
# Antimicrobial resistance (AMR) action plan

# Kingdom of Saudi Arabia

# 2022-2025

# Contents

## Abbreviations and acronyms

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| **AMR** | antimicrobial resistance |
| **ASP** | Antimicrobial stewardship program |
| **MEWA** | Ministry of Environment, Water and Agriculture |
| **MOH** | Ministry of Health |
| **NUPCO** | National Unified Procurement Company |
| **SFDA** | Saudi Food and Drug Authority |
| **SCFHS** | Saudi Commission for Health Specialties |
| **Weqaya** | Public Health Authority |
| **WHO** | World Health Organization |

## Introduction

This Antimicrobial Resistance (AMR) National Action Alan is a revised accompaniment to the National Strategy for Combating Antimicrobial Resistance (2022-2025) and follows on to the Kingdom's 2017 National Action Plan on Combating Antimicrobial Resistance. This plan was developed collaboratively with multisectoral stakeholders and provides an overview of the Kingdom's existing efforts to combat AMR from the previous plan, how the new action plan was developed, and clear actions detailing the way forward for the next four years. The plan was reviewed by national experts in addition to experts from international agencies, with a special acknowledgment to Dr. Colin Brown BSc (Med Sci) MBChB MSc (Epi) DTM&H DipHIVMed MRCP FRCPath, Director Clinical and Emerging Infections & Deputy Director HCAI, Fungal, AMR, AMU, & Sepsis Division, UK Health Security Agency and team.

AMR is an emerging global challenge with potential life-threatening impacts. Multidrug-resistant pathogens are spreading rapidly in many parts of the world causing severe medical and economic consequences, rendering common illness and infections untreatable, and putting the success of lifesaving operations and procedures at risk. Several factors have led to the proliferation of AMR, including:

- Over-prescription of antibiotics to people for viral and bacterial infections
- Exposure to antibiotics through the food chain—including water—through misuse and overuse in animals and agriculture
- Emerging bacterial resistance through mutation for which there are few new vaccines and drugs, impacting the effectiveness of currently available medications
- Poor infection and disease prevention in communities, housing and living conditions, healthcare and livestock facilities, food safety and feed production, community education, and the environment

## Existing efforts to combat AMR

In 2015, Saudi Arabia's Ministry of Health (MOH) recognized the significance and impact of AMR and introduced antimicrobial containment and infection prevention and control programs in MOH hospitals. In 2017, the Kingdom Arabia developed its first AMR National Action Plan, adopting the five objectives of the World Health Organization's (WHO) Global Action Plan on Antimicrobial Resistance (see Table 1 below).

**Table 1: WHO Global Action Plan on Antimicrobial Resistance objectives**

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| **Objective 1:** Improve awareness and understanding of antimicrobial resistance through effective communication, education, and training |
| **Objective 2:** Strengthen the knowledge evidence base through surveillance and research |
| **Objective 3:** Reduce the incidence of infection through effective sanitation, hygiene, and prevention measures |

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| **Objective 4:** Optimize the use of antimicrobial medicines in human and animal health |
| **Objective 5:** Develop the economic case for sustainable investment that takes account of the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines, and other interventions |

Source: WHO. (2016) Global action plan on antimicrobial resistance.

Of the determined strategic initiatives laid out in the 2017 National Action Plan, many have been successfully completed, while others are still in various stages of implementation. Table 2 below details the status of initiatives from the 2017 National Action Plan.

**Table 2: Status of 2017 National Action Plan initiatives**

| No. | Initiative | Status |
|---|---|---|
| **1.1** | **Establish an evidence-based communication program targeting the public for both human and animal health** | |
| 1.1.1 | Assess public awareness about AMR through<br>1. Survey on public awareness of use and misuse of antibiotics. Assign a research team to conduct qualitative (focus group) and quantitative (surveys) data collection<br>2. Survey on knowledge and attitude towards use and misuse of antibiotics in livestock | Initiated |
| 1.1.2 | Production of media related materials including documentary on AMR | Completed |
| 1.1.3 | Annual awareness campaign during antimicrobial in response to WHO World Antibiotic Awareness Week | Awareness campaigns were conducted 2017, 2018, 2019, 2020, and 2021 targeting the public and health care professionals |
| 1.1.4 | Mainstream media engagement | Initiated |
| 1.1.5 | Applying the tailored interventions:<br>1. Universities carry out direct public engagement campaigns<br>2. Award university clubs<br>3. Work with MOH and launch the Public Health Champion program and<br>4. Work with MOE on national curriculum to include the AMR topic | Universities participated in activities to raise AMR awareness<br>The discussion is still ongoing to include AMR in the curriculum |
| **1.2** | **Establish an evidence-based public communication program targeting the healthcare providers for both human and animal health** | |

