

National action plan on antimicrobial resistance: An evaluation of implementation in the World Health Organization Africa region

Walter L. Fuller,¹ Omotayo T. Hamzat,² Aaron O. Aboderin,³

Laetitia Gahimbare,¹ Otridah Kapona,⁴

Ali A. Yahaya,¹ Watipaso Kasambara,⁵

Jean-Baptiste Nikiema,¹ Didier W.

Ilboudo,¹ Mirfin M. Mpundu⁶

¹World Health Organization Regional Office for Africa, Brazzaville, Congo;

²Universal Health Coverage/Life Course Cluster, World Health Organization,

Abuja, Nigeria; ³Department of Medical Microbiology, College of Health

Sciences, Obafemi Awolowo University,

Ile-Ife, Nigeria; ⁴Zambia National Public

Health Institute, Lusaka, Zambia;

⁵Public Health Institute, Lilongwe,

Malawi; ⁶ReAct Africa, Lusaka, Zambia

essential medicines list. Fourteen of 20 countries have established an active/functional national secretariat/coordinating center for AMR. Discernible progress is being made on the implementation of NAP in WHO AFR region. Gaps identified in the strategic elements of action plans need to be filled for effective AMR control.

Introduction

Antimicrobial Resistance (AMR) is a global threat with far reaching implications because of its crosscutting nature. Failure of effective control of AMR invariably jeopardizes significant progress in medicine, health and food security as well as economic growth.¹ Due to the crosscutting nature, AMR not only affects human health but also agricultural (plant and animal) health and the environment, including the social and political determinants inherent to these different strategic and core areas of existence in the ecosystem. It is not an overreach that the well-being of the whole ecosystem is under threat in the absence of effective multi-sectoral coordinated actions and control for AMR. Recognizing the urgent need to combat the global threat that sustained uncontrolled bacterial resistance poses led to a series of World Health Assembly (WHA) Resolutions dating back to 1998 which culminated in the development of the Global Action Plan (GAP) on AMR and its adoption with the World Health Assembly Resolution, (WHA 68.7), in 2015.² The Global Action plan provides guidance on proposed actions on AMR control for different actors including Member States to develop National Action Plans (NAPs), adapted to national priorities and context.

Addressing the threat of AMR is an urgent issue in Africa as the continent bears an unconscionably high burden of infectious diseases and antibacterial resistance in spite of paucity of data. Of the total estimated 10 million annual deaths attributable to AMR by 2050, 4.1 million will be from Africa.³ Systematic reviews of published literature covering different demographics⁴ or time periods including 1990-2013,⁵ 2013-2016,⁶ 1990-2019⁷ documented the concerning rates of resistance to common antibiotics for prevalent bacterial infectious diseases. Beyond rates of resistance to antibacterial agents, adverse patient outcomes from infections, including mortality and prolonged hospitalization are currently undocumented within the African region. Outside the direct health burden of drug-resistant infections, AMR has other heavy cost implications. African countries GDP

Correspondence: Walter Fuller, World Health Organization Regional Office for Africa, Brazzaville, Congo.

Tel. +12402713795.

E-mail: wfuller@who.int

Key words: Antimicrobial-resistance; WHO-AFRO; AMR-action-plan; workshop.

Acknowledgements: The authors would like to thank all the country focal persons that provided responses to the survey tool and participated to the Lessons Learnt Workshop in 2019.

Contributions: Conception and design of the work: WLF, OTH, AOA, OK; Acquisition, analysis and interpretation of data: WLF, OTH, AOA, LG, OK, AAY, WK, NJB, IDW; Drafting the manuscript: WLF, OTH, AOA, OK, MMM; Critical revisions for important intellectual content: WLF, OTH, AOA, LG, OK, AAY, WK, NJB, IDW, MMM; Final approval: WLF, OTH, AOA, LG, OK, AAY, WK, NJB, IDW, MMM.

Funding: The UK the Fleming Fund provided support for the Lessons Learning Workshop on Implementation of AMR National Action Plans in Africa that was held in Douala, Cameroon, whose report provided the core of this evaluation. Germany BMG supported the completion of NAP assessment for countries in the African region.

Conflict of interest: None of the funders had any roles in the design, data collection, analysis and writing of the report. Authors declare there are no financial or personal relationships that may have inappropriately influenced them in writing the manuscript.

Availability of data and materials: All data generated or analyzed during this study are included in this published article.

Ethics approval and consent to participate: All procedures performed in studies involving human participants were in accordance with the ethical standards of the Institutional Research Committee and with the 1964 Helsinki declaration and its latest amendment.

Informed consent: The manuscript does not contain any individual person's data in any form.

