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# ADVANCING AWARENESS ON ANTIMICROBIAL RESISTANCE: A SITUATION ANALYSIS IN SUDAN

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## ABSTRACT
The issue of antimicrobial resistance (AMR) is a priority area identified by the Government of Sudan and development partners. This paper is part of a rapid assessment using the available documents covering all relevant fields pertaining to AMR. Documents were obtained from relevant websites for policies, strategies, guidelines, reports, and plans from relevant organisations at the federal level as well as interviews with relevant individuals from WHO office Sudan, Federal Ministry of Health, Ministry of Environment, Ministry of General Education, and Sudan Medical Council in Khartoum. The review was guided by the five strategic objectives of Global Action Plan on Antimicrobial Resistance (GAP). This paper focuses on one of the objectives on improving awareness and understanding of AMR. The importance of promoting the rational use of antibiotics and raising the awareness about AMR is acknowledged and efforts have been made by relevant stakeholders. However, lack of harmony and collaboration between different institutions to promote one message in relation to AMR remains a challenge. In addition, limited teaching of AMR in health sciences professional education and general education in schools is limited due to low capacity in terms of technical expertise and training material.

**KEYWORDS:** antimicrobial resistance, education, multisectoral action, Sudan, training.

## INTRODUCTION
Antibiotics are valuable therapeutic agents that brought many infectious diseases under control.[1] Today, they are indispensable in all health systems. Achievements in modern medicine, such as major surgery, organ transplantation, and cancer chemotherapy would not be possible without access to effective treatment for bacterial infections.[2]

Unfortunately, the imprudent use of these medicines is bringing their miraculous effect to an end. The rapid development of resistance is threatening heath security globally. Antimicrobial resistance (AMR) is increasingly recognised as a key public health concern for both developed and developing countries due to its potentially alarming socioeconomic impact on health.[3]

The control of infectious diseases is seriously threatened by the steady increase in the number of microorganisms that are resistant to antimicrobial agents. Resistant infections adversely affect mortality, treatment costs, disease spread, and duration of illness.[4]

Although antimicrobial resistance is a natural phenomenon, it is being propagated by misuse of antimicrobial medicines, inadequate or inexistent programmes for infection prevention and control (IPC), poor-quality medicines, weak laboratory capacity, inadequate surveillance and insufficient regulation of the use of antimicrobial medicines.[5,6]

## BACKGROUND
Surveillance of AMR is now one of the components of International Health Regulations (IHR). In 2012, the World Health Assembly (WHA65.23) urged State Parties to take the necessary steps to prepare and carry out appropriate national implementation plans in order to ensure the required strengthening, development and maintenance of the core public health capacities as provided for in the IHR.[7]

On October, 2016, a multi-sectoral international External Evaluation Team conducted a joint assessment of IHR core capacities of Sudan using the World Health Organization (WHO) International Health Regulation (IHR) Joint External Evaluation (JEE) tool. The assessment concluded that AMR scored low. The

indicators included antimicrobial resistance detection, surveillance of infections caused by resistant pathogens, healthcare associated infection prevention and control programmes, and antimicrobial stewardship activities.[8]

Sudan has been the focus of interest for many programmes and partners and many capacity reviews or programmatic assessments have been conducted in different sectors relevant to AMR. A significant information gap was identified in several areas during a joint Food and Agricultural Organization-World Organization for Animal Health-World Health Organization (FAO-OIE-WHO) consultation on AMR in Sudan towards developing a national action plan on AMR.[9] It was deemed necessary to gather information for use in developing a national action plan on AMR for Sudan, which led to undertaking a review that was guided by the WHO five strategic objectives of Global Action Plan on Antimicrobial Resistance (GAP).[10]

This paper focuses on the first objective of the review which focuses on improving awareness and understanding of antimicrobial resistance through effective communication, education and training in Sudan.