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| 1.2.1 | Awareness program will be prepared for healthcare providers for both in human and animal health | Completed |
| **2.1** | **AMR and related topics as core components of professional education, training, certification, and development** | |
| 2.1.1 | AMR and related topics in undergraduate curricula for human health professionals, animal health professionals and food industry and agriculture professionals | Letter to MOE to initiate discussion |
| 2.1.2 | AMR e-learning educational program | One launched for healthcare workers |
| 2.1.3 | AMR revised and approved educational programs in healthcare facilities | Completed targeting healthcare workers |
| **3.1** | **Establish a national coordination structure for surveillance of AMR** | |
| 3.1.1 | National coordinating committee with appropriate mandate and terms of reference and a focal point | The committee was established in 2017, and restructured in 2019 and again in 2021 |
| **3.2** | **Designate and develop reference microbiology laboratory facilities to coordinate effective epidemiological surveillance of antimicrobial resistance** | |
| 3.2.1 | Seven CAP accredited laboratories were designated to collect the antimicrobial resistance data for the last five years. **Riyadh**: KAMC-Riyadh, King Faisal Specialist Hospital & Research Center, KFMC, and King Khaled University Hospital, Prince Sultan Military Medical City.<br>**Eastern Province**: King Fahd University hospital in Khobar<br>**Western Province:** King Abdulaziz University Hospital | AMR data was collected retrospectively for 2011-2015 and analyzed. Two published papers were released |
| 3.2.2 | Twenty-four MOH laboratories antibiogram from various regions in the Kingdom | Antibiogram started by collecting data from 24 hospitals and reached to 81 by 2020 |
| 3.2.3 | Determination of KPIs needed from each of the Sentinel sites | Completed |
| 3.2.4 | Utilize point of care tests | Not completed |
| **3.3** | **AMR surveillance Sentinel sites in humans** | |
| 3.3.1 | 12 AMR surveillance Sentinel sites from different regions are selected:<br>• **Riyadh**: KAMC-Riyadh, King Faisal Specialist Hospital & Research Center, KFMC, and King Khaled University Hospital<br>• **Eastern Province**: King Fahd University Hospital in Khobar<br>• **Western Province**: King Abdulaziz University Hospital | Started with 12 Sentinel sites and expanded to include 42 hospitals |

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| | • **Jeddah**: King Abdulaziz, King Fahd Hospital<br>• **Eastern Region**: Dammam Medical Complex<br>• **Aseer**: Central Hospital<br>• **Tabouk**: King Khaled Hospital | |
| **3.4** | **AMR surveillance Sentinel sites in animals** | |
| 3.4.1 | Six Sentinel sites for surveillance of infections caused by AMR pathogens:<br>• Riyadh<br>• Al-Ahssa<br>• Dammam<br>• Jeddah<br>• Aseer<br>• Al-Kharj | They have been assigned, but not all have been activated |
| 3.4.2 | Surveillance for detection of salmonella, campylobacter, and total bacterial count in poultry in all regions of the Kingdom | Surveillance was established by SFDA and needs to be enhanced in new action plan |
| **3.5** | **Determine the country priority microorganisms with mechanisms of resistance for AMR surveillance and adapt and apply WHO model systems for antimicrobial resistance surveillance (GLASS)** | |
| 3.5.1 | WHO priority pathogens including S. aureus, E. coli, K. pneumoniae MRSA, VRE, Non-Fermentative GNB Acinetobacter, and pseudomonas | Completed |
| 3.5.2 | GLASS protocol endorsed to laboratories during a workshop (10 labs) and includes age and sites in the upcoming data | Completed and expanded to 42 labs |
| **3.6** | **Establishment of systems IT for monitoring antimicrobial and link all sentinel sites to the national center for analysis and reporting** | |
| 3.6.1 | Working on software to link designated Sentinel to national lab to improve reporting analysis | The system has been developed and activated and will be further expanded |
| **4.1** | **Designate a national reference laboratory for AMR surveillance** | |
| 4.1.1 | The National Lab will assume responsibility for AMR lab in the future. Currently, the AMR Sentinel sites labs will perform required AMR testing and reporting | The National Laboratory was not activated during the previous action plan period but will be activated and functioning within 2022 |

