

Optimising the use of antimicrobial medicines in Sudan

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Abstract

Antimicrobial resistance (AMR) has been a priority area identified by the Government of Sudan and development partners. This paper is part of a study in Sudan using the available documents covering relevant fields pertaining to AMR and interviews with key informants from World Health Organization (WHO) office Sudan, Federal Ministry of Health and other relevant entities. Documents were obtained from related websites for policies, strategies, guidelines, reports, and plans as well relevant international and government agencies in Khartoum.

The study was guided by the WHO's five strategic objectives of Global Action Plan on Antimicrobial Resistance. This paper focuses on the fourth objective on optimising the use of antimicrobial medicines in human health and animal health. The study revealed the presence of numerous policies and guidelines on antibiotic use and generic prescribing at different levels with little evidence of their implementation. There were a lack of supervisory or monitoring systems to ensure proper and rational prescribing, and appropriate dispensing of antimicrobials in both public and private sectors. The system is weakened due to low capacity for monitoring and checking as a result of limited resources both in terms of human resources, skills, tools and quality checks to ensure the quality of medicines post-marketing. There is a need to set up a quality management system within the existing structures for the distribution, prescription and dispensing of antibiotics in both public and private institutions. The system should clearly define the processes and provide adequate resources to ensure appropriate monitoring and control of antibiotic distribution, prescription and dispensing.

Keywords: Antimicrobial Resistance, Antimicrobial Stewardship, Marketing, Regulation, Sudan.

Introduction

Antibiotics are valuable therapeutic agents that have brought many infectious diseases under control [1-3]. Today, they are indispensable in all health systems. Achievements in modern medicine, such as major surgery, organ transplantation, cancer chemotherapy and even some viral infections would not be possible without access to effective antibiotics [4].

Unfortunately, the imprudent use of these medicines has the potential to bring their miraculous effect to an end. The rapid development of resistance is threatening health security globally [5]. 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 [6].

For example, in the United States of America, 2.8 million patients acquire serious infections caused by antibiotic-resistant bacteria each year, and 35,000 of them die as a result [7-9]. Local studies carried out in Sudan by Elbadawi et al show high level of resistance among gram-negative bacilli in Khartoum State Hospitals and urged local health authorities to step up infection control programmes and introduce the concept of antimicrobial stewardship in the country [10].

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 adding costs to health systems [11, 12]

Although antimicrobial resistance is a natural phenomenon, it is being propagated by the misuse of antimicrobial medicines, inadequate or inexistent programmes for infection prevention and control, poor-quality medicines, weak laboratory capacity, inadequate surveillance and insufficient regulation of the use of antimicrobial medicines [13, 14].

Surveillance of AMR is now one of the components of International Health Regulations (IHR). In 2012, the World Health Assembly (WHA65.23) [15] 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 [16].

In 2016, a multi-sectoral International Evaluation Team conducted a joint assessment of IHR core capacities of Sudan using the World Health Organization’s International Health Regulations (IHR) Joint External Evaluation tool. The assessment concluded that capacities for combating 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 [1, 17].

On the other hand, a significant information gap was identified in several areas during a Joint Food and Agricultural Organization-World Organization for Animal Health-World Health Organization consultation on AMR in Sudan with the goal of working towards developing a national action plan on AMR [18]. It was deemed necessary to gather information for use in developing a national action plan on AMR for Sudan, which led to undertaking this study that was guided by the WHO’s five strategic objectives of Global Action Plan on AMR (Figure 1) [3].