## METHODS

The review consisted of meetings and interviews with key informants, which involved key officials from the WHO Country Office and other governmental institutions in Khartoum that play a role in combating AMR. Secondly, documentary review was undertaken which involved all relevant documents available pertaining to the subject of AMR in Sudan, including strategic plans, policy documents and mission reports available at WHO Sudan, Federal Ministry of Health (FMoH), Khartoum State Ministry of Health (KSMoH), Sudan Medical Council (SMC), and Ministry of General Education (MOGE) among others. Documents were either obtained physically or from various websites.

The review was guided by the Framework for WHO's member States of the first objective, as illustrated in figure 1.[10]

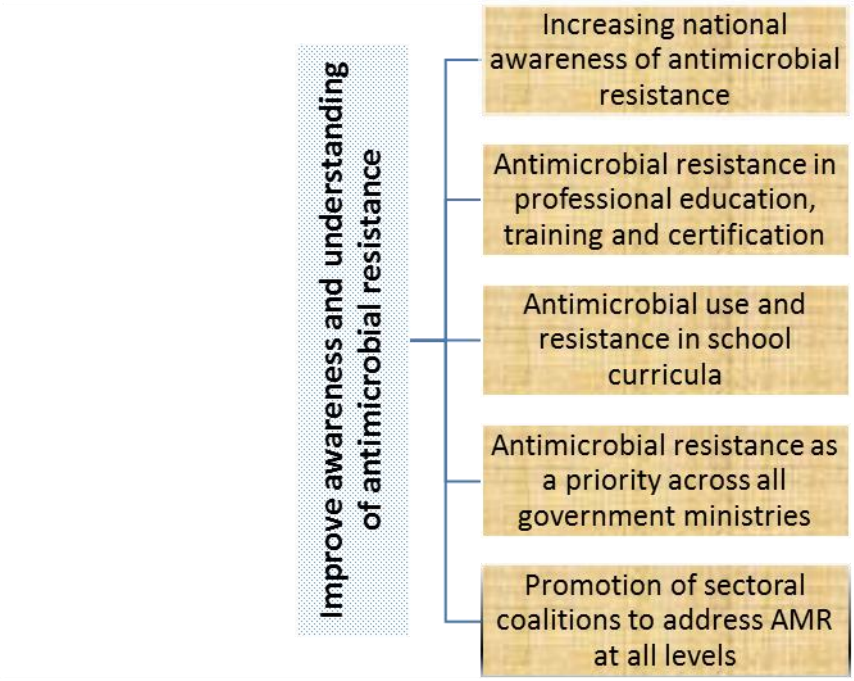


**Figure 1: Components of objective 1 of Global Action Plan on Antimicrobial Resistance.**

Information from the document review and interviews was collated to identify gaps that need to be addressed in line with the objectives of the WHO Global Action Plan on Antimicrobial Resistance and the required deliverables.

## Findings

### National awareness of antimicrobial resistance

Public education programmes were found to be delivered by different Institutions that are all working independently to achieve the objectives of health promotion and rational use of medicines in general. Raising the awareness about the rational use of antibiotics has been among the several topics of health education programmes, although this did not specifically address the issue of AMR.

#### *Health Promotion Directorate, Federal Ministry of Health*

The Health Promotion Directorate (HPD) of the Federal Ministry of Health (FMoH) has the overall responsibility for the promotion of healthy lifestyles at national level by developing policies and guidelines and setting strategic directions for health promotion activities which include health education messages at the Federal level. However, each State in Sudan is required to also develop

their own health education messages that are appropriate and relevant to their priority health needs and social setting.

Although, HPD has no specific education activities with regard to AMR, there is a realisation that it has the potential through its School Health Department. This could be done by incorporating messages promoting the rational use of antibiotics and how to combat AMR in the Health Manual that is used as a guide by school teachers in delivering health messages at school level. The manual, which is regularly updated, has the advantage of being flexible and receptive to different needs and priorities.

Similarly, the ongoing 'Health Promotion Schools Project' would be a suitable venue to introduce the importance of infection control and other preventive measures such as promoting personal hygiene and hand washing as well as raising awareness about the rational use of antibiotics and AMR.