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| **4.2** | **Training workshops for microbiologist and laboratory technicians** | |
| 4.2.1 | Plan for series training, workshops will be formulated for microbiology doctors and lab technicians for all hospitals >150 beds | Training workshops are conducted annually |
| **5.1** | **Create a formal organizational structure to ensure proper development and use of infection prevention and control policies and strategies** | |
| 5.1.1 | IC organizational structure has been established and distributed | Completed |
| 5.1.2 | Core component has been established and distributed | Completed |
| 5.1.3 | Infection control national manual distributed to all healthcare regions | Completed |
| 5.1.4 | IC auditing tool program | Completed |
| 5.1.5 | Hand hygiene campaign | Conducted annually |
| **6.1** | **Create a formal organizational structure to ensure proper development and use of infection prevention and control policies and strategies in veterinary and animal husbandry** | |
| 6.1.1 | Write and approve Infection Control Guideline in animal health by KSA MEWA | Guideline was prepared by MEWA |
| **6.2** | **Include hygiene and infection prevention and control as core (mandatory) content in training and education of veterinary professionals** | |
| 6.2.1 | MEWA plans for infection control training | Completed and ongoing |
| **7.1** | **Promote personal hygiene by social mobilization and behavioral change activities** | |
| 7.1.1 | Estimate knowledge of personal hygiene in different social groups as a basis for the social mobilization campaigns | Unknown |
| **8.1** | **Strengthen the pharmaceutical supply chain, including the procurement, supply, and management system** | |
| 8.1.1 | Establish a quality management system for the supply of medicines, covering storage, transport, expiry date, etc. | Initiated by SFDA |
| **9.1** | **Create formal antimicrobial stewardship programs in healthcare facilities** | |
| 9.1.1 | Plan for series training, antimicrobial stewardship programs workshops will be formulated in all healthcare facilities >150 beds | Completed |
| **9.2** | **Awareness and education on stewardship for healthcare facilities and veterinary practice** | |
| 9.2.1 | Target selected hospitals based on bed capacity from each region of the Kingdom:<br>1. Antibiotic Awareness Week<br>2. Workshops, seminars, case studies, grand rounds, etc. | Completed |

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| | 3. Booklets, brochures, posters, and pocket cards<br>4. Teleconference or phone consults to hospitals with no ID or clinical pharmacists to perform ASP<br>5. Increase awareness of public pharmacists on ASP<br>6. Training activities in ASP | |
| 9.2.2 | To consider standardized educational material or electronic tool | Antimicrobial Stewardship Mobile application implemented |
| **9.3** | **Guidelines and order sets** | |
| 9.3.1 | Development, awareness, and implementation of empiric antimicrobial guidelines for treatment of community & healthcare associated infection to 20 MOH hospitals | Antimicrobial national guidelines developed in 2018 |
| 9.3.2 | Integrating those guidelines into electronic health records whenever possible | Initiated |
| 9.3.3 | Standardizing surgical antibiotic prophylaxis through preset order sheets in 20 selected MOH hospitals | Surgical prophylaxis guideline developed |
| **9.4** | **Clinical Care Standards "bundle" implementation** | |
| 9.4.1 | Hospitals (>150 beds) should apply "MOH-approved" stewardship bundles/best practices to optimize prescribing practices | Bundles provided to hospitals with >150 beds and some applied it |
| **9.5** | **Mandating stewardship implementation in all JCI/CBAHI accredited hospitals** | |
| 9.5.1 | Communicate with CBAHI to include ASP in the requirements for accreditation/reaccreditation | Process was initiated, and needs to be followed up with the updated accreditation manual |
| **9.6** | **Requesting stewardship program KPIs on process and outcome** | |
| 9.6.1 | 5 antibiotics, 5 MDROs<br>1. DOT per 1000 patients<br>2. Duration of empiric antibiotics therapy more than 7 days<br>3. Prevalence and trend of CDI | KPIs were assigned |
| **9.7** | **Postgraduate education: enrollment requirement for national residency training programs** | |
| 9.7.1 | Communication with Saudi Commission for Health Specialties (SCFHS) to add to infection control module Stewardship component; it can be an online module as a prerequisite for enrollment in all medical, nursing, paramedical, and pharmacy residency programs | Process was initiated by communicating with SCFHS |

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| **9.8** | **Building capacity: Training clinical pharmacists and ID fellows** | |
| 9.8.1 | Antimicrobial stewardship training programs | Completed |
| **9.9** | **Train the Trainers once a group of certified trained personnel is available** | |
| 9.9.1 | Setting up a training center/academy in MOH to train trainers in the Principles and Practices of Implementation of ASP in Healthcare Settings | Antimicrobial Stewardship E-learning module developed |
| **9.10** | **Antimicrobial stewardship research** | |
| 9.10.1 | 1. National Point Prevalence Survey on antimicrobial consumption & resistance in line with Global PPS 2. Multicenter study on the impact of implementation of stewardship on length of stay and cost savings | National multicenter point prevalence survey was conducted in 2016 and 2017 |
| **10.1** | **Restrict use of critically important antimicrobials for human medicine in food production animals** | |
| 10.1.1 | Ongoing surveillance of antibiotics consumed in food production animals and avoiding the following antimicrobial classes: quinolones, 3rd and 4th generation cephalosporins, macrolides, ketolides, and glycopeptides | Initiated |
| **11.1** | **Economic impact assessment and burden of antimicrobial resistance** | |
| 11.1.1 | Study the cost and economic burden of AMR in humans | Initiated |
| 11.1.2 | Study the cost and economic burden of AMR in animals | Not completed |

Source: Weqaya analysis of status of 2017 National Action Plan interventions. (2021).