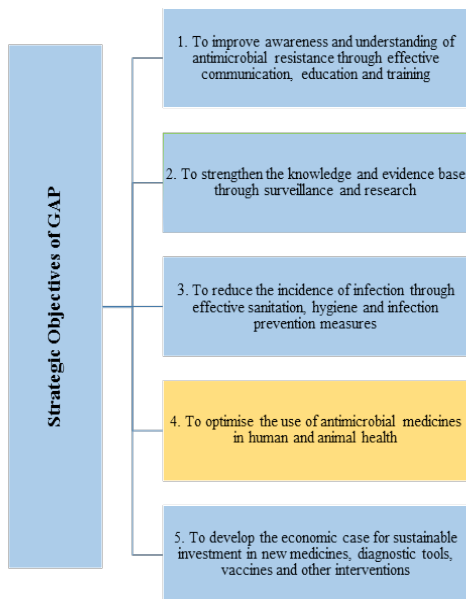


Figure 1: WHO Strategic Objectives of Global Action Plan on AMR. This paper focuses on the fourth objective, which emphasises on the optimisation of use of antimicrobial medicines in human

health, as illustrated in Figure 2.

Material and methods

This study was carried out in Sudan in 2018 and comprised a series of methods. These involved meetings and interviews with key informants from the WHO Country Office and other government departments such as health, environment and education among others in Khartoum that play a role in combating AMR. Relevant documents pertaining to the subject of AMR in Sudan were also reviewed. The documents included strategic plans, national and sectoral policy documents and mission reports available at WHO Office in Sudan, Federal Ministry of Health (FMoH), Khartoum State Ministry of Health (KSMoH), National Medicines and Poisons Board (NMPB) and Sudan Medical Council (SMC), which were either obtained physically or from various websites.

This study was guided by the WHO’s Framework for member States of the fourth objective [3] as highlighted in figure 2.

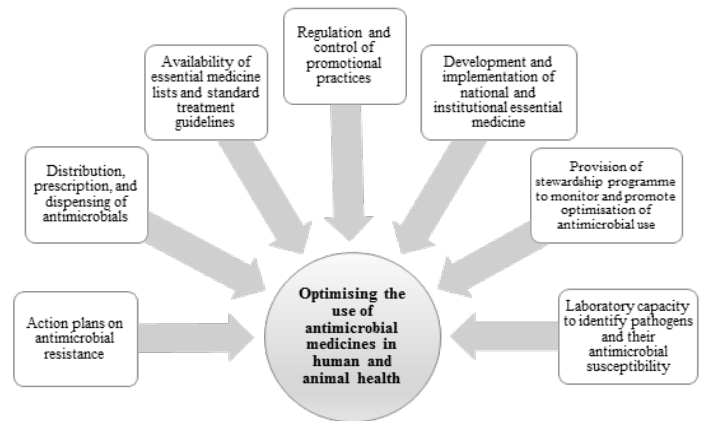


Figure 2: Components of objective 4 Global Action Plan on Antimicrobial Resistance

Information from the document reviews and the interviews was collated to identify gaps that need to be addressed in line with the strategic objectives of the WHO Global Action Plan (GAP) on Antimicrobial Resistance.

Findings

Action plans on antimicrobial resistance

A number of organisations were found to be involved in conducting a series of programmes and events that aim to combat the development of AMR. During the period 2016-2018, the General Directorate of Pharmacy, FMoH, produced a series of policies such as a national antibiotic use policy, generic prescribing policy, and community pharmacy practice guidelines. On the other hand, the formulation and implementation of a national drug policy has led to promoting rational prescribing, dispensing and use of medicines. However, there was limited evidence regarding the extent of implementation of the National Drug List in the country.

At the FMOH level, a Standing AMR Committee was established in 2016 as part of the AMR programme and initiatives on promoting the rational use of antibiotics. On the other hand, in 2018, Khartoum State Ministry of Health reported to have undertaken a number of activities on promoting the rational use of medicines including antibiotics, which involved:

- Establishing a system to monitor AMR development and trends using baseline studies at Khartoum State hospitals.
- Training of clinical pharmacists on AMR.
- Advocacy events in the form of public lectures, radio programmes, brochures and posters to promote the rational use of antibiotics or both the public and health professionals.