***National Medicine Information Center (NMIC)***

The NMIC under GDoP of the FMoH is responsible for the promotion of the rational use of medicine in general. It targets both health professionals and the public through different activities such as:

- Educational programmes on the rational use of medicines, including AMR, using different media outlets such as radio and TV programmes, production of pamphlets and brochures, and contributing pieces on AMR in the national newspapers.
- The Sudan Journal for Rational Use of Medicine (SJRUM), published by Directorate General of Pharmacy, Federal Ministry of Health targets health professionals, includes matters pertaining to the rational use of medicine in each of its issues, including the subject of AMR. So far, 14 issues have been published. SJRUM is available in both hard and electronic forms. The latter has increased the dissemination rate to nearly 1800 health professionals.

An annual AMR awareness week, organised by civil society organisation, Sudan Sepsis Alliance has aired numerous TV and radio programmes focusing on AMR during the week.

***Rational Drug Use Department***

The Rational Drug Use Department (RDUD) in the GDoP at Khartoum State Ministry of Health (KSMoH) is responsible of promoting the appropriate use of medicines in Khartoum State for both health professionals and the public. It has an active and well-functioning drug information centre which responds to all drug related enquiries. The RDUD delivers its health education through TV and Radio programmes, flyers, pamphlets and posters. Antibiotic use and AMR have been among the topics of these programmes.

***Sudanese Consumer Protection Society (CPS)***

All over the world, civil society organisations play an important role in raising awareness and understanding of pertinent social issues such as health, enhancing and promoting changes, and advocating for policy development in areas such as AMR. CPS is also responsible to ensure the rights of consumers and provide additional protection for the most vulnerable in society. The society plays a role in promoting laws and regulations that aim to protect the rights of consumers. For example, the law may require businesses to disclose detailed information about products—particularly in areas where safety or public health is an issue, such as food and medicines.

CPS has been involved in raising public awareness on antibiotic use and AMR in addition to the importance of hygiene, food and water safety. CPS has the advantage of reaching everyone and it operates throughout Sudan.

CPS works in close collaboration with GDoP and WHO and has effectively participated in the antibiotic awareness week that is held on an annual basis. Among its regular forums, CPS dedicated a fixed forum for discussing the issue of antibiotic use and development of antimicrobial resistance.

***Public Initiatives***

There are small-scale initiatives which are organised by members of the public. For example, students from the Faculty of Pharmacy, University of Khartoum have on the 29$^{th}$ of March 2017 organised a campaign to raise public awareness on the problem of AMR. Such an initiative, if supported, could be cascaded to other universities and schools across the country. If done on a regular basis, such activities will help promote a better understanding of the harm caused by the irrational use of antibiotics, especially among pharmacy students (future pharmacists) and will prepare them address such roles after graduation.

On the other hand, the added benefit of events organised by the public is the fact that the dissemination of information is not just limited to those attending the events, but will equally be shared through social media such as Facebook, WhatsApp, Twitter, etc., which is particularly common among the younger generation, making it opportune to influence positive changes in their attitude and behaviours in regard to the rational use of medicines and antibiotics in particular.

Gaps Identified in the area of national awareness of antimicrobial resistance through public communication include, among others, a lack of harmony and collaboration between different institutions to promote one message in relation to AMR; irregular and inconsistent messages; and lack of sustainable or regular funding sources.

**Antimicrobial resistance in professional education, training and certification**

***Professional education***

In Sudan, the Ministry of Higher Education (MOHE) together with the Sudan Medical Council are the responsible bodies for setting the standards for educational programmes such as medicine, pharmacy, dentistry. However, AMR was not found to be a core component of professional education although a number of schools include pharmacotherapeutics in their curriculum. Similarly, there are a few number of schools that made individual efforts to teach rational use of drugs (RUD) and essential medicine concept in their programmes with little emphasis on AMR.

On the other hand, there have been numerous efforts by the GDoP-FMoH in collaboration with WHO to include RUD into all medical school curricula. A proposal of the content of the curricula was developed and endorsed by the MOHE but has not found its way to implementation.

Training of health professionals in Sudan consisting of doctors, pharmacists, dentists, laboratory technicians, nurses and other allied health workers is looked at from the perspective of pre-service training, in-service training and post-graduate training.

