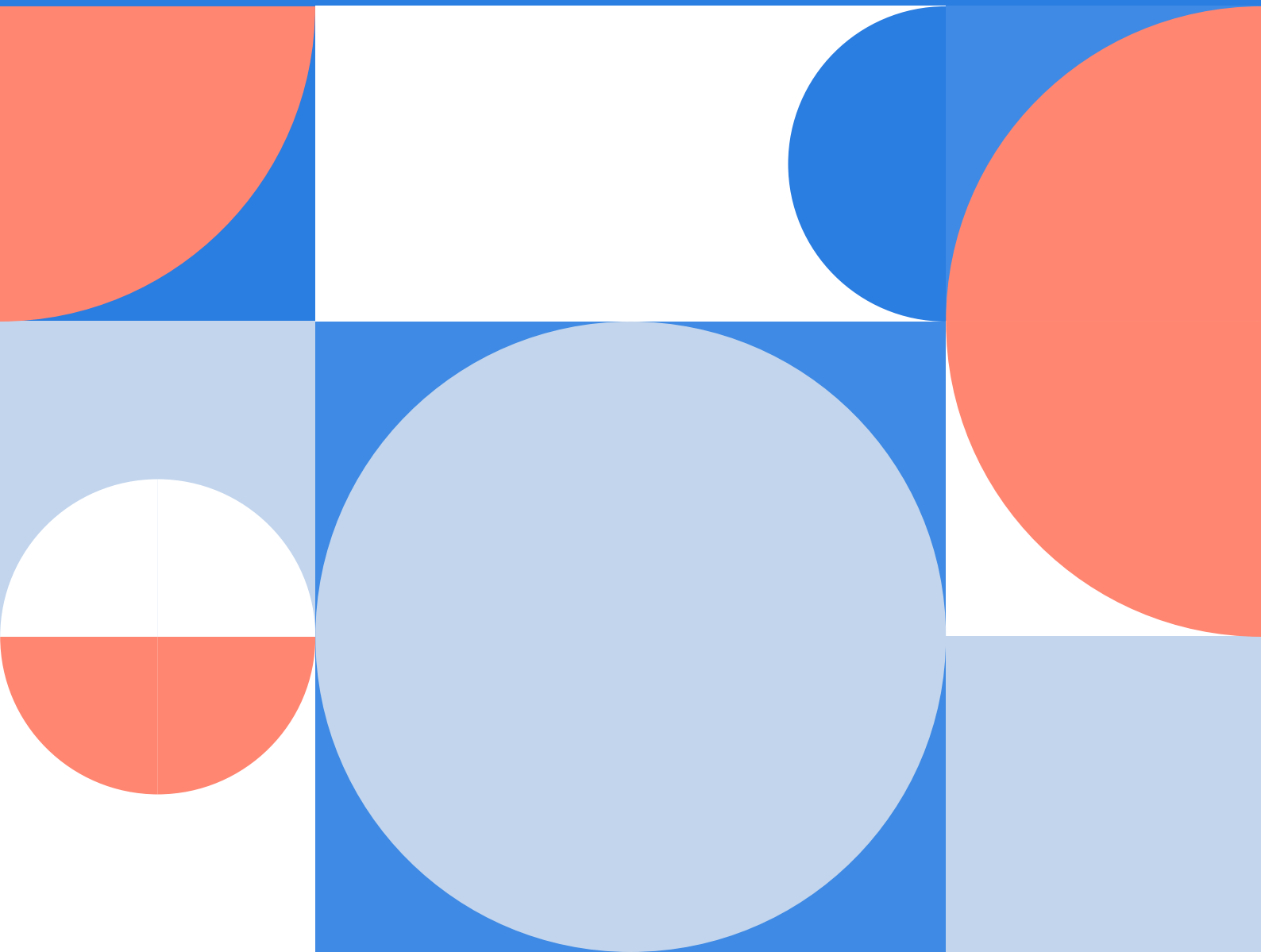
World Health Organization

Mali national action plan on antimicrobial resistance

Review of progress in the human health sector

Antimicrobial resistance policy information and action brief series



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Mali national action plan on antimicrobial resistance: review of progress in the human health sector

(Antimicrobial resistance policy information and action brief series)

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Acronyms and abbreviations

AAAMR	African Association for Research and Control of Antimicrobial Resistance
AMC	antimicrobial consumption
AMR	antimicrobial resistance
AMS	antimicrobial stewardship
AMU	antimicrobial use
AST	antimicrobial susceptibility testing
AWaRE	Access, Watch, and Reserve
CDC	United States Centers for Disease Control and Prevention
CFA	West African franc
COVID-19	Coronavirus disease
CVD	Center for Vaccine Development
DPT3	diphtheria-pertussis-tetanus-containing vaccine
GAP	global action plan
GLASS	Global Antimicrobial Resistance Surveillance System
HAI	health care-associated infection
HIB3	*Haemophilus influenzae* type b vaccine
IPC	infection prevention and control
KAP	knowledge, attitudes and practices
KI	key informant

KII(s)	key informant interview(s)
KOICA	Korea International Cooperation Agency
M&E	monitoring and evaluation
MSF	Médecins Sans Frontières
MTaPS	Medicines, Technologies, and Pharmaceutical Services
NAP	national action plan
NCC	National Coordinating Committee
NCCS	National Coordinating Committee for Surveillance
NFP	national focal point
NRL	national research laboratory
PCV3	pneumococcal conjugate vaccine
R&D	research and development
RECOTRADE	Network of Traditional Communicators for the Development of Mali
TG	technical group
TOR	terms of reference
TrACCS	Tracking AMR Country Self-Assessment Survey
USAID	United States Agency for International Development
WAAW	World Antimicrobial Awareness Week
WASH	water, sanitation and hygiene
WHO	World Health Organization

Executive summary

In 2018, the National Multisectoral Coordinating Committee on Antimicrobial Resistance[1] in Mali, also referred to as the National Coordinating Committee (NCC), published its national action plan (NAP) on the prevention and containment of antimicrobial resistance (AMR), covering the years 2019–2023[1]. The NAP on AMR is well aligned with the World Health Organization's (WHO) Global Action Plan on AMR, adopts a One Health approach, and details activities and budgets needed for implementation. Recognizing the importance of governmental appropriation of the plan for its sustainable implementation, the NAP on AMR contains a sixth objective that advocates for developing a legislative and regulatory framework for AMR.