Distribution, prescription, and dispensing of antimicrobials

In general, drug distribution in the public sector is the responsibility of the National Medical Supplies Fund (NMSF) which has established revolving drug fund projects in 17 out of 18 States of Sudan to facilitate the process of procurement and distribution of medical supplies to different parts of the country.

A key informant reported that the NMSF had implemented a comprehensive reform programme, which led to an increased availability of medicines at NMSF warehouses to annual averages that range between 92% and 95% since 2012. The 2018 NMSF annual report has shown that the average availability of medicines at the warehouses of the NMSF State branches was 78% and NMSF health facilities was 65%. This shows a remarkable increase of availability of medicines as a whole in the public sector, but there is no data on the availability of antibiotics in particular.

On the other hand, this study has also found discrepancies between the antibacterial medicines in the Standard Treatment Guidelines (STGs), the National Essential Medicine List and the procurement list of the NMSF as shown below:

- 7% of antibacterial medicines in the STGs were not available in the NMSF procurement list.
- 36% of the antibacterial medicines in the NEML were not available in the NMSF procurement list.
- 37% of antibacterial medicines in the NMSF procurement list were neither in the standard treatment guidelines nor the national essential medicine list.
- 13% of antibacterial medicines in the STGs were not available in the national essential medicine list.

The private sector equally plays a key role in drug distribution which is regulated by the National Medicines and Poisons Board. However, no data is available regarding the extent of antibiotic distribution including the quantity and number of outlets within the private sector.

For authorisation of medical practice, healthcare personnel including all medical doctors, dentists and pharmacists are required to be registered with the Sudan Medical Council; while medical assistants and pharmacy assistants are required to be registered with the National Council for Medical and Health Professions. However, there are no clear supervisory or monitoring systems in place to ensure only authorised personnel are practicing in the provision of health care, including prescription of antibiotics, especially in the

private sector.

Inspection of pharmacies in the Khartoum State is carried through visiting private pharmacies by the Federal Ministry of Health to confirm that dispensing is done by registered pharmacists or trainees under supervision. However, no data is available in regard to the number and frequencies of visits, and outcomes following the visits.

Marketing and marketing authorisation of antimicrobial agents

The National Medicines and Poisons Board (NMPB) is the responsible body for market authorisation of all medicines including anti-microbial agents. Only medicines registered at the NMPB are allowed to be marketed and used in the country. A pre-requisite for registration includes assessment of safety, quality and efficacy of medicines that are based on adequate and scientific data. Registration criteria are reviewed when necessary in accordance with the national policies, national legal requirements or international standards. As stated in article 20 of the Medicines and Poisons Act 2009, the registration of medicines is only valid for five years, after which every medicine is required to be re-assessed for re-registration [19, 20] However, there is no monitoring system in place to ensure their quality and proper usage after they are marketed.

The NMPB classifies antibiotics as ‘prescription only medicines’. The level of use of antimicrobials is also specified in the essential medicines list. However, this study identified a number of gaps which include poor post-marketing surveillance, in particular for antimicrobials, and the lack of a system to regulate the use of antibiotics according to their classification in spite of their clear categorisation.

Development and implementation of national and institutional essential medicine

According to the key informants, the National Medicines Policy of 2014 has pioneered the implementation of the Sudan Essential Drugs Programme and promoting the concept of Essential Medicines and its principles in selecting essential medicines. In general, this policy follows the WHO guidelines and formula regarding the development of such documents [21].

Available documents show that, there is a National Essential Medicines List, which was last updated in 2014. However, according to the National Pharmaceutical Sector Assessment of 2012 [22], only 50% of public health facilities were found to have had the list of essential medicines. On the other hand, the Sudan national standard treatment guidelines which were updated in 2014, included infectious diseases such as diarrhoea, tonsillitis, bacterial meningitis, community-acquired pneumonia in adults, pelvic inflammatory disease, lower urinary tract infection, otitis media, typhoid fever, cellulitis, as well as infectious diseases of epidemiologic concern. However, only 36.7% of public health facilities were found to have standard treatment guidelines available, with questionable compliance.