Received for publication: 2 August 2021.

Accepted for publication: 23 April 2022.

This work is licensed under a Creative Commons Attribution NonCommercial 4.0 License (CC BY-NC 4.0).

©Copyright: the Author(s),2022

Licensee PAGEPress, Italy

Journal of Public Health in Africa 2022; 13:2000

doi:10.4081/jphia.2022.2000

Publisher's note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article or claim that may be made by its manufacturer is not guaranteed or endorsed by the publisher.

Abstract

In line with global instruments, within the last five years, two-thirds of all countries in the WHO Africa Region (WHO AFR) have developed a National Action Plan (NAP) on Antimicrobial Resistance (AMR). We sought to evaluate progress made across the countries implementing NAP for effective response to AMR. A semi-structured survey tool was administered to obtain information from national focal persons on the implementation of strategic elements of NAP on AMR. This was followed by a Lessons Learnt Workshop in June 2019 at Douala, Cameroon, where focal persons made presentations on the country's progress. Later, a desktop review of the LLW report and other key documents was conducted. Countries in WHO AFR that have set up a national surveillance system and are enrolled into the WHO global antimicrobial resistance surveillance system have progressively increased to 30 (of 47 countries), of which 15 are already submitting surveillance data. Of the 20 countries at the Lessons Learnt Workshop, 14 have infection prevention and control (IPC) policies and functional healthcare facility IPC programs, 15 participate in the commemoration of the annual world hand hygiene days. Although almost all countries surveyed have national standard treatment guidelines, only five have incorporated the WHO AWaRe classification into the national

will go down from the previous positive projections of 3.1% to anywhere between -2.1 to 15% and loss of output between \$37 billion and \$79 billion in output. With further complications due to on-going COVID-19 pandemic, Africa is poised for a great recession, the first in 25 years. This will severely affect implementation of national action plans to address AMR as resources constrict and competing priorities increase. In the worst-case scenario, health care expenditure by 2050 would be 25.3% higher than the baseline for LMICs including most African countries. This in effect will translate into a net present value of additional health expenditures of 1.2 trillion USD annually in a high-AMR scenario and 0.33 trillion in low AMR scenario by 2050.¹ Furthermore, within a high-AMR case scenario, 28.3 million people most likely will experience extreme poverty by 2050 of which 26.2 million will be in low-income countries. AMR significantly disrupts attainment of the global landmark sustainable development goals (SDGs), which seek to end poverty, protect our planet and ensure that all people enjoy peace and prosperity by 2030. AMR directly impacts negatively on many of the SDGs including achievement of Universal Health Coverage (UHC), target 3.8 of SDG 3. Effectiveness of response to AMR has become rate-limiting to ensuring success of critical priorities such as SDGs, UHC, primary health care (PHC), food security, and the fight against emerging infectious diseases and overall health systems strengthening which are critical to ending poverty, ensuring strong labor and productivity with overall national and regional development.

In recognizing AMR as an urgent threat, the World Health Organization Regional Office for Africa (WHO AFRO), working with the tripartite partners (World Organization for Animal Health (OIE), Food and Agriculture Organization (FAO) and United Nations Environment Programme (UNEP) and national, regional and global stakeholders, began in 2016 to support member states in the development and implementation of National Action plan (NAP) to contain and slow the emergence of AMR. In this manuscript, we seek to provide an appraisal of the progress made in addressing the threat of AMR in the WHO Africa region, while detailing challenges and threats that have hampered robust implementation in the member states and the region as a whole and provide recommendations that could further catalyze and speed up AMR control moving forward.

Support and actions for control of antimicrobial resistance in the WHO Africa Region

Human resource capacity development for AMR control

In line with global resolutions including the GAP² on AMR and UNGA political declaration,⁸ and in partnerships with FAO, OIE and other partners, the World Health Organization Regional Office for Africa (WHO AFRO) in May 2017 began building a core of experts through AMR training of trainers' workshop to facilitate development of NAP with a One-Health approach in different countries. Two hundred and ninety-five (295) AMR National Focal Persons (NFPs) representing human health, veterinary and agricultural sectors from 44 countries were trained. The NFPs (experts) not only supported respective member states in the development of NAPs but continue to serve as essential and critical capacity for implementation of AMR NAPs in the African region. Thirty-six (36) of the Member States have been supported in the development of multisectoral NAP for AMR, of which 20 have been officially approved.⁹ Furthermore, during the same period, all except one of the 47 countries in the region conducted the Joint External Evaluation (JEE) of the International Health Regulations (IHR 2005) co-capacities to assess 19 technical areas including AMR. Thirty (30) countries have developed costed NAP for Health Security to address priority gaps identified in the technical areas including AMR.