The NAP on AMR was developed by the Ministry of Health and Social Affairs,[2] in collaboration with the Ministry of Livestock and Fisheries, the Ministry of Agriculture and the Ministry of the Environment, Sanitation and Sustainable Development; however, it awaits formal approval by the prime minister's office. Unfortunately, the absence of this high-level political endorsement and the absence of dedicated domestic funding and allocation of human resources has impacted implementation and operationalization of the NAP on AMR. Other factors that have negatively impacted implementation include ongoing cycles of political instability, security issues and the coronavirus disease (COVID-19) pandemic.

Despite these challenges, Mali has made progress in addressing and mitigating AMR. The NCC oversees the country's AMR activities and coordinates national and regional technical groups (TGs) that align with each of the six primary objectives of the NAP on AMR. The Ministry of Health and Social Affairs recently established a One Health platform to provide a multisectoral framework to detect and respond to disease outbreaks of pandemic potential, including a working group dedicated to AMR *(2)*. Interviews with key AMR experts in the country highlighted the need for hiring permanent staff to support NCC activities. In addition, monitoring and evaluation (M&E) activities across the different levels of governance and coordinating mechanisms are crucially needed to identify priority areas.

Due to limited resources, few AMR awareness activities are currently taking place in Mali. While Mali has participated in World Antimicrobial Awareness Week (WAAW), the need for awareness-raising activities at the community and health care level remains. To advocate for action on AMR, researchers and AMR experts in Mali and other African countries have created the African Association for Research and Control of Antimicrobial Resistance (AAAMR), an illustration of the efforts of scientific experts to advance the AMR agenda on the continent.

Significant progress has been made regarding AMR surveillance. In 2019, with support from WHO and the Korea International Cooperation Agency (KOICA), the Ministry of Health and Social Affairs established a patient-based national AMR surveillance system in five hospitals. Additionally, Mali enrolled in WHO's Global Antimicrobial Resistance and Use Surveillance System (GLASS) in 2018. Since then, the country has participated in the data calls of 2019, 2020 and 2021. More recently, Mali also enrolled in the GLASS IT platform for antimicrobial consumption (GLASS-AMC) *(3, 4)*. However, AMR surveillance solutions are needed in regions with less access to health care outside the area of Bamako, the capital city. Expanding AMR surveillance across the country is necessary to get a better understanding of the AMR situation in the country and to support patient care, as well as to make the economic case for investment in activities and interventions to address AMR.

Mali recently updated its national infection prevention and control (IPC) guidelines based on WHO IPC guidelines. IPC committees have been created in 12 facilities across the country, and IPC guidelines are now implemented in the five facilities selected as AMR surveillance sites *(5)*. Despite this progress, the lack of adequate IPC measures in many hospitals in Mali remains a grave concern; IPC monitoring in health care facilities is needed to identify and address critical gaps that contribute to the high incidence of health care-associated infections (HAIs).

Data on the AMR burden in Mali are scarce; however, results from the AMR surveillance network reported to GLASS indicate significant levels of resistance to Watch[3] antibiotics *(3)*. Strengthening and expanding laboratory diagnostics and surveillance capacity are necessary to obtain a better view of the health and economic burden imposed by AMR.

[1] In French: Groupe de Coordination Multisectorielle National-Résistance aux Antimicrobiens.
[2] The Ministry of Health and Social Affairs was previously known as the Ministry of Health and Public Hygiene.
[3] WHO created the AWaRe (Access, Watch, Reserve) classification in 2017 to promote the appropriate use of antibiotics and slow emergence of AMR.

The following are key findings and needs to accelerate AMR mitigation efforts in Mali:

1. Conduct an assessment of the NAP on AMR in preparation for the development of the NAP on AMR 2.0.
2. Advocate for high-level governmental endorsement of the NAP on AMR.
3. Advocate for dedicated domestic funding to implement and monitor the NAP on AMR 2.0 as well as mobilization of resources from external partners.
4. Conduct routine M&E activities to update stakeholders on implementation progress and to identify priority action areas.
5. Implement AMR, antimicrobial use (AMU) and antimicrobial stewardship (AMS) awareness-raising activities among health care workers and the public to promote appropriate antibiotic use and prevention of infections. Leverage the existing pool of expertise available through the AAAMR.
6. Strengthen and expand laboratory and AMR and AMU surveillance capacities across all levels of health care.
7. Prioritize investment and capacity building in cross-cutting areas such as IPC and water, sanitation and hygiene (WASH).
8. Improve access and optimal use of antimicrobials by leveraging AMS expertise from AMR surveillance sites and expand AMS capacities to other health centres.
9. Support prioritization of AMR activities through an economic assessment of the health and economic burden of drug-resistant infections in paediatric and adult populations.

1. Overview

This policy brief describes the current implementation status of Mali's national AMR mitigation policies and strategies.

The brief identifies findings to accelerate efforts to address the challenges related to AMR. It has been developed based on a review of publicly available data, government-sourced reports and documents, peer-reviewed literature, press releases, funding proposals and interviews with select AMR focal persons in Mali conducted between October and December 2021.

This analysis is aligned with the strategic objectives outlined in WHO's Global Action Plan (GAP) on AMR; it encompasses public awareness and understanding of AMR, laboratory diagnostics, surveillance and research, prevention of infections, optimized use of antimicrobials, and research and development (R&D) in the human health sector.