This study has also identified a number of important documents that may serve both as guides and/or regulate prescribing and dispensing of antimicrobials. These are as follows:

a) Sudan National Antibiotic Use Policy 2016-2020
This policy has been developed by the General Directorate of Pharmacy of the Federal Ministry of Health and aims to improve patient outcomes through the judicious and rational prescribing of antibiotics. It is a clearly written document with a Five-year implementation plan that include monitoring and evaluation strategies. If properly implemented, the policy could be the backbone of the National Action Plan to combat AMR.

b) Antimicrobial Policy Khartoum State
The objective of this policy is to ensure that patient's management is improved by the appropriate use of antimicrobials. The policy includes important components for combating AMR, which could be used to develop the national action plan. The Directorate General of Pharmacy of the Khartoum State Ministry of Health has listed advocacy activities to disseminate the policy and to oversee its implementation, but there is no clear plan of action to ensure the implementation.

c) Classification of registered medicines
This booklet, which is published by the National Medicines and Poisons Board in 2014, classifies the registered medicines in Sudan into those that are 'Prescription only Medicine', 'Controlled Medicine' and those that can be dispensed without a prescription. It is a well written and useful guide but is unfortunately underused due to its poor distribution and lack of reinforcement mechanisms for implementation.

d) Community Pharmacy Practice Guidelines
The General Directorate of Pharmacy of the Federal Ministry of Health has developed the Community Pharmacy Practice Guidelines in 2015. These guidelines include standards of practice for Community Pharmacy in Sudan and details the minimum requirements that the community pharmacy must meet to help community pharmacists to provide quality services for patients. The guidelines clearly state the importance and mechanism of rational dispensing with all its components. It also emphasises the importance of patient counselling and the role of the pharmacist in ensuring rational use of medicine to promote health.

e) National Hospital Pharmacy Policy
The National Hospital Pharmacy Policy was developed in 2015 by the General Directorate of Pharmacy, Federal Ministry of Health to serve the needs of the patients treated in the hospitals by providing integrated patient-centred pharmaceutical care. It stresses adequate supply, safe, effective and good quality of medicines in appropriate dosage forms consistent with the needs of the patients, and effective clinical practice and management. The policy equally describes the role of the hospital pharmacists and the type of services that should be provided at hospitals. When looking at the capacities of the hospitals in relation to promoting the rational use of antibiotics in accordance to National Hospital Pharmacy Policy of 2015, the study revealed that:

- Only 35% of the pharmacies had active Pharmacy and Therapeutic Committees.

- 65% of the hospitals had medicines list.
- 42% of the hospitals had protocols and treatment guide lines.
- 37% of the surveyed hospital pharmacies had medicine information service.

The National Hospital Pharmacy Policy is one of the most important tools for promoting and ensuring the rational use of antimicrobials at hospital level. However, a clear plan of action to ensure its implementation in order to achieve its expected outcomes needs to be developed.

f) Generic Prescribing Policy 2015
The Federal Ministry of Health has developed a generic prescribing policy to promote the practice of generic prescribing and generic substitution throughout the different levels of the healthcare system. The objective of the policy is to improve the affordability and availability of medicines for patients across Sudan. The Medicines and Poisons Act 2009 also compels the use of generic names by prescribers who work in public health facilities [19]. However, the extent of implementation of this policy and the enforcement of the Act are not yet clear.

g) The Sudan National Formulary
The Sudan Medical Council updated the Sudan National Formulary in 2014, and it currently contains a list of medicines, including antimicrobials that are approved and registered for use in Sudan. The formulary includes key information about each medicine, dosage, side effects and contra-indications. The Sudan National Formulary is in line with the currently approved national patient management protocols in Sudan and is compatible with the policies and directives of the National Medicines and Poisons Board. The Sudan National Formulary is available to prescribers, pharmacists, health care professionals, and other relevant stakeholders as a national reference guide and resource. It aims to optimise drug therapy and rationalise scarce resources to improve patient safety and limit unnecessary medical spending. However, like other printed documents, the wide distribution of the Sudan National Formulary has been constrained by a number of factors, which include competing priorities and limited financial resources.