We conducted a thorough review and analysis of what was done on the previous action plan, which revealed that many great efforts and initiatives were started and completed. We also identified some gaps in implementation and sustainability of various activities. In the 2022-2025 action plan, will concentrate on filling in these gaps as well as building on the excellent efforts already started, such as enhancing surveillance in humans, and particularly in animals and the environment, expanding AMR stewardship programs in hospitals; consumption of antimicrobials in humans and animals; and ensuring robust monitoring of AMR activities.

## Developing the national action plan (2022-2025)

Like its predecessor, the Kingdom's 2022 AMR plan emphasizes the need for an effective One Health approach, which is collaborative, multisectoral, and transdisciplinary; works at the local, regional, national, and global levels; and recognizes the interconnection between people, animals, agriculture, and the shared

environment. This plan provides a framework for collaborative action for the interdisciplinary stakeholders in the Kingdom to implement the necessary AMR activities that contribute to the overall goals. The goals are consistent with those laid out in 2017, but have a narrower focus given the shift in scope and current situation in the Kingdom.

## Existing National AMR Committee

To combat AMR in the Kingdom, a National AMR Committee was established in January 2017 consisting of a group of scientists and experts from relevant sectors. The Committee was restructured in 2019 and supported the development of the 2022 strategy and action plan. This was done through active engagement and consultation, including one-on-one meetings and workshops with the representatives of the multidisciplinary Committee and other stakeholders including:

**Weqaya**

**Ministry of Environment, Water, and Agriculture (MEWA)**

**King Saud University**

**Ministry of National Guard – Health Affairs**

**MOH**

**King Faisal Specialist Hospital & Research Centre**

**King Abdulaziz City for Science and Technology**

**National Unified Procurement Company (NUPCO)**

**King Fahad Medical City**

**Saudi Food and Drug Authority (SFDA)**

**Ministry of Defense Health Affairs**

## Current governance framework

While reviewing the previous governance structure under the previous National AMR Committee, we identified some challenges:

- The role and function of the national committee was unclear which can lead to lack of participation and weak commitment from members
- Different level of authority among the committee members which can impede implementation and adoption of recommendations
- Communication difficulties between different sectors
- Lack of agreement and commitment to share accurate data

Based on the above, the National AMR Committee is currently undergoing another restructuring. Lead by Weqaya, the Committee will include more sectors with representation with matching levels of authority to ensure clear governing power. The purpose of the National AMR Committee is to support and coordinate the execution and monitoring of the AMR activities laid out in the strategy in their respective sectors. We are also developing a scientific committee.

The functions of the National committee include:

- Ensure the oversight, execution, and monitoring of the national strategy and action plan to fulfill the Kingdom's national and international commitments to combatting AMR
- Suggest subcommittees based on need, including a scientific committee
- Approve and execute plans, policies, legislation, and regulations to improve performance based on the AMR scientific committee's recommendations
- Review the plans and policies prepared by the National AMR Program at Public Health Authority
- Suggest legislation that will improve the work of the National AMR Program

The new committee members include:

| | **Weqaya (Lead)** | |
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| **Ministry of Municipal, Rural Affairs and Housing** | **Ministry of National Guard Health Affairs** | **Ministry of Environment, Water, and Agriculture** |
| **Ministry of Interior Security Forces Hospital** | **Saudi Food and Drug Authority (SFDA)** | **Ministry of Defense Health Affairs** |
| **Health Holding Company** | **Council of Saudi Chambers** | **Saudi Health Council** |
| | **Ministry of Health** | |

## Goals and objectives

The 2022-2025 National Action Plan is built on the work already established by the 2017 plan, and while it still follows the essence of the five WHO global objectives, we did a reassessment of the current situation, capabilities, and resources, and we narrowed our focus for the upcoming years on 5 objectives based on the current priorities.

**Objective 1: Strengthen and improve collaboration and coordination of interdisciplinary and intersectoral efforts**

**Initiatives for Objective 1:**

1. Govern National Committee efforts to combat AMR
2. Govern multisectoral AMR efforts

**Objective 2: Strengthen the knowledge evidence base through surveillance and research**

**Initiatives for Objective 2:**

1. Improve national AMR surveillance for humans, animals, food, and the environment (including AMR trends in antimicrobial consumption in humans and animals, antimicrobial residue in food and animal feed, and in the environment)
2. Improve laboratory capacity to produce high-quality microbiological data for humans
3. Increase laboratory capacity to produce high-quality microbiological data for animals and the environment
4. Enhance and promote evidence-based research to build better knowledge about AMR

**Objective 3: Improve awareness and understanding of antimicrobial resistance through effective communication, education, and training**

**Initiatives for Objective 3:**

1. Increase national public awareness about antimicrobials and AMR
2. Include AMR and related topics as a core component of professional education, training, certification, and development