2. Health and AMR in Mali

In 2020, Mali had an estimated population of 20.2 million people, with an annual growth rate of 3.0% *(6, 7)*. In 2020, 41.9% of the people in Mali lived below the national poverty line, and 90% of the country's poorest lived in rural areas *(8, 9)*. Overall life expectancy at birth increased from 28 years in 1960 to 59 years in 2019 *(6)*. Leading causes of death include neonatal disorders, malaria, lower respiratory infections, malnutrition and diarrhoeal diseases *(10)*.

Mali's decentralized health care system operates at five levels, ranging from national and regional to district, health area and community tiers *(11)*. The total health care expenditure per capita in 2018 was US$ 35.0, with an average out-of-pocket expenditure of US$ 11.9, accounting for 33.9% of the total health expenditure *(6)*. In 2019, the Government of Mali announced several reforms expected to go into effect in 2022 to address critical issues regarding access to health care services, especially among urban-dwelling residents and vulnerable groups such as children under 5, pregnant women and the elderly *(12)*. According to the WHO spatial database of health facilities in the public health sector in sub-Saharan Africa, in 2019 Mali had 18 hospitals, three of which were university hospitals *(13)*.

Cycles of political instability and security issues spanning a decade, compounded by the recent COVID-19 pandemic, have presented significant challenges to advancing work addressing AMR issues in Mali. However, despite these barriers, dedicated professionals with support from governmental departments and external partners have made efforts to acknowledge and address AMR as a pressing public health issue. Due to data gaps, the current AMR burden in Mali is unclear. Nonetheless, there is an emerging understanding of AMR from peer-reviewed literature and national surveillance efforts covering five health facilities *(14-19)*. Mali reported to GLASS that 4168 patients had a blood sample taken by the five participating hospitals in 2019. The most commonly identified pathogens from these blood samples were *Salmonella* spp. (*n* = 196), followed by *Streptococcus pneumoniae* (*n* = 78), *Acinetobacter* spp. (*n* = 41) and *Escherichia coli* (n = 40). The resistance proportions reported for *S. pneumoniae* were 25% (CI: 14–40%) for co-trimoxazole and 28% (CI: 116–43%) for oxacillin, and the resistance proportions for *Acinetobacter* spp. were 46% (CI: 23–71%) for gentamicin and 38% (CI: 18–64%) for imipenem. As the number of blood isolates reported was relatively low, and antimicrobial susceptibility testing (AST) results were not available for all isolates, caution should be taken when interpreting the data *(14)*.

A 2018 study reported that 20% of tested isolates collected from patients at a paediatric hospital were resistant to multiple antimicrobials *(15)*. High rates of resistance to tetracycline, amoxicillin, ciprofloxacin and the combination of sulfamethoxazole and trimethoprim from HAIs were also documented among children admitted for surgery at Gabriel Touré University Hospital in Bamako between 2017 and 2018 *(19)*. High AMR rates at the community-level were also observed in 2017. Among 120 children under the age of five presenting with diarrheal disease in four community health centres in Bamako between 2016 and 2017, *Escherichia coli* – isolated in one-third of the cases – indicated resistance to beta-lactams was 86.4% for amoxicillin, 59.5% for the association with clavulanic acid, and 21.6% for cefoxitin. In contrast, the highest *Escherichia coli* susceptibility was seen towards aminoglycosides, with 29.7% resistance to gentamicin and 18.9% to amikacin *(20)*.

A 2017 study of patients from the Department of Infectious Diseases at Point G University Teaching Hospital, the majority of whom were HIV-positive, found that *Escherichia coli* isolates from patients had full susceptibility to colistin and imipenem, high susceptibility to amikacin (96%) and partial susceptibility to beta-lactams (16.7–52%), gentamicin (34.6%) and quinolones (20.8–53.3%) *(21)*. A more recent study covering *Pseudomonas aeruginosa* samples from the same hospital between 2010 and 2019 found substantial resistance to ticarcillin, aztreonam, gentamicin, tobramycin, netilmicin and ciprofloxacin, with significantly higher levels of AMR among inpatients compared with outpatients for half of the antibiotics tested *(22)*. Another study assessing antibiotic resistance profiles of *Mycoplasma hominis* and *Ureaplasma urealyticum* in women between 2014 and 2017 revealed that antibiotic resistance varied between 85% and 96% for fluoroquinolones, and 13% to 85% for macrolides and related agents *(23)*.

Available data suggest varying but mostly high levels of resistance in both adult and paediatric populations. The data also identify vulnerable groups, such as HIV-positive individuals, at high risk of losing treatment options due to resistance to last-resort antibiotics. To obtain better insight into the health and economic burden associated with AMR and drug-resistant infections, surveillance efforts at a nationally representative scale are urgently needed.

3. Status of the national action plan on AMR

2020/2021 Tripartite AMR Country Self-Assessment Survey (TrACCS) status:

- A NAP on AMR has been developed and revised.
- The NAP on AMR development and implementation process has been negatively affected by the COVID-19 pandemic.

Current status:

- The NAP on AMR is technically approved by various ministries, including the Ministry of Health and Social Affairs, but awaits endorsement from the prime minister's office.
- The One Health platform in Mali has a thematic working group dedicated to AMR.
- Limited financial resources, including the lack of a dedicated AMR budget from the government, are a critical barrier to NAP on AMR implementation.

Key findings and needs:

- Advocate for high-level government endorsement of the NAP on AMR through the legal framework and infrastructure provided by the One Health platform.
- Conduct an assessment of the NAP of AMR to guide development of the NAP on AMR 2.0.
- Advocate for dedicated domestic funding to implement and monitor the NAP on AMR 2.0 and commitment at the highest level of government.

To address the health and economic impacts of AMR, in November 2018 the NCC published a NAP on AMR for Mali *(1)*. The NAP on AMR, whose inception commenced in 2014, was developed by the then Ministry of Health and Public Hygiene in collaboration with the Ministries of Livestock and Fisheries, Agriculture, and Environment, Sanitation and Sustainable Development. Officially titled *National action plan to fight antimicrobial resistance in Mali: NAP-AMR 2019–2023*,[4] the plan is aligned with the strategic objectives of the Global Action Plan on AMR and outlines the following six objectives:

1. Improve awareness and understanding of AMR through communication, education and training.
2. Strengthen knowledge through monitoring and research.
3. Reduce the incidence of infections through hygiene, sanitation and prevention measures.
4. Optimize the use of antimicrobial agents in human, animal and agricultural sectors.
5. Develop an economic case for sustainable investment, taking into account the country's needs and increasing investment in the R&D sector.
6. Develop the legislative, regulatory and legal texts necessary to implement AMR control activities.

According to key informants (KIs), the NAP on AMR has been adopted by the Ministry of Health and Social Affairs. However, as of December 2022 it was still awaiting formal endorsement from the prime minister's office. The sixth objective of the NAP on AMR was added to promote legal recognition of AMR in various government documents (including regulation of antibiotic sales and use) and to support the plan's implementation. As highlighted in the NAP on AMR, recognition of the plan by the prime minister's cabinet is indispensable to ensure allocation of dedicated human and financial resources for its implementation.

The NCC has outlined a budget totalling 55 million West African francs (CFA) (US$ 95 million) to implement the six objectives and their respective activities *(24)*. According to KIs, despite the lack of financial and legislative support, which hinders operationalization and implementation of the plan, some important activities have been initiated with the support of dedicated experts, scientists, doctors, pharmacists, laboratory technicians in-country and financial support from partner organizations. KIs have also pointed out that the repeated political changes in Mali have resulted in significant delays regarding the formal adoption of the NAP on AMR.

In a promising development for AMR mitigation, the Government of Mali, with support from the Preparedness and Response project of United States Agency for International Development (USAID), launched a One Health platform to strengthen human and livestock health security and to detect and address epidemic threats *(2)*. According to a recent publication, the One Health platform provided input on the NAP on AMR *(25)*. According to KIs, an AMR working group is included in the One Health platform, and efforts are currently underway to include two thematic groups: biosecurity and epidemiological surveillance.

[4] *Plan d'action national (PAN) de lutte contre la résistance aux antimicrobiens (RAM) au Mali: PAN-RAM 2019–2023.*

4. AMR governance and coordination mechanisms

2020/2021 TrACCS status:

- A multisectoral working group(s) or coordination committee on AMR was established with government leadership.

Current status:

- The NCC has developed an operational plan and a detailed plan for M&E of the NAP on AMR implementation; however, routine M&E activities are not taking place and have been further stalled by the COVID-19 pandemic.

Key findings and needs:

- Conduct routine M&E activities to update stakeholders on implementation progress and to identify priority action areas.
- Mobilize resources through grants or external partners to complement domestic funding to support the NCC in coordinating and implementing the NAP on AMR.

The NCC coordinates all AMR-related activities in Mali. A terms of reference (TOR) document, published by the Ministry of Health and Social Affairs in 2019, details the roles and responsibilities of NCC members and six national TGs, each aligned with the strategic objectives of the NAP on AMR that coordinate with the NCC at the national *level (26)*. The NCC is composed of 22 members: one focal point from each sector (human, animal, agriculture and environment) plus 18 members affiliated with the six national TGs, which encompass communication and awareness, surveillance and research, IPC, rational use of drugs, resource mobilization and legislation.

The NCC is led by the AMR national focal point (NFP) from the human health sector. In addition to the six TGs operating at the national level, the TOR stipulates that the NCC, in coordination with TGs, can also set up ad hoc working groups that are dissolved at the end of their mission. The roles and responsibilities of the NFP for AMR and the sectoral focal points are clearly described in the NAP on AMR. While focal points for each sector are responsible for building partnerships and coordinating the development and implementation of the NAP on AMR within and between the different sectors, the NFP is responsible for building sustainable partnerships nationally and internationally and coordinating data collection and reporting to GLASS. The structures and processes outlined in the NAP on AMR are adequate, according to a KI; however, the lack of dedicated staff challenges the operationalization of NAP activities.

Members of the NCC meet quarterly, and while the committee members are not remunerated, expenses related to NCC activities are covered by external partner funds or facilitated by existing mechanisms at the level of government technical services. During the COVID-19 pandemic, online meetings were held but posed a challenge for members lacking good access to videoconferencing systems. The NCC has developed an operational plan and a plan for M&E of NAP on AMR implementation, detailing the activities, stakeholders involved, progress indicators and frequency of meetings *(27)*. However, M&E activities could not be organized routinely (especially mid-term evaluations) due to restrictions or reallocation of funds related to the COVID-19 pandemic. While the organization of M&E requires efficient and timely interministerial coordination, implementation of the NAP on AMR remains quite challenging given the lack of formal political adoption of the plan.

5. AMR awareness and knowledge

2020/2021 TrACCS status:

- Limited or small-scale AMR awareness campaign targeting some but not all relevant stakeholders.
- AMR is covered in some preservice training and some in-service training or other continuing professional development for human health workers.

Current status:

- The inclusion of traditional communicators in the TG for communication and awareness (TG1) highlights a commitment to bringing AMR awareness to the community.

Key findings and needs:

- Conduct knowledge, attitudes and practices (KAP) surveys on AMR at both the community and health care level.
- Deliver simple and effective messages during awareness campaigns to encourage appropriate antibiotic use in the community for both the human and animal health sectors.
- Consider establishing programmes that advocate for AMR awareness-raising through education.
- The AAAMR contains a pool of expertise that can be leveraged to develop AMR awareness and training materials (for both formal and informal curricula), which can then be used in Mali and other African countries.