Regulation and control of promotional practices by industry

The Sudan Medical Council has a code of conduct, with a clear section on promotional practices, which is given to doctors on registration prior to commencing their practice. Although Sudan Medical Council and Medicines and Poisons Act 2009 ban the advertisement of drugs, there is neither a system to control promotional activities nor a mechanism of monitoring and preventing misinformation to health care professionals and to the public [19]. Similarly, there is no supervisory and monitoring mechanism in place to enforce the implementation of the code of practice or regulate the promotional material and activities.

Laboratory capacity to identify pathogens and their antimicrobial susceptibility

There are 50 hospitals and 238 Community Health Centres in

Khartoum State, all equipped with medical laboratories. Of the 50 hospital laboratories, 17 are reported to have carried out regular culture and sensitivity testing. However, the validation of these results is debatable due to the lack of quality assurance mechanism in the country. On the other hand, 68 out of the 238 Community Health Centres are identified as referral Centres to carry out C-reactive protein (CRP) testing to differentiate between bacterial and viral infections. The private sector in Sudan contributes by delivering 60% of health services. In Khartoum State alone, there are 80 private hospitals with medical laboratory services. However, no reliable information was available in regard to the type, quantity and quality of services delivered by private sector laboratories.

Overall, this study found out that the capacity of the laboratories was inadequate for the current needs and their capability of carrying out culture and sensitivity testing is rather limited in terms of numbers, equipment, location, functions and staffing. In addition to that, there is lack of quality assurance mechanisms, hence raising questions in regard to validation of test results produced by existing laboratories.

Provision of stewardship programme to monitor and promote optimisation of antimicrobial use

Having stewardship programmes to ensure the correct choice of medicines at the right doses in accordance with international standards is essential at both national and local levels. As Sudan currently has no postgraduate programme for infection prevention and control/Antibiotic Stewardship, clinical microbiologists and pharmacists are taking the lead, but there is no data to illustrate the level and degree of their functioning such stewardship programmes.

Identification and elimination of economic incentives that encourage inappropriate use of antimicrobial agents

Economic incentives that encourage inappropriate use of antimicrobials agents may be identified at many levels. Pharmaceutical promotion plays a substantial role in this matter, as the amounts of sales of antibiotics may be directly related to profit making. In Sudan, retail pharmacies receive a bonus that is directly related to the amount of medicines sold. This is a major driving force that may lead to the unnecessary sales of antibiotics, especially in the absence of strict regulatory measures.

Promotional activities also extend to influence the prescribing practices of health professionals. In some cases, pharmaceutical companies have been known to pay commissions to prescribers who prescribe their products in addition to other incentives, which may include meals, event tickets, and travel to conferences.

Regulation and governance for licensing, distribution, use and quality assurance of antimicrobial medicines

There is a Medicines and Poisons Act 2009 which is meant to ensure the regulation of pharmaceuticals manufacturing, importation, pricing, and distribution. The Medicines and Poisons Act extends to monitoring medicines' adverse reactions, assuring availability of safe, effective and affordable human and veterinary medicines, cosmetic products and medical devices. The Medicines and Poisons Act is meant to ensure compliance with legal, scientific, ethical and administrative requirements [19]. However, there have

been challenges in the enforcement of the Medicines and Poisons Act including among others, the fact that antibiotics are not given special consideration and regarded equal to all other medicines in the Act.

Discussion

This study has shown the presence of a number of well-written policies and guiding documents, yet their use and impact in ensuring the rational use of antibiotics and combating the development of AMR was unclear. This could be due to many reasons such as lack of properly costed strategies and workplans to ensure proper advocacy, dissemination, implementation and monitoring mechanisms of these policies and guidelines. Above all, the absence of a collaborative approach between the different bodies, which is fundamental to harmonise and coordinate all policies and guidelines related to AMR could be another factor [23].