Policy and guidance documents for action on AMR

Underlying the trainings to build capacity are various policy and guidance documents ranging from the GAP² informing development of NAP, to other tools and protocols focusing on the strategic objectives of Action Plan on AMR. Tools that support rational use of antimicrobial medicines include, *WHO methodology for point prevalence survey on antibiotic use in hospitals*,¹⁰ *Antimicrobial stewardship programmes in health-care facilities in low- and middle-income countries - A practical toolkit*¹¹ and the 20th Model List of Essential Medicines (EML) with a new AWaRe classification which helps to identify issues of inappropriate antibiotic use and inform specific interventions. Other tools support surveillance of AMR include *WHO ESBL E. coli Tricycle protocol for integrated One Health surveillance of antibiotic resistance and the Global Antimicrobial Resistance Surveillance System (GLASS)*.¹²

Lessons learning workshop for implementation of AMR national action plans

Between 15-18 July 2019, the WHO Regional Office for Africa (WHO AFRO) convened an AMR Lessons Learning Workshop in Douala, Cameroon. The workshop brought together AMR policy makers and technical experts from the health and agricultural sectors to share ideas, experiences and best practices around governance, multisectoral coordination, monitoring, getting AMR into plans and budgets. A major aim of the meeting was to assess progress member states have made in moving beyond development to implementation of their National Action Plans on AMR. The workshop recorded participants from 20 countries of the 47 countries with representations from the Central, West, East and the Southern African regions.

Prior to the face-to-face meeting at the Workshop, participants responded to a pre-workshop survey and also provided a PowerPoint presentation using a standard template to provide information relating to progress on implementation of their country's NAPs on AMR. The responses helped to determine status of each of the participating member states with regards to each of the strategic elements of GAP.

Grey literature on AMR in WHO Africa region

This included WHO AFRO Regional Director's biennial reports from 2016-2020,^{9,13-15} Global Database for Antimicrobial Resistance Country Self-Assessment¹⁶ (Tripartite Country Self-Assessment Surveys), Global Antimicrobial Resistance and Use Surveillance System 2020 report,¹² ReAct Africa and South Centre conference 2019 report.

Findings and status on implementation of elements of national action plan on AMR in the WHO Africa Region

Surveillance and research to strengthen knowledge and evidence base on AMR

Eighteen (90%) of the 20 countries at the LLW reported presence of in-country National Reference Centers for surveillance of AMR, with 16 (80%) countries having antimicrobial susceptibility testing capacity both in human and animal health sectors. Twelve (60%) of the countries had established a national AMR surveillance system

as well as carrying out surveillance on antimicrobial drug-resistant organisms in humans. Only seven (35%) countries reported AMR surveillance in the animal health sectors, with the same number of countries (7, 35%) for each of antibiotic consumption and use (AMC/AMU) surveillance as well as an integrated AMR surveillance system. Eleven (55%) of the countries are registered to the WHO global antimicrobial resistance surveillance system (GLASS) with six (54.5%) already submitting data to the system. Only eight (40%) countries had undertaken mapping of available AMR data.

Effective sanitation, hygiene and infection prevention measures to reduce incidence of infection

Fourteen of 20 countries have IPC policies as well as functional healthcare facility IPC programs with committees. However, only nine countries conduct surveillance for Healthcare-Associated Infection (HAI) at facility levels. Only five countries had biosecurity and biosafety measures in the animal sector. Fifteen of the countries have waste management systems in hospitals, 16 countries have a system for disposal of unused or expired medicines in the human/animal sector. Fifteen countries participate in world hand hygiene day activities. On vaccination, almost all the countries (19) across have standards for distribution and administration in place.

Optimized use of antimicrobial medicines in human and animal health: Access to essential medicines

Eighteen (90%) of 20 participating countries have up-to-date essential medicines list, however only 5 (27.8%) have aligned with the recent WHO AWaRe categorization of antibiotics, aimed at optimizing use. Thirteen (65%) countries reported on updated national Standard Treatment Guidelines (STGs) and only 4 reported having antibiotic treatment guidelines. Only 3 (15%) countries reported a “Restriction list on critically important antimicrobials for human use only”, while 16 (80%) use antibiotics as growth promoters in animal husbandry.

Optimized use of antimicrobial medicines in human and animal health: Antimicrobial stewardship

Responses concerning institutional antimicrobial stewardship in human and veterinary medicine showed that while eight (40%) countries reported AMS in hospitals, only two (10%) countries have AMSP in veterinary settings. Notably, 60%

of countries receiving significant external funding have established AMS programs in hospitals compared to only 20% of countries who were not receiving such funding.