AMR awareness activities in Mali are coordinated by TG1. The TG is composed of different stakeholders from the education, pharmacy and animal health sectors, among others. The NAP on AMR contains three specific objectives aimed at improving awareness and understanding of AMR:

1. Prioritize AMR at all relevant ministries by disseminating the NAP on AMR plans and implementation responsibilities for each of the sectors, as well as advocating for budget allocations.
2. Raise awareness through communication programmes, starting with a situational analysis and workshops to develop a communication strategy for AMR.
3. Design training for health professionals, schools and the general public.

Some of the activities proposed to achieve these objectives include implementing communication campaigns targeting all sectors, participating in global and regional AMR awareness campaigns, leveraging existing communication programmes for other infectious diseases and developing teaching modules on AMR and related topics in formal and nonformal curricula. Including the Network of Traditional Communicators for the Development of Mali (RECOTRADE) in TG1 clearly highlights the commitment of the NCC to promote AMR awareness across the different spheres of society. However, due to limited resources and competing priorities, awareness activities in the community have not materialized. As reported in the 2020/2021 TrACSS survey, few AMR awareness activities took place in Mali. However, Mali has participated in WAAW.

Based on a KI interview, training of postgraduate students in the health sector (health care workers completing an MSc/PhD) is expected to contribute to the sustainability of the awareness activities and strengthen human resources dedicated to addressing AMR in the country. A 2019 cross-sectional KAP study suggests there are low levels of knowledge on antibiotic use among medical students in Mali *(28)*. The average knowledge score was 4 out of 10 among 446 future health professionals, and 80% of those practising self-medication had used antibiotics *(28)*. Awareness through educational materials and the creation of incentives that promote research on AMR is crucial to close the knowledge gaps around AMR and its implications for health.

Researchers in Mali and representatives from the Ministry of Health and Social Affairs participate in the AAAMR, contributing to increased regional AMR expertise. In 2018, 150 scientists from 14 countries in Africa and the United States of America attended a 3-day congress focusing on the challenges of AMR in Africa *(29)*. Additionally, in January 2019, the AAAMR made a plea for support in the fight against AMR during the two-day workshop in Bamako to launch AMR monitoring activities based on previous scientific work *(30)*.

6. Surveillance, laboratory and diagnostic capacity

2020/2021 TrACCS status:

- A functional national AMR surveillance system covers common bacterial infections in hospitalized and community patients with external quality assurance and a national coordinating centre that produces reports on AMR.
- Most bacteriology laboratories in the public health sector are part of a national laboratory network.
- The national reference laboratory (NRL) supports the bacteriology laboratory network in identifying pathogens and has established a national external quality assurance programme that is available to the national bacteriology laboratory network.

Current status:

- There is a clear surveillance structure and an M&E framework for the sentinel surveillance system across existing sentinel sites.
- The national AMR surveillance system includes five sentinel sites that reported to WHO GLASS during the 2019, 2020 and 2021 data calls.

Key findings and needs:

- Further strengthen laboratory services, expand the national AMR surveillance system and maintain AMC surveillance.
- Dedicate funding to maintain operations in the five sentinel sites and expand surveillance capabilities to other hospitals.
- Mobilize funding to establish a micro-laboratory system to increase access to point-of-care rapid tests across the country.

AMR surveillance is a core component of the NAP on AMR; it aims at strengthening knowledge and evidence on AMR through monitoring and research *(31)*. Based on a KI interview, the implementation of a functional AMR surveillance system is a key priority because of its potential to guide AMR mitigation strategies and provide quantifiable indicators to support policy-makers and government officials. The national AMR surveillance programme was officially launched in January 2019 with support from KOICA. The programme was endorsed by the USAID-supported One Health platform.

The national coordination structure for AMR surveillance (NCCS)[5] leads the national surveillance programme. The NCCS comprises the National Institute for Public Health Research,[6] which supervises and supports the national surveillance network in close collaboration with the National Directorate of Health[7] and the Directorate of Pharmacy and Medicines.[8]

As a result of these efforts, a patient-based approach to surveillance has been implemented in five sentinel surveillance sites (Point G University Teaching Hospital, Mother–Child University Hospital "Le Luxembourg", Ségou Regional Hospital, Sikasso Regional Hospital and the Koutiala Reference Health Centre), where clinicians enrol patients according to national surveillance strategy case definitions. This strategy prioritizes AST for the following 11 pathogens: *S. pneumoniae, Neisseria meningitidis, Haemophilus influenzae, Staphylococcus aureus, E. coli, Klebsiella pneumoniae, Acinetobacter baumannii, P. aeruginosa, Salmonella* spp., *Shigella* spp. and Neisseria gonorrhoeae. Surveillance sites are required to send AST results to the NCCS monthly and to report unusual resistance immediately. However, based on a KI interview, routine data collection and reporting across the different facilities need to be improved.

[5] Structure Nationale de Coordination pour la surveillance de la RAM (SNC-RAM).
[6] Institut National de Santé Publique (INSP).
[7] Département de la Surveillance Épidémiologique de la Direction National de la Santé (now known as Direction Générale de la Santé et de l'Hygiène Publique, DGSHP)
[8] Direction de la Pharmacie et des Médicaments (DPM).

Standard procedures of the national internal quality control programme are now implemented routinely at the five surveillance sites. The NRL is running the national external quality assessment; standard panels are sent annually to the laboratory of the five surveillance sites. All surveillance sites are sending quarterly aliquots of all identified strains to a national directory (repository) that has been established at the NRL level.

According to a KI, AMR surveillance reports are developed every 6 months by the NCCS and are then disseminated to national partners. Recently, guidelines on surveillance data collection were developed by the Ministry of Health and Social Affairs *(32)* which outline the responsibilities at each coordinating level: *(1)* surveillance sites computerize patient-level data using WHONET microbiology laboratory database software and share their monthly surveillance reports with the NCCS; *(2)* the NCCS validates the data collected from the sentinel sites, develops semi-annual and annual surveillance reports and provides feedback on data quality; and *(3)* the NFP approves the reports, supervises dissemination of key results to stakeholders and organizes submission of national AMR data to GLASS. An annual report on the progress of the national surveillance system is part of the M&E framework of the surveillance system.