**Objective 4: Optimize the use of antimicrobial medicines in human and animal health**

**Initiatives for Objective 4:**

1. Optimize antimicrobial consumption data collection in humans and animals
2. Improve antimicrobial stewardship programs (ASP) in all healthcare facilities
3. Ensure prudent use of antimicrobial agents in terrestrial and aquatic animals and agriculture

**Objective 5: Reduce the incidence of infection through effective sanitation, hygiene, and prevention measures**

**Initiatives for Objective 5:**

1. Strengthen National Infection Prevention and Control Program
2. Establish a National Infection Control Program for the animal health sector

## Action plan

The activities listed in the action plan include a timeline for implementation, the responsible party, and proposed process indicators and deliverables. Overall, there are 13 initiatives and 44 activities. The activities are broken down by responsible party, and they largely fall to Weqaya, MEWA, MOH, and other health sector entities. A detailed operational plan with budget allocation, targets, and indicators is forthcoming shortly after approval of the plan.

**Table 3: 2022-2025 action plan activities**

| Objective 1: Strengthen and improve collaboration and coordination of interdisciplinary and intersectoral efforts | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Initiative Name** | **Activities** | **Milestone** | **Responsible sectors** | **Proposed process indicators** | **Baseline** | **Target** | **Deliverable** |
| **1.1 Govern National Committee efforts to combat AMR** | 1.1.1 Approve the redesign of the National AMR Committee | Q1 2022 | **Weqaya** | [11] Proposed entities included in governance structure (%) | 70% | 100% | Active governing body (1) |
| | 1.1.2 Develop National AMR Committee terms of reference and operational procedures | Q1 2022 | **Weqaya** | Completion of [1] necessary documentation (%) | 0% | 100% | Committee body terms of reference and operational procedures (1) |
| | 1.1.3 Ensure active participation and involvement of members regarding implementation of Committee work | Q3 2022 | **Weqaya** | Committee actions completed (%) | 0% | 60% | Biannual Committee reports (2 per year) |
| **1.2 Govern multisectoral AMR efforts** | 1.2.1 Establish clear governance structures for selected multisectoral AMR operational activities | Start Q3 2022 | **Weqaya** | Completion of [5] necessary documentation (%) | 0% | 100% | Governance structures for operational activities (Stewardship, research, antimicrobial consumption, veterinary pharmacies, surveillance) (1 per quarter) |
| | 1.2.2 Establish clear monitoring and evaluation framework for AMR operational activities | Start Q4 2022 | **Weqaya** | Completion of [1] necessary documentation (%) | 0% | 100% | Monitoring and evaluation framework for AMR operational activities (Stewardship, research, antimicrobial consumption, veterinary pharmacies, surveillance) (1 per quarter) |

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| | 1.2.3 produce Monitoring and evaluation on multisectoral AMR efforts per the action plan | Q1 2023 | **Weqaya** | Monitoring and evaluation reviews (%) | 0% | 70% | Annual monitoring and evaluation report |
| | 1.2.4 Provide recommendations for improvement of policies and legislation based on Committee monitoring and evaluation reports and surveillance data | Q2 2022 | **National AMR Committee** | Report results used as basis for recommendations (%) | 0% | 100% | Recommendations for policies and legislation after each meeting.<br>measuring # of amended policies/legislations based on committee's recommendations (outcome measurement)? |
| Objective 2: Strengthen the knowledge evidence base through surveillance and research | | | | | | | |
| **Initiative Name** | **Activities** | **Milestone** | **Responsible sectors** | **Proposed process indicators** | **Baseline** | **Target** | **Deliverables** |
| **2.1 Improve national AMR surveillance for humans, animals, food, and the environment (including AMR trends in antimicrobial consumption in humans and animals, antimicrobial residue in food and animal feed, and in the environment)** | 2.1.1 Update list of priority pathogens in humans, animals, food, and the environment | Q1 2022 | **Weqaya, and other sectors** | Completion of list (%) | 70% | 100% | Updated list of priority pathogens (1) |
| | 2.1.2 Develop a comprehensive dynamic dashboard that collects input on various surveillance data from different sectors | Q4 2022 | **Weqaya, and other related sectors** | Completion of the system (%) | 20% | 100% | Electronic AMR surveillance dashboard with clear user access (1) |
| | 2.1.3 Develop standard operating procedures for the dashboard | Q4 2022 | **Weqaya, and other sectors** | Completion of operating procedures (%) | 0% | 100% | AMR dashboard standard operating procedures (1) |
| | 2.1.4 Ensure collection and integration of data from entities into dashboard | Q1 2023 | **Weqaya, and other sectors** | Entities contributing to the dashboard (%) | 25% | 100% | Fully integrated dashboard (1) |
| | 2.1.5 Conduct analyses and produce reports on data and trends | Q2 2023 | **Weqaya** | Completion of quarterly data analysis (%) | 20% | 100% | Annual report on data and trends (1) |