Governance and multisectoral coordination on AMR

The LLW survey sought to know elements of political commitment and leadership for national response to AMR in different countries. The findings showed that 14 (70%) of the participating countries reported an active/functional national secretariat or coordinating center for AMR. Twelve (60%) of the countries have a reporting mechanism within their AMR secretariat but only seven (35%) actively share information that are helping to craft policies at the national, sub-regional, regional and global levels.

Discussion

Strategic objective two of the GAP-AMR incorporates activities including development of a national surveillance system for antimicrobial resistance, which incorporates a national reference center that systematically collects and analyzes data for informed national policies. The surveillance system integrates with animal health and agricultural sectors to include a reference laboratory with testing capacity as well as participation in regional or global network of data sharing. More than half (12, 60%) of the countries that participated in the LLW have developed a national AMR surveillance system. Fewer (7, 35%) have surveillance for AMR in animal health which are also integrated with human health and data sharing beyond the national level. While 11 (55%) of the countries have registered in the WHO Global Antimicrobial resistance Surveillance System (GLASS), only six have made data submission to the system. The 2020 GLASS report showed that of the 47 countries in the Africa region, 25 (53.2%) are enrolled, of which 15 (60%) responded to the second data call and have supplied data on national AMR surveillance.¹² At the time of this writing, 30/47 (64%) countries are enrolled in GLASS since March 2016 distributed as 25 in GLASS-AMR module only, South Sudan in GLASS-AMC module only and four countries simultaneously in both GLASS-AMR and GLASS-AMC. National antimicrobial resistance surveillance systems provide the framework to measure and effect reductions in prevalence of AMR as building blocks of regional and global networks of surveillance systems. The systems are essential for formulating guidelines for antimicrobial use

, evaluating evidence-based interventions, monitoring antimicrobial resistance and conducting public health research.

Contrary to the budding initiatives on national and regional surveillance systems on AMR in Africa, most high-income countries and some LMICs support such systems. In the United States, the National Antimicrobial Resistance Monitoring System for Enteric Bacteria (NARMS) was established more than two decades ago. The European Antimicrobial Resistance Surveillance Network (EARS-Net) was developed from the earlier European Antimicrobial Resistance Surveillance System (EARSS) that started two years after US NARMS in 1998. Other established systems include Latin American Surveillance Network of Antimicrobial Resistance (ReLAVRA), Asian Network for Surveillance of Resistant Pathogens (ANSORP), Danish Integrated Antimicrobial Resistance Monitoring and Research Program (DANMAP), Norwegian Surveillance System for Antimicrobial Drug Resistance (NORM/NORM-VET) and China Antimicrobial Resistance Surveillance Study (CHINET). Ghana demonstrated the feasibility of nationwide laboratory-based AMR surveillance by conducting a 6-month AMR surveillance study in 2014, which showed that resistance rates were higher than expected within the country. With the current global concern and support, it is expected the 30 countries already registered into WHO GLASS will sustain and deliver on AMR surveillance; while the remaining 17 countries will leverage on the growing experience within the continent to develop national surveillance systems with all the possible benefits.

Infection Prevention and Control (IPC) is a core strategic element of the Global Action Plan for control of AMR, Fourteen (14) of the 20 countries at the Lessons Learning Workshop reported on core components of IPC including functioning IPC programs as well as IPC guidelines. Organization of IPC programs define objectives and specify professionals or professional organizations for preventing infections and combating AMR through IPC good practices including the leveraging of IPC teams at healthcare facility level to support antimicrobial stewardship interventions. More than half of the represented countries (11, 55%) did not have a system of surveillance of Healthcare-Associated Infections (HCAI). Also, there is paucity of surveillance data on HCAI from Africa and many developing countries. Till date, three different systematic reviews of HCAI, covering the periods 1995-2008,¹⁷ 1995-2009¹⁸ and 2010-2017¹⁹ have documented status of

HCAI in Africa. All the reviews recognized and highlighted the need for robust national and regional surveillance of infections in Africa.

Fundamental and essential to effective IPC programs as well as surveillance of infections is Water, Sanitation and Hygiene (WASH) infrastructures including water supply, toilets and healthcare waste disposal. A quarter of all the countries at the LLW have waste management systems in hospitals while the same proportion specify a system for disposal of expired medicines as well as participate in WHO annual hand hygiene activities. Hand hygiene saves between 5 and 8 million lives per year and has become more important now in the context of COVID-19 pandemic. In contrast to status in human health, only five (25%) countries have biosecurity and biