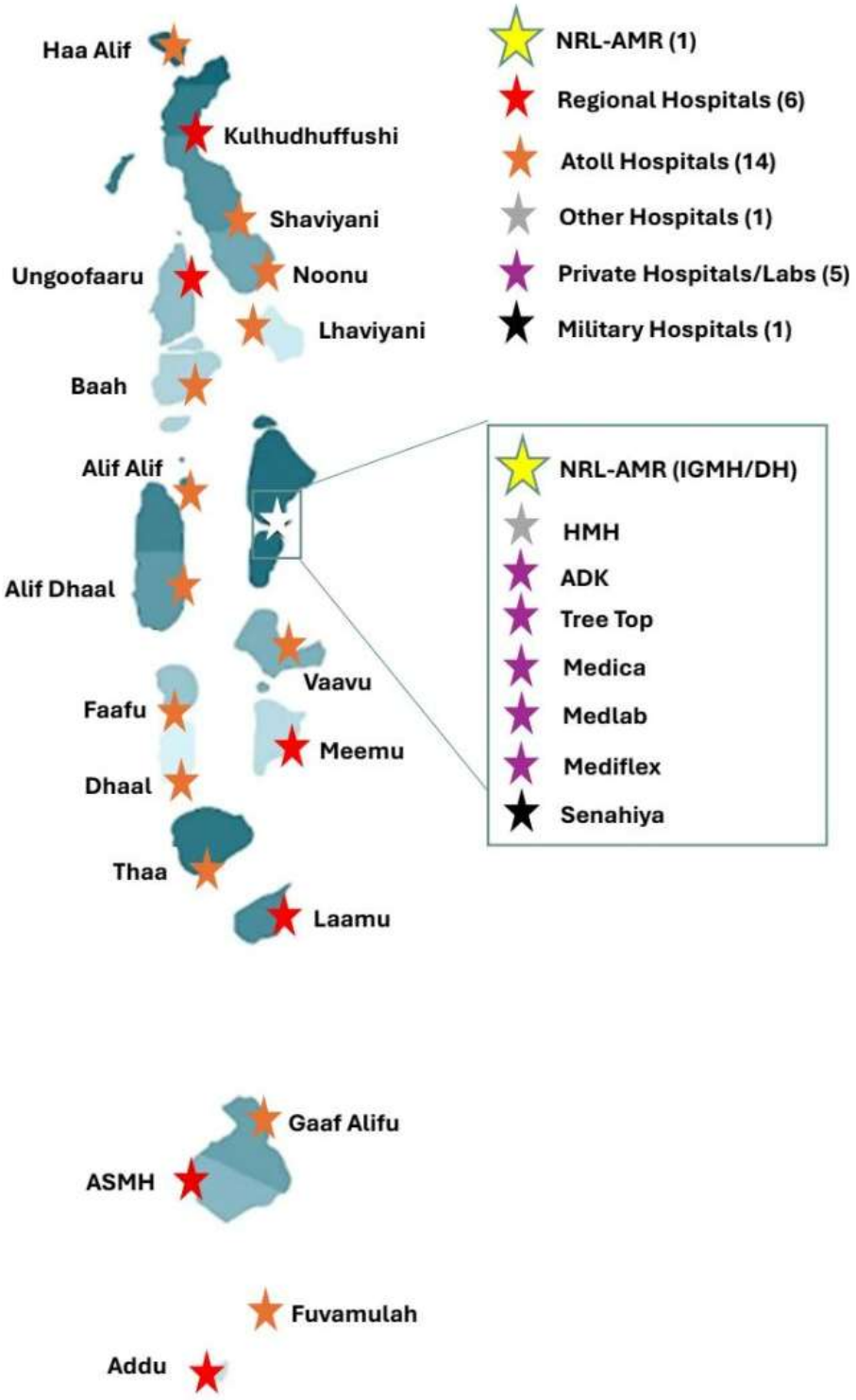
AMR Data Analysis – Patient and Isolate Characteristics

AMR Data Analysis - %RIS

AMR Data Analysis – Trends over Time

AMR Data Analysis – MDR, XDR, PDR

Appendix I : Maldives National AMR Surveillance Sentinel Sites – Location Map



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