Despite the presence of important guidelines, the study has also shown discrepancies between the antibacterial medicines in the Standard Treatment Guidelines, National Essential Medicines List, and the procurement list of the National Medical Supplies Fund. This raises questions in regard to the development process of these lists and it shows clear lack of governance and harmonisation between the different bodies in availing the antibiotics that are actually needed in the country [24, 25]. This discrepancy adversely affects the prescribing and use of antibiotics and could be a major contributing factor to the development of AMR. Further studies are needed to investigate these inconsistencies and the underlying causes in order to address the issue of antibiotic availability in Sudan.

Poor access and availability of antibiotics may lead to inappropriate prescription and overuse of certain types, contributing to the development of multi-drug resistance [26]. Therefore, the development of policies and guides alone cannot affect the complex nature of antibiotic misuse and other related factors. This should be linked with wider dissemination, ensuring the availability of essential antibiotics according to the country's needs, in addition to regular supervision and monitoring to ensure their proper use [3]. In the same manner, the existing policies, manuals and guidelines need to be made available and accessible to different health professionals including prescribers and dispensers. The use of these policies and guidelines need to be reinforced by regulations and proper monitoring mechanisms [27].

The lack of supervisory or monitoring systems, and appropriate dispensing of antimicrobials in both public and private sectors adversely affect the prescribing, dispensing and use of antibiotics [28]. In the context of Sudan, the system is weakened due to low capacity in monitoring and control because of limited resources both in terms of human resources, skills, tools, and funds.

This study highlighted that the capacity of the laboratories in Sudan were inadequate for the current needs. Their capability to carry out culture and sensitivity testing is rather limited in terms of numbers, equipment, location, functions and staffing in addition to lack of quality assurance mechanisms. It was found that only 29% of Community Health Centres carried out C-reactive protein (CRP) testing to differentiate between bacterial and viral infections. An

interventional comparative study was carried out by Elkheir et al [29] to see the impact of CRP measurement on prescribing of antimicrobials. The study found that antibiotics were prescribed for only 16.9% of patients in the intervention group and for 83.4% in the control group. The study revealed that the use of CRP test has greatly reduced the rate of antibiotic prescription among the intervention group [29]. However, this might not be the most cost-effective intervention to decrease the prescribing of antibiotics in the current context of Sudan due to the additional costs it may impose to the patients. Getting antibiotic treatment could be much cheaper than the tests required to show that the drug is needed. CRP testing has been shown to be cost-effective in high-resource settings, but data in Low-to-Middle-Income Countries are limited [30].

The close relationships between drug promotion, prescribing practices and drug sales have been demonstrated in several studies [31]. Since drug promotion increases usage, it may be assumed that it can contribute to the prevalence of antimicrobial resistance, particularly if it results in increased inappropriate use of antimicrobial agents [32]. A study conducted in Khartoum State has shown that the pharmaceutical industry promotional activities were highly valued, welcomed, accepted and liked by the doctors. Pharmaceutical industry promotional activities seem to have a considerable impact on the prescribing pattern or behaviour of Sudanese doctors [33].

Regulating promotional practices is quite a major task [34]. Having guidelines and code of ethics alone might not be enough. While it could be possible, to some extent, to regulate and control promotional practices in public health facilities, it will remain a challenge to do the same in the private sector. This calls for a strong mechanism to enforce the regulations through monitoring systems and punitive measures [35]. In addition to having a code of practice and guidelines, there is a clear need for greater efforts to ensure that health professionals have access to regular continuous professional development (CPD) programmes, in addition to credible resources to obtain accurate information regarding the efficacy and safety of antimicrobial agents and the problems of antimicrobial resistance [36].