**a) Pre-service training**

The General Directorate of Human Resources (GDoHR) at FMoH is responsible for the pre-service training within health training institutions (medicine, pharmacy and nursing) and of new graduates as part of the internship programmes for medicine, pharmacy and dentistry. The internship period is a structured, assessed training that takes place over 12 months. The interns undergo training in different specialties at the relevant health facilities. Prior to this, the GDoHR, FMoH in collaboration with the Sudan Medical Council (SMC), conducts a two-day orientation course during which the new graduates are introduced to the concept and principles of professionalism, among others, and its importance for good medical/pharmacy practice. The course includes a session on AMR and the rational use of antibiotics.

**b) In-service training**

In-service training is conducted on an ad-hoc basis according to the needs of the specific health facilities. For example, hospitals are involved in offering in-service training to interns during their internship period. As part of this in-service training, some of the hospitals were found to expose pharmacists to issues of infection control and antimicrobial resistance at a very limited scale. On the other hand, the Centre for Continuous Professional Development (CPD), which is under the FMoH, has recently developed a training package on primary health care (PHC) targeting medical doctors, nurses and medical assistants with a major focus on the use of antibiotics. This training is planned to be conducted nationwide but has not yet started.

**c) Postgraduate Training**

The Sudan Medical Specialisation Board (SMSB) is the main professional body authorised to manage and deliver medical and health specialty programmes in the country. In collaboration with Sudan Medical Council (SMC), SMSB runs a three-day training course on professionalism in medical practice for registrars, during which it sheds light upon the use of antibiotics. However, these training courses are optional and do not cover all SMSB candidates.

Overall, the analysis has revealed several gaps in regard to training of health professionals and found that AMR is not currently taught in professional education and there is lack of a standardised training package pertaining to AMR, and a mechanism to ensure the introduction of AMR into health profession education.

**Antimicrobial use and resistance in school curricula**

The basic school curriculum in Sudan have been changing over the years in response to the changing needs and expectations of the learners, the community and the country in general. At primary school level, the curriculum is delivered in three cycles. The first cycle extends from grade one to three and aims at familiarising the children with their social surroundings. The second cycle extends from grade four to six and represents the period of entry into the perception stage. At this stage, emphasis is placed on the use of language skills to gain knowledge and understanding from various sources so as to cope with the environment and society. In grade six, students are briefly introduced to medicine use in general but particularly for antibiotic use and AMR. The third cycle, i.e. grades seven and eight, complements the basic education. It aims at positive interaction between the pupils, the society and the environment. At this level the topic of "health and nutrition" is introduced which sheds light into bacterial and viral infections but there is no mention on antibiotics and their use. Similarly, the secondary school curriculum does not include any components on AMR.

**Antimicrobial resistance as a priority across all government ministries**

The Sudan National Health Policy recognises that health is a multifaceted issue, which requires the involvement of other sectors. The policy also mentions intersectoral collaboration and stated that "the FMoH, working through appropriate authorities in Government, will advocate and ensure, for example by becoming a member of appropriate bodies, that the policies of other sectors are health-friendly as part of 'Health in All Policies" drive. Emphasis, in this regard, will be on healthy residential conditions, occupational environment, social support and the promotion of health".[11] This goes hand in hand with the issue of combating AMR.

In 2013, a review of the policy was conducted and found no clear guidance on how intersectoral collaboration should happen in practice. The policy review

recommended that all cross-cutting issues need policy dialogue with other sectors and other stakeholders for improving social determinants that are directly linked to health e.g. agriculture, water and sanitation, education and environment. The FMoH, through the Public Health Institute, worked towards introducing a 'Health in All Policies' (HiAP) approach as a mechanism to improve health by addressing public policies across sectors.

Although a document has been developed to implement the HiAP approach, the role of other stakeholders and non-health sector remains undefined and the actual mechanism of implementation remains unclear.