Other initiatives support strengthening Mali's AMR surveillance system. The Standardised AMR Laboratory for Resource-Limited Settings (Stand-AMR) project, funded by Germany's Global Health Protection Programme, planned to establish a bacteriology laboratory in Koro. However, given the insecurity in the area, this laboratory was instead set up in Bamako. As of May 2021, the laboratory was fully equipped, and training activities were underway *(33)*. In addition to establishing a clinical bacteriology laboratory in Mali, which is currently one of the sentinel surveillance sites (Koutiala Reference Health Centre), Médecins Sans Frontières (MSF) has also provided an application (Antibiogo) to assist laboratory technicians in interpreting AST results *(34-36)*.

There has been significant progress in the national surveillance system as reflected in the 2020 and 2021 GLASS reports; Mali is now presenting annual data from all five surveillance sites *(3, 4)*. However, despite substantial progress related to the successful implementation of national AMR surveillance, the KIs raised concerns about the sustainability and the technical and financial support needed to maintain and improve the current surveillance network. KOICA currently represents the primary funding source for the establishment of AMR surveillance laboratories, and a financial extension to maintain these laboratories and establish new ones is urgently needed to ensure the sustainability of surveillance efforts.

According to a KI, there is a plan to systematically enrol all hospitals in Mali in the surveillance network. For this reason, plans are underway to establish a micro-laboratory system (ready-made laboratories in the form of containers) to increase access to point-of-care rapid tests and address some of the disparities in AMR surveillance capacity across the country. For the livestock sector, which is profoundly limited by the lack of laboratories outside the Bamako area, the leverage of surveillance infrastructure from human health is expected to alleviate some of the constraints.

Mali is also one of the 12 countries in the WHO African Region that is enrolled in GLASS-AMC. According to a KI, national macrolevel AMC data (from imports, distribution and sales) for the period 2017–2019 were submitted during the GLASS data call of July 2021.

7. IPC, WASH and immunization

2020/2021 TrACCS status:

- A national IPC programme and operational plan are available, and national guidelines for health care IPC are now available and have been disseminated. Selected health facilities are implementing the guidelines, with monitoring and feedback in place.

Current status:

- IPC guidelines are implemented in the five AMR surveillance sites; however, there is no monitoring of IPC activities in other health care facilities across the country.
- The Medicines, Technologies, and Pharmaceutical Services (MTaPS) programme supported emergency IPC capacity building to respond to the COVID-19 pandemic.

Key findings and needs:

- Inadequate IPC measures in hospitals present a significant risk for the emergence and spread of HAIs and require substantial improvement in sanitation and hygiene measures.
- An opportunity exists to adapt and use the e-learning infrastructure from COVID-19 measures to enhance IPC routines to reduce the risk of HAI occurrence.
- Promotion of routine vaccination is needed through campaigns that highlight the health benefits of vaccines, especially for diseases with ongoing transmission, such as measles, yellow fever and typhoid.
- Investments and capacity building in cross-cutting areas such as IPC and WASH need to be prioritized.

The NAP on AMR strategy for IPC aims to reduce infections through seven specific objectives:

1. Promote personal hygiene through behavioural change utilizing awareness and communication programmes and training of health care workers
2. Promote good food hygiene practices through training of agri-food professionals.
3. Develop and incorporate IPC in training programmes for human, animal, environment and agricultural health sciences.
4. Strengthen the wastewater treatment system in urban municipalities by installing new treatment plants and ensuring compliance with international standards.
5. Increase vaccination coverage.
6. Strengthen hospital hygiene measures in both the human and animal health sectors by installing hygiene stations, training sessions and better waste management, and developing a guide on good hygiene practices.
7. Promote community hygiene and sanitation with a main focus on waste management (collection, transport and discharge of solid waste).

National guidelines for IPC in the human health sector (*Directives nationales de prévention et de contrôle des infections*) were updated and published in 2020 with support from USAID's MTaPS programme *(5)*. Following the guidelines update, a validation workshop was organized in January 2020; it was attended by the heads of the hygiene and sanitation divisions of Mali's 10 regions and regional and central stakeholders *(25)*. The guidelines disseminated during the workshop included: a training curriculum, a participants' manual and training modules. Furthermore, in response to the COVID-19 pandemic, MTaPS supported IPC training for 310 frontline health care workers using a blended (on-site and online) "training of trainers" approach in May 2021 *(37)*.

As reported in the most recent 2020/2021 TrACCS survey and confirmed by KIs, the national IPC guidelines have only been implemented and monitored in the AMR surveillance sites. According to a KI, inadequate IPC measures in hospitals are of grave concern and warrant substantial improvement in sanitation and hygiene. A longitudinal study conducted between November 2017 and November 2018 at the Gabriel Touré University Hospital in Bamako estimated that the HAI infection rate was 15% among 200 paediatric patients admitted for surgery *(19)*. HAIs were mainly caused by *A. baumanii* (33%), followed by *E. coli* (30%), *K. pneumoniae* (27%) and *S. aureus* (27%) *(19)*. In 2019, 21% of health care facilities in Mali had no hand hygiene facilities at point-of-care, while 30% of the population had no handwashing facility at home in 2020 *(38)*. According to a KI, some health facilities have completed the online WHO IPC assessment framework questionnaire and administration of AMS-related questionnaires was in progress as of November 2021 *(39)*.