Over-the-counter sales of antibiotics is another primary driver to AMR. In Sudan, studies have shown that the rates of self-medication with antibiotics are high, which is attributed to factors such as poor knowledge and beliefs of the patients [37, 38]. However, the pharmacists are equally playing a role in supplying the medicine without prescriptions. This practice could be due to several reasons such as the level of knowledge and awareness of the dispenser, pressure from patients demanding antibiotics as well as the non-functioning regulatory and monitoring systems. As such, antibiotics are considered as fast moving items whose sale rates contribute greatly to the pharmacy's profit [39]. Since 2018, it reinforced that pharmacies dispense antibiotics only by prescriptions, yet compliance remains questionable.

In order to minimise the unwanted consequences of antimicrobial use, implementation of antimicrobial stewardship programmes are mandatory [40, 41]. Formal antimicrobial stewardship programmes in healthcare facilities, that include multidisciplinary

stewardship teams with clear terms of reference, should be established [42].

Ideally, antimicrobial stewardship should be designed to include the following [40]:

- Educational measures (antibiotic guidelines, educational sessions);
- Active interventions (clinical rounds, audits, reassessment of antibiotic use);
- Restrictive measures (limiting antibiotics on the hospital formulary, reporting of susceptibility by the microbiology laboratory, antibiotic order form).

It is evident that monitoring and regulating the prescription, dispensing and use of antibiotics is a challenge in Sudan. Involving beneficiaries in regulating the use of antibiotics is worth exploring. The National Health Insurance Fund provides a good example; their efforts to cut down the expenditure for antibiotics resulted in rationalising the use of these medicines, which was facilitated by the establishment and use of an electronic monitoring system [41]. Drug companies may be involved in this sense. It is true that increasing their sales is their ultimate goal, but overuse and misuse of antibiotics will eventually end their shelf life in the pharmacy i.e. there will be no sale at all due to their loss of efficacy. Rationalising their use will at least ensure a sustainable profit [43].

There is a need to set up quality assurance and management systems within the existing structures for the distribution, prescription and dispensing of antibiotics in both public and private institutions. The system should clearly define the processes and provide adequate resources for appropriate monitoring and control of antibiotic distribution, prescription and dispensing [42]. While assessing the quality, safety and efficacy of medicines is crucial, post-marketing surveillance of these drugs to oversee and monitor their quality is highly needed [25, 44].

Introduction of incentives to optimise the use of antibiotics is another important area of work, but may pose a challenge [14]. Nevertheless, such interventions may be feasible and effective at small scale for instance in health insurance schemes, while enforcing the guidelines on classification of registered medicines and developing a supervisory mechanism may be among other possible long-term solutions to optimise the use of antimicrobial medicines in Sudan.

Conclusion

This study revealed the presence of a number of policies and guiding documents. However, the extent of implementation and periodic update of these documents was unclear. If properly implemented and reinforced by regulations through proper monitoring mechanisms, they would contribute significantly to combating AMR in Sudan.

On the other hand, the development of a national action plan to combat AMR and the implementation of the existing national antibiotic use policy will be a good start. Therefore, existing policies, manuals and guidelines such as Standard Treatment Guidelines, National Essential Medicines List, and the National Medical Supplies Fund procurement list, need to be regularly revised and updated in order to overcome the existing discrepancies. They should

also be made available to all health professionals including prescribers and dispensers, and their use be reinforced by regulations through proper monitoring mechanisms.

The presence of properly functioning supervisory and monitoring systems in Sudan is a challenge. Optimising the use of antimicrobials in Sudan requires the establishment of effective supervisory, monitoring and quality assurance systems to ensure proper distribution, rational prescribing and appropriate dispensing of safe effective antimicrobials in both public and private sectors. Measures for improving the capacity of laboratories in terms of numbers, services and quality across the country with the capability of carrying out culture and sensitivity testing need to be put in place.

Finally, there is urgent need for strong political will in addition to enhanced capacity in terms of human resources, finance, technology and tools within the existing structures to optimise the use of antimicrobials in Sudan.

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