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| | 2.1.6 Identify, collect, and test necessary environmental samples for AMR and antimicrobial residues | Q1 2024 | **MEWA** | Samples tested (%) | 0% | TBD | Annual report on AMR in the environmental |
| | 2.1.7 Enhance reporting of AMR in food products | Q1 2023 | **SFDA** | Completion of policies and procedures (%) | 0% | 60% | Annual Report on policies and procedures for monitoring and reporting of AMR in food products |
| **2.2 Improve laboratory capacity to produce high-quality microbiological data for humans** | 2.2.1 Develop policies and procedures for active surveillance of AMR at the National AMR Laboratory at Weqaya | Q1 2022 | **Weqaya** | Completion of policies and procedures (%) | 70% | 100% | Policies and procedures for fully functional AMR laboratory at Weqaya |
| | 2.2.2 Conduct assessment of capacity at national microbiology laboratories | Q3 2022 | **Weqaya with other health sectors** | Response rate of assessment (%) | 0% | 100% | Report on assessment of microbiology laboratories |
| | 2.2.3 Apply recommendation from the assessment to improve microbiology laboratory capacity at hospitals by bed capacity:<br>• >500 beds<br>• >300 beds | Q4 2022<br>Q4 2025 | **MOH, health sectors** | Laboratory operational capacity (%) | TBD | 100% | Labs >500 bed capacity: 100% by end of 2022<br>Labs >300 bed capacity: 100% by end of 2025 |
| | 2.2.4 Provide technical support to laboratories on testing and reporting of AMR, and contributing to national AMR surveillance | Q2 2023 | **Weqaya** | Fulfillment of technical support (%) | 0% | 100% | Report with technical support provided to laboratories |
| | 2.2.5 Improve capacity at National AMR Laboratory at Weqaya to test up to 15,000 isolates | Q3 2022 | **Weqaya** | AMR isolates tested (#) | 0% | 15,000 | National AMR lab with increased capacity to test up to 10,000 isolates/year |
| | 2.2.6 Build capability for AMR molecular epidemiology at National AMR Laboratory at Weqaya to test up to 8,000 isolates | Q4 2022 | **Weqaya** | AMR isolates tested (#) | 0% | 8,000 | National AMR lab with increased capacity to test up to 8,000 isolates/year<br>A yearly report on tested isolates |

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| **2.3 Increase laboratory capacity to produce high-quality microbiological data for animals and the environment** | 2.3.1 Reassess the selected sentinel sites and increase selection for surveillance in the animal and environmental sectors | Q4 2023 | **MEWA** | Sentinel sites selected (#) | 1 | 3 | List of Sentinel sites for animal sector and (add over time) |
| | 2.3.2 selected sentinel sites and increase selection for surveillance in environmental sectors | Q4 2022 | **MEWA** | Sentinel sites selected (#) | TBD | TBD | List of Sentinel sites for environmental sector (add over time) |
| | 2.3.3 Develop a standardized mechanism for AMR testing and reporting according to accepted international standards | Q4 2023 | **Weqaa** | Completion of testing mechanism (%) | 10% | 100% | AMR testing guidelines in animal sector |
| | 2.3.4 review operation of reference laboratories for the isolation and identification of resistant pathogenic bacteria in animals | Q4 2023 | **Weqaa** | Isolates tested (%) | 5% | 100% | Report on operation at animal reference laboratories |
| **2.4 Enhance and promote evidence-based research to build better knowledge about AMR** | 2.4.1 Establish a list of research priorities and gaps related to AMR for researchers | Q1 2023 | **Weqaya, and other sectors** | Completion of priorities list (%) | 0% | 100% | List of research priorities (100%) |
| | 2.4.2 Identify national burden of AMR including health and economic impact | Q4 2024 | **Weqaya, and other sectors** | Completion of assessment (%) | 0% | 100% | AMR burden assessment |

Objective 3: Improve awareness and understanding of antimicrobial resistance through effective communication, education, and training

| Initiative Name | Activities | Milestone | Responsible sectors | Proposed process indicators | Baseline | Target | Deliverables |
|---|---|---|---|---|---|---|---|
| **3.1 Increase national public awareness about antimicrobials and AMR** | 3.1.1 Report results of national baseline survey to measure awareness level in the population | Q3 2022 | **Weqaya** | Participants in the survey (%) | 70% | 100% | Report on results of national baseline survey |
| | 3.1.2 develop AMR related educational materials targeting different population groups | Q3 2022 | **Weqaya** | Completion of educational materials (%) | 30% | 100% | Educational programs for targeted populations launched annually Q4 during antimicrobial awareness week |