The Expanded Programme on Immunization delivers vaccines to children under 5 through routine immunization sessions at community health care facilities and campaigns *(40)*. Between 2001 and 2023, Mali has received or been pledged over US$ 222 million in support from Gavi, the Vaccine Alliance, with most funding being allocated for pneumococcal vaccines (over US$ 86 million), pentavalent vaccines (over US$ 48 million) and rotavirus vaccine (over US$ 32 million) *(41)*.

The Center for Vaccine Development, Mali (CVD-Mali) performs ongoing surveillance of vaccine-preventable diseases. The CVD has accelerated the introduction of many vaccines in Mali, including a meningococcal A conjugate vaccine (MenAfriVac), which has led to the disappearance of *N. meningitidis* serogroup A outbreaks in Mali *(42)*. Additionally, vaccine coverage for the rotavirus vaccine was similar to that for the diphtheria-pertussis-tetanus-containing vaccine (DPT3) (86.1%) within the first 3 years of introduction in 2014 *(43)*.

While vaccinations in Mali are provided free of charge, it is estimated that only 45% of children receive all recommended vaccinations, with coverage rates exceeding national estimates in Bamako *(43)*. Critical barriers to complete vaccination include difficulties accessing care and insufficient mobilization of parents *(44)*. These challenges were compounded by disruptions due to the COVID-19 pandemic which led to further declines in vaccination coverage in 2020 *(45)*.

Disparities in vaccine coverage heighten the population's vulnerability to diseases such as measles and yellow fever, for which there is ongoing transmission. A recent modelling study highlighting the value of vaccines in preventing infections, including antimicrobial-resistant ones, showed that routine immunization with typhoid conjugate vaccines supplemented with a catchup campaign would avert 72% of typhoid cases over 10 years *(46)*.

Mali's NAP on AMR contains a strategic objective that aims to reinforce vaccine coverage in both humans and animals, especially in hard-to-reach and high-risk areas. However, the plan does not explicitly address the role of vaccines in mitigating AMR. CVD-Mali has provided insight into the value and cost–effectiveness of vaccines in Mali *(47, 48)*, and the inclusion of AMR in these estimates could provide further evidence of the benefit of addressing AMR through vaccination.

8. Access and optimal use of antimicrobials

2020/2021 TrACCS status:

- Mali has laws or regulations on the prescription and sale of antimicrobials for human use.
- Mali designed a system for surveillance of AMU that includes monitoring national level sales or consumption of antibiotics in health services.
- The country uses relevant AMC/U and/or AMR data to amend national strategy and/or inform decision-making in human health.
- There are practices to assure appropriate AMU being implemented in some health care facilities, and guidelines for appropriate use of antimicrobials are available,
- Mali intends to adopt WHO's AWaRe classification of antibiotics in the next few years.

Current status:

- Diagnostic and antibiotic stewardship has been developed in the five AMR surveillance sites.
- The Directorate of Pharmacy and Medicines has developed guidelines for establishing therapeutic committees to guide therapeutic disease management.

Key findings and needs:

- Leverage AMS expertise from AMR surveillance sites to expand AMS capacities to other health centres utilizing mentor and mentee approaches.
- There is a need to use national-level AMC surveillance data to inform on the overuse of antibiotics and to guide AMS strategies.

With the aim to optimize AMU in the country's human health sector, the NAP on AMR outlines the following objectives:

1. Fight against illicit sales and counterfeiting.
2. Regulate the prescribing and dispensing of antimicrobials.
3. Strengthen oversight of the antimicrobial supply chain.
4. Ensure antimicrobial quality through rigorous surveillance.
5. Reduce self-medication.

Mali is one of the 12 countries in the African region that are enrolled in GLASS-AMC. According to KIs, a macrolevel study of AMC was conducted and an analysis of results was underway as of December 2021.

Widespread AMU in Mali is fuelled by weak enforcement of prescription-only sales and the ease of purchase of these medications in retail pharmacies and markets, according to KIs. Although nationally representative data describing AMU are lacking, several studies have aimed to quantify AMU and KAP regarding AMU. For instance, a cross-sectional study found high rates of AMU through self-medication among medical students; more than 80% (121 out of 151) of medical students self-medicated with antibiotics when ill *(28)*.

Some antibiotics, such as ciprofloxacin, are commonly prescribed, whereas others, such as imipenem and ureidopenicillin, are rarely prescribed or available *(22)*. A 2017 study showed that antibiotic prescriptions based on microbiological evidence represented a small proportion (27.7%) of the total prescriptions; on average, patients were prescribed 3.55 different antimicrobials per person per stay, with the most frequently prescribed antibiotics being beta-lactamines (48.1%), imidazoles (22.7%) and aminoglycosides (19.3%) *(21)*.

Antibiograms are not commonly available nor are they utilized at health care facilities, according to one KI, mainly due to financial constraints. According to a KI, diagnostic and antibiotic stewardship guidelines have been developed at the five AMR surveillance sites, and therapeutic committees guiding infectious disease management are functioning in more than 16 hospitals and health districts. While the establishment of therapeutic committees does not represent a challenge, the KI cited continued support and evaluation as bottlenecks for their proper functioning.

9. Research, development and innovation

National targets from the NAP on AMR:

- Develop and implement research protocols on the incidence, prevalence, morbidity, mortality and economic impact of AMR.
- Develop protocols for managing multidrug-resistant cases.
- Develop and carry out R&D projects for new antimicrobials, vaccines and diagnostic tools.

Current status:

- Researchers in Mali are actively working towards a better understanding of the AMR burden in the country through national and international projects.
- CVD-Mali aims to quantify the burden of vaccine-preventable diseases and the cost–effectiveness of immunization.

Key findings and needs:

- There is a need for an economic assessment of the health and economic burden of drug-resistant infections in paediatric and adult populations.