The Health Emergency and Epidemic Control Department (HEECD) of FMoH has signed a memorandum of understanding (MOU) with the Ministry of Animal Resources and Fisheries (MARF) in the spirit of enhancing and promoting close collaboration between the two ministries in controlling and addressing AMR issues. However, the commitment to follow through to operation is yet to happen.

It is worth mentioning that the DGoP, which is the focal point for the AMR programme in the health sector, is working in close collaboration with the Ministry of Animal Resources through the joint programmes between WHO, FAO and OIE.

This review has identified a number of gaps regarding cross governmental actions, which include:

- Lack of clear mechanism of implementation of Health in All policy among different government sectors.
- Lack of clear plan for achieving Health in All policy (that should address governance structure, training needs, resources needed) to ensure the road map to be turned into a realistic strategy and implementable activities.

**Promotion of multi sectoral coalitions to address AMR at all levels**

There is a national multidisciplinary and multisectoral committee (AMR committee) composed of experts in clinical microbiology, pharmacy, infection prevention and control, and veterinary medicine, as well as representatives from the Federal Ministry of Health (FMoH), Ministry of Agriculture (MoA), and WHO Country Office (WCO). This committee has conducted a number of meetings aiming to initiate and establish working groups to cover specific technical areas and carry out specific actions in regard to AMR.

Major concerns include the fact that the committee lacks power and authority as reflected in its meagre outputs. It is underrepresented by not including other important actors, and is not bound with clear, time framed and resourced plans.

**DISCUSSION**

The importance of promoting the rational use of antibiotics and raising the awareness about AMR is acknowledged. However, the regularity of awareness activities is not clearly stipulated, and sustainability is threatened by irregular funding. Having a body to coordinate, harmonise and unify the messages delivered about the rational use of antibiotics and AMR is important, especially as this function is currently carried out by different institutions and organisations who are working independently.[12] Each of these institutions carries unique strength in terms of expertise and know-how, wider access to the community, sustainable financial and technical support. Therefore, coordinating and bringing together the efforts of these institutions will inevitably lead to maximising the use of the available resources and expertise which will lead to a greater impact.[13]

Choosing the appropriate means to deliver a message is imperative to ensure that it is well received by the targeted audience.[14] In this aspect, the Health Promotion Directorate (HPD) may play an important role because of their Well-established structure, especially at State levels where they use radio and TV programmes in addition to mobile video cars and mobile theatres to reach different target groups in the area. The use of social media such as Facebook, Twitter, WhatsApp and others can also be more effective to disseminate message and raise awareness regarding AMR.[15]

Another opportunity in maximising the effect of raising awareness at national level may be achieved by collaborating with well--established national programmes such as those for TB and HIV/AIDS. These are well resourced both technically and financially to deliver health education messages, provide counselling and monitoring, and have huge access to the community.

Having one source of awareness messages to promote the rational use of antibiotics to combat AMR is important. These messages need to be defined, checked and refined for content and have to be endorsed by a specific body to ensure their relevance, appropriateness and accuracy.[16] According to Walker[17], in addition to AMR, educational messages should also consider issues such as:

- Importance of measures to prevent infection, such as immunisation, vector control, etc.
- Simple measures that may reduce transmission of infection in the household and community, such as hand washing, waste disposal, food hygiene, etc.
- Encouraging appropriate and informed health care seeking behaviour;
- Educating patients on suitable alternatives to antimicrobials for relief of symptoms and discourage patient self-initiation of treatment, except in specific circumstances.

However, raising awareness about AMR should not be confined to the public and health professionals. It should extend to the government at its highest levels. Taking it to the political agenda is pertinent; especially due to AMR being a component of International Health Regulations (IHR) of which Sudan is a member. Combating AMR needs to be coordinated nationwide and to achieve this, more involvement is needed.[18]

The findings concur with the need to integrate rational use of antibiotics and AMR into health professional education curricula as well as in other professional development activities in order to equip health professionals with the understanding and skills that enable them to rationalise antibiotic use and combat AMR as well as for the prevention and control of nosocomial infections.[19]

Communication skills and patient counselling are other important components of health professional education as these are important skills and tools that could be used to effectively combat the AMR problem.[14] Prescribers and dispensers have the role of educating patients on how to use antimicrobial medicines correctly and the importance of adherence to the prescribed treatment.

This analysis has identified a number of opportunities in regard to training of health professionals in different institutions such as SMSB, SMC and AHS, whereby AMR could either be incorporated in the existing curricula or delivered as a standalone obligatory training to trainees in different training programmes.[20]

Teaching school children the harms caused by drugs and antibiotic misuse is considered effective to reduce the problem of AMR in the society.[21] In the context of Sudan, the 'health & nutrition' teaching in grades 7 and 8 is the best place to bring in the rational use of antibiotics and AMR. It complements the content of the curriculum as students are introduced to bacterial and viral diseases.

The fact that the secondary school curriculum is flexible to accommodate and integrate any new issue that is relevant to the needs of the students and the society is an asset. New issues such as human rights, HIV/AIDS and life skills have been introduced recently. Emphasis on AMR may be more detailed at the secondary level and could be included in the 'Family science' strand of the new curriculum.

An opportunity in this area could be establishing partnership between MOGE and international organisations such as UNICEF to bring together a package of key health activities, including health education on hand washing, which goes well in line with infection prevention and combating AMR, which is tried in other countries.[22]

Infections that cannot be treated continue to develop.[23] The rapid spread of multidrug resistant organisms means that we may not be able to treat everyday infections or diseases with antibiotics in the near future. Many existing antimicrobials are becoming less effective as bacteria, viruses, protozoa and fungi are adapting and becoming resistant to medicines. Inappropriate use of these valuable medicines has also added to the problem.[24] However, given the diversity of government actors involved in combating antimicrobial resistance, interventions within and outside the health sector are needed to address the underlying determinants of health. In order to address antimicrobial resistance as a priority need for action across all government ministries, it is pertinent to have a clear and well-defined multisectoral body with proper governance structure, defined roles and responsibilities, and clear jurisdictions. These measures are likely to contribute in the promotion of sectoral coalitions to address AMR at all levels. The existing initiative of health in all policies could be used as a platform to develop strategies that are relevant to different government sectors in order to tackle the problem of AMR.[25]

The complexities of antimicrobial resistance (AMR) require multisectoral coalitions involving stakeholders from different sectors. Experience has shown that the problem of AMR can be best tackled using a multidisciplinary approach with long term political support from a higher level.[13] The establishment of a multi-sectoral anti-microbial resistance (AMR) committee and related sub-committees in Sudan was a good start. However, the scope of these committees need to be expanded beyond the technical level to actively engage in mobilising support, understanding the context, developing and implementing action plans as well as the monitoring and evaluation of the implementation of policies pertaining to AMR as illustrated in figure 2.[13]