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| **3.2 Include AMR and related topics as a core component of professional education, training, certification, and development** | 3.2.1 Review the current undergraduate curricula for human health, animal health, and food industry and agriculture professionals and determine needs for AMR and related topic | Q2 2024 | **Weqaya and MOE and MEWA** | Completion of review (%) | 0% | 100% | Report on status of AMR in current undergraduate curricula |
| | 3.2.2 Develop educational content for AMR and related topics for undergraduate curricula | Q4 2025 | **Weqaya and MOE** | Completion of development of content (%) | 0% | 100% | courses content for undergrad curricula |
| | 3.2.3 Include developed AMR and related content and related topics in undergraduate curricula | Q4 2025 | **MOE** | Inclusion of developed content in curricula (%) | 0% | 100% | Courses in AMR and related topics in undergrad curricula |
| | 3.2.4 Review the current curricula for postgraduate residents and fellows in human health | Q2 2024 | **SCFHS** | Completion of review (%) | 0% | 100% | Report on status of AMR in current postgraduate curricula |
| | 3.2.5 Develop educational content for AMR and related topics for curricula for postgraduate residents and fellows in human health | Q2 2025 | **SCFHS** | Completion of development of content (%) | 0% | 100% | Courses content for postgraduate curricula |
| | 3.2.6 Include developed content for AMR and related topics in postgraduate curricula | Q4 2025 | **SCFHS** | Inclusion of developed content in curricula (%) | TBD | TBD | Courses in AMR and related topics in postgraduate curricula |
| | 3.2.7 Develop training courses for medical professionals working in microbiology laboratories and antimicrobial stewardship | Q4 2022 | **Weqaya, SCFHS** | Trainees per year | TBD | 250 trainees/ year | Training courses available online, workshops |
| | 3.2.8 Develop training courses for veterinary professionals in hygiene and infection prevention and control, and in antimicrobial stewardship in veterinary practice | Q2 2022 | **MEWA** | Trainees per year | 400 | 800 | Training courses, educational materials |

Objective 4: Optimize the use of antimicrobial medicines in human and animal health

| Initiative Name | Activities | Milestone | Responsible sectors | Proposed process indicators | Baseline | Target | Deliverables |
|---|---|---|---|---|---|---|---|
| **4.1 Optimize antimicrobial consumption data collection in humans and animals** | 4.1.1 Conduct national point prevalence survey on antimicrobial consumption and resistance in the 40 participating MOH hospitals and compare previous results for trends in hospitals participating in antimicrobial stewardship programs | Q4 2022 | **Weqaya, MOH and healthcare facilities** | Participation of 40 hospitals (%) | 0% | 70% | Report on results of national point prevalence survey |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 4.1.2 Produce periodic reports on antimicrobial consumption with increase in contributing entities | Q1 2023 | **Weqaya SFDA, NUPCO, and healthcare facilities** | Completion of report (%) | 0% | 100% | Annual monitoring reports (with 10% annual increase of entities contributing antimicrobial consumption data) |
| **4.2 Improve antimicrobial stewardship programs (ASP) in all healthcare facilities** | 4.2.1 Develop and distribute national guidelines on the implementation of ASP in all hospitals | Q1 2022 | **Weqaya** | Adoption of guidelines (%) | 0% | 60% | National antimicrobial stewardship guidelines |
| | 4.2.2 Conduct baseline assessment of ASP in non-MOH governmental and selected private healthcare facilities with over >150 beds | Q3 2022<br>Q1 2024 | **Weqaya, all healthcare facilities** | Response rate of non-MOH governmental healthcare facilities (%) | 0% | 80% | Report on baseline assessment of antimicrobial stewardship in non-MOH governmental by Q3 2022 and selected private healthcare facilities Q1 2024 |
| | 4.2.3 improve monitoring and reporting of antimicrobial stewardship programs in participating healthcare facilities with over >150 beds | Q3 2022<br>Q3 2023<br>Q3 2024 | **Weqaya, all healthcare facilities** | TBD | TBD | TBD | Improved reporting for MOH by Q3 2022<br>Include reporting for non-MOH governmental by Q3 2023<br>Include reporting for private facilities Q3 2024 |
| **4.3 Ensure prudent use of antimicrobial agents in terrestrial and aquatic animals and agriculture** | 4.3.1 Produce a comprehensive annual list of restricted antimicrobials consumed in the animal health sector (specially in food producing animals) | Q2 2022 | **Weqaa and SFDA** | Completion of list (%) | 10% | 100% | Annual report on the usage of restricted antimicrobials in animal |
| | 4.3.2 Establish an antimicrobial prescription and utilization monitoring system for the animal health sector. | Q4 2023 (agriculture projects), Q2 2024 (veterinary clinics) | **Weqaa** | Antimicrobial use in animals (rate) | 0% | 60% | Antimicrobial monitoring system in animal sector |
| | 4.3.3 Develop and distribute national guidelines for antimicrobial use in different animal species according to needs:<br>a. Food animals<br>b. Pet's animals<br>c. Aquatic animals (fish, etc.) | Q4 2023 | **Weqaa** | Adoption of guidelines (%) | 30% | 100% | National guidelines for antimicrobial use in animal sector |