To develop a better R&D ecosystem on AMR and novel products, the NAP on AMR outlines the following strategies:

1. Meet the needs for sustainable investment focusing on laboratory capacity, wastewater treatment and waste management.
2. Identify R&D projects through quality studies, as well as other baseline measurements of other TGs.
3. Participate in national and international R&D projects, such as a multinational protocol on surveillance systems.
4. Encourage public-private partnerships for the development and production of new drugs, vaccines, tools and other AMR-related projects, such as WASH and IPC interventions.
5. Promote new ideas and innovations through incentives such as grants.

Researchers from medical and research centres, including the National Institute for Public Health Research and CVD-Mali, have conducted research to reduce the AMR burden data gap in Mali *(49-53)*. A recent genomic study that provided sequence information for antibiotic resistance genes was completed in collaboration with the WHO Collaborating Centre at the United States Centers for Disease Control and Prevention *(54)*. Research has also been conducted to understand the quality of information on antibiotics given to consumers *(55)* and knowledge of antibiotic use and misuse among medical students *(28)*. Additionally, researchers in Mali contribute to initiatives that promote scientific research in the region. “Mali Médical” and "Revue malienne d'infectiologie et de microbiologie" are internationally recognized scientific research journals and are important platforms for the medical community in many French-speaking countries in Africa *(56)*. Malian researchers continue to contribute to and participate in larger international collaborative projects to understand the AMR burden *(56)* or test leapfrog technologies to overcome the logistical challenges in the face of limited diagnostic capacities *(57)*. Additionally, the AAAMR (funded by researchers and AMR experts in Mali) supports research project design, implementation and writing and raises awareness of AMR-related issues in Mali and the region.

Data on the AMR burden in Mali are scarce; however, the newly established AMR surveillance network could provide valuable insights into the AMR burden in some of the leading health care facilities in the country. These data could assess the anticipated high health and economic burden imposed by AMR and further inform policy and advocacy efforts.

10. Key findings for policy and action to accelerate implementation of the NAP on AMR

Since development of the NAP on AMR in 2018, and despite political and security issues in the country, Mali has made significant progress in the fight against AMR by establishing an AMR surveillance system, a critical step towards understanding the health and economic burden of AMR. However, while the NAP on AMR has been developed and endorsed by the Ministry of Health and Social Affairs, the plan awaits formal acknowledgement and appropriate funding from the government. As a result, implementation of the NAP on AMR has depended mainly on financial support from external partners. With support from KOICA, the patient-based AMR surveillance network established in 2019 included five hospitals as of December 2021. Funding is needed to maintain and expand this surveillance system to obtain additional nationally representative insights related to the AMR burden. Mali has contributed data to the 2019, 2020 and 2021 GLASS data calls and has recently enrolled in GLASS-AMC, which illustrates the successful implementation of AMR and AMC surveillance in the country, including data reporting and dissemination *(3, 4)*. Mali recently updated its national IPC guideline, which has already been successfully implemented in the five AMR surveillance facilities. However, IPC guideline implementation should be expanded to other facilities. Monitoring of IPC activities at the health care facility level is needed to provide insight into their current implementation status and identify priority action points *(5)*. Although efforts have been made to establish therapeutic committees in several health care facilities to drive infectious disease management, the creation of national AMS guidelines could further support the appropriate prescription of antibiotics. Finally, in addition to AMR awareness activities at the health care level, awareness campaigns in the community could have a significant impact and reduce the AMR burden attributed to the inappropriate use of antibiotics.

Despite significant gains since the creation of the plan, the lack of dedicated funding from the government and reliance on external grants are critical barriers to implementing the NAP on AMR. This policy brief has identified several key findings that could impact AMR mitigation efforts in Mali.

Key findings to accelerate AMR mitigation efforts in Mali:

1 **Advocate for high-level government endorsement of the NAP on AMR**

- Leverage the legal framework and infrastructure provided by the One Health platform to advocate for formal recognition of the NAP on AMR by the highest levels of government.
- Conduct an assessment of the NAP on AMR to guide development of the NAP on AMR 2.0.
- Advocate for dedicated domestic funding to implement and monitor the NAP on AMR 2.0.
- Mobilize resource grants from external partners to support the recruitment of dedicated staff for the NCC.
- Conduct routine M&E activities to monitor progress in NAP on AMR implementation, and identify success stories and priority action areas.

2 **Organize awareness-raising activities among health care workers and the public to promote appropriate antibiotic use**

- Conduct KAP surveys on AMR at both the community and health care level.
- Simple and effective messages can be delivered during awareness campaigns to encourage appropriate antibiotic use in the community, for both the human and animal health sectors.
- Consider establishing programmes that advocate for AMR awareness raising through education.
- The AAAMR contains a pool of expertise that can be leveraged to develop AMR awareness and training materials (for both formal and informal curricula), which can then be used in Mali and other African countries.

3 **Expand the national AMR surveillance system**

- Advocate through the One Health platform for dedicated funding to maintain existing AMR surveillance operations.
- Further strengthen the laboratory system, expand the national AMR surveillance system and maintain AMC surveillance.
- Dedicate funding to maintain operations in the five sentinel sites and expand surveillance capabilities to other hospitals.
- Mobilize funding to establish a micro-laboratory system in order to increase access to point-of-care rapid tests across the country.

4 **Prioritize investments and capacity building in cross-cutting areas such as IPC and WASH**

- Conduct IPC monitoring in all health care facilities to identify priority areas for improvement.
- Leverage COVID-19 response measures and e-learning infrastructure to enhance IPC routines.
- Promote routine vaccination through campaigns that highlight the health benefits of vaccines.

5 **Ensure access and optimal use of antimicrobials**

- Use national-level AMC surveillance data to inform on the overuse of antibiotics and to guide AMS strategies.
- Create national AMS guidelines and leverage AMS expertise from sentinel surveillance sites to expand AMS capacities to other health centres, utilizing mentor and mentee approaches.

6 **Understand the AMR burden**

- There is a need for an economic assessment of the health and economic burden of drug-resistant infections in paediatric and adult populations.

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https://www.who.int/health-topics/antimicrobial-resistance

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