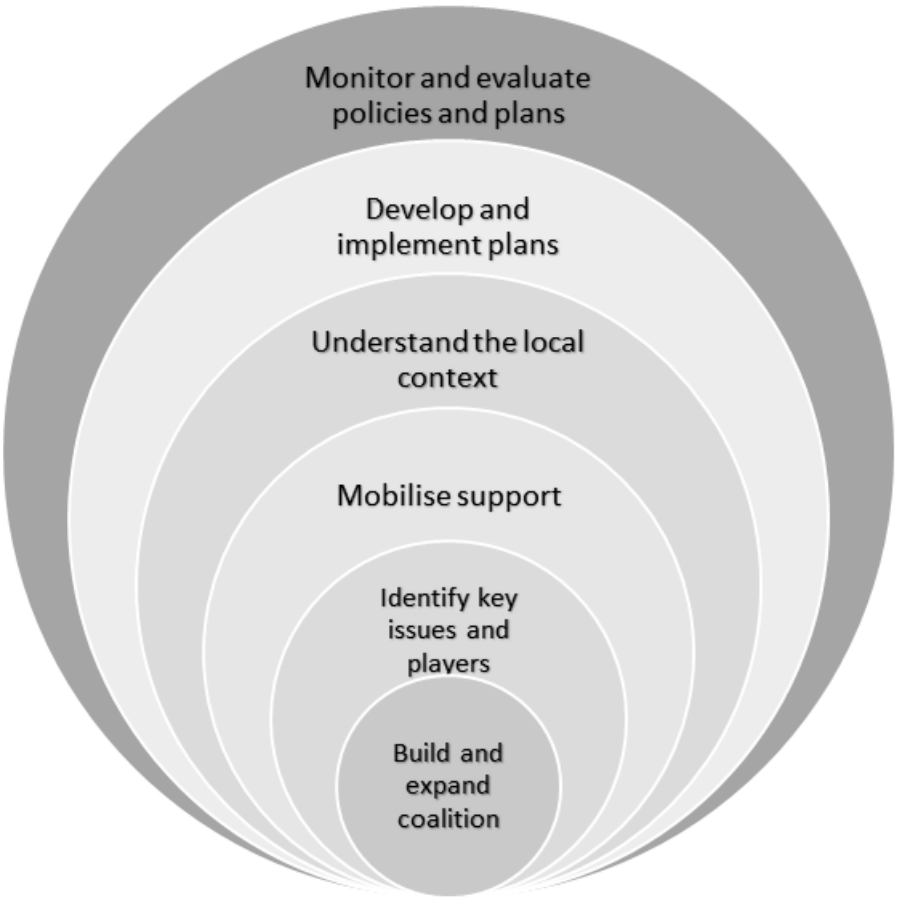


**Figure 2: Building coalition against AMR.**

To attain its ultimate goal, the AMR Committee need to include senior staff from different sectors to ensure a "one health" approach to AMR and to set the overall strategic directions. The committee would need to set priorities for action at the national level and provide overall guidance to the implementation of policies and guidelines, ensure communication and flow of information to higher level bodies of the government.[13]

The coalition of relevant sectors and a rapid assessment of the local AMR situation could help to build consensus and develop action plans that can help solidify vision and scope to address AMR at all levels.[26] The multisectoral AMR committee and stakeholders should discuss the findings from the local situational analysis and come to consensus on raising awareness regarding AMR with respect to the identified problems, including what the priorities are, who should take the lead, and what is feasible to accomplish.[26] Although no set of interventions for raising awareness will be appropriate for all settings, many overarching areas that typically emerge align with WHO recommendations.[27]

## CONCLUSIONS

This review identified the capacities and opportunities available with regard to combating antimicrobial resistance through proper information, education, communication and training, in order to raise awareness. In terms of health professional training, existing institutions, such as SMSB, SMC and AHS have the potential to integrate topics regarding AMR in both basic sciences and professional development training courses. In addition to this, the requirements of revalidation of medical professionals could also include attending training courses on AMR and be made a requirement of the CME project of doctors' advancement from specialist to consultant, as well as a component of the licensing exam for practice.

Similarly, the Ministry of General Education in its reform plans for national curricula has the prospective to incorporate AMR in the new teaching on subjects according to different level of students. In order to ensure proper inclusion of AMR in the proposed new curricula to prepare topic guides, there is a need to address existing issues concerning capacity gaps in relation to resources, technical expertise and skills of teaching staff to deliver the teaching.

This study has also found that most of the necessary infrastructure in the form of institutions and committees are in place, though scattered and operating independently from each other. The presence of a body to address the issue of AMR with the aim of developing policies and guidelines and bringing together different institutions under a single umbrella would contribute to the desired outcome of combating AMR in the country. On the other hand, the ongoing efforts to work towards

one-health-approach along with the operational plans to meet the requirements for developing surveillance and monitoring systems could be considered as a strength. However, a more integrated approach is needed to maximise efficient use of the available limited resources.

There is realisation for the need to harmonise and coordinate all activities related to AMR through a structured organ that is properly resourced and given the authority for making decisions and taking appropriate actions as needed. This is seen to be the key for joining forces on the development of the global action plan to combat the problem of AMR.

The representation of these committees needs to include a coalition of stakeholders such as academics, practitioners, food safety and environment experts, and researchers in order to bring together diverse views on the subject of AMR.

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