| Objective 5: Reduce the incidence of infection through effective sanitation, hygiene, and prevention measures | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Initiative Name** | **Activities** | **Milestone** | **Responsible sectors** | **Proposed process indicators** | **Baseline** | **Target** | **Deliverables** |
| **5.1 Strengthen National Infection Prevention and Control Program** | 5.1.1 Review and update national infection control guidelines for all healthcare facilities | Q2 2024 | **Weqaya, MOH** | Adoption of guidelines to healthcare facilities (%) | TBD | 100% | Updated infection control guidelines |
| | 5.1.2 Establish infection control auditing for multiple control standards on the electronic system for MOH, non-MOH and private hospitals | Q1 2025 | **MOH** | Periodic system audits (#) | TBD | Annual | Annual audit reports from MOH, non-MOH, and private hospitals |
| | 5.1.3 Add the following bundles to the electronic infection control auditing system for all hospitals >100 beds:<br>• HAI electronic surveillance system<br>• VAE<br>• CAUTI<br>• CLABSI<br>• MDROs | Q4 2024 | **MOH** | Inclusion of 5 bundles to system (%) | TBD | 100% | Monitoring reports for the 5 additional bundles on the electronic auditing system (5) |
| **5.2 Establish a National Infection Control Program for the animal health sector** | 5.2.1 Establish a team and operational framework to manage the program | Q3 2022 | **Weqaa** | Completion of team and framework (%) | 0% | 100% | Team with clear framework to manage the National Infection Program for the animal sector [1] |
| | 5.2.2 Develop and distribute infection prevention and control policies in animal health care and husbandry settings | Q3 2022 | **Weqaa** | Adoption of guidelines (%) | 0% | 100% | AMR infection prevention and control policy manual for animals |
| | 5.2.3 Establish monitoring and evaluation framework for the program | Q1 2024 | **Weqaa** | Completion of framework (%) | 0% | 100% | Monitoring and evaluation framework [1] |

## Outcome Indicators

To measure success in the reduction of antimicrobial resistance in the Kingdom, we aim to measure reductions in antibiotic resistance using indicators related to five pathogens and regarding the use of antimicrobial agents (see Table 4). As we are working to enhance AMR reporting in hospitals, we are expecting the value of these indicators to increase from 2022 through 2023. We will be monitoring these indicators very closely during this time and aim to start reporting at the beginning of 2024.

**Table 4: Outcome indicators for AMR**

| Indicator | Formula | Potential data sources |
|---|---|---|
| Rate of *Clostridium* difficile infection (%) | Number of healthcare-associated *clostridium* difficile infections over a period of time/Total number of patient days within that period*100,000 | • MOH and non-MOH governmental hospitals microbiology laboratory and infection control data collection systems |
| Rate of *Escherichia coli (E. coli)* in blood specimen resistant to 3rd generation cephalosporins (%) | *E. coli* in blood specimen resistant to 3rd generation cephalosporins/All tested *E. coli* in blood specimen*100 | • Weqaya AMR surveillance system<br>• MOH and non-MOH governmental hospitals microbiology laboratory and infection control data collection systems |
| Rate of methicillin resistant *Staphylococcus aureus (MRSA)* in blood specimen *(%)* | *MRSA* in blood specimen/All tested *Staphylococcus aureus* in blood specimen*100 | |
| Rate of carbapenem resistant *Klebsiella pnumoniae* in blood specimen (%) | Carbapenems resistant *Klebsiella pnumoniae* in blood specimen/All tested *Klebsiella pnumoniae* in blood specimen*100 | |
| Rate of carbapenem resistant *Escherichia coli (E. coli)* in blood specimen (%) | Carbapenems resistant *E. coli* in blood specimen/All tested *E. coli* in blood specimen*100 | |
| Rate of carbapenem resistant *Pseudomonas Aeruginosa in* blood specimen (%) | Carbapenems resistant *Pseudomonas Aeruginosa in* blood specimen/All tested *Pseudomonas Aeruginosa in* blood specimen*100 | |
| Rate of colistin resistant *Acinetobacter* in blood specimen (%) | Colistin resistant *Acinetobacter* in blood specimen/All tested *Acinetobacter* in blood specimen*100 | |
| Rate of defined daily dose (DDD) of an agent per 100 patient-days in selected antimicrobials (%):<br>• Meropenem<br>• Imipenem<br>• Piperacillin/tazobactam<br>• Colistin<br>• Vancomycin | DDD of an agent purchased/dispensed/consumed in a period of time/Total number of patient-days within that period of time*100 | • TBD |

## Monitoring and evaluation

Upon approval of the AMR National Action Plan, we will jointly develop a Monitoring & Evaluation Framework including measurable targets and the associated indicators, as well as a clear monitoring and reporting process for relevant entities. Such a framework is critical to monitor the implementation and measure the impact of the proposed interventions. We will conduct a review midway through the plan (2023) to monitor the progress of its implementation. End of term evaluation will be conducted in 2025, from which we will build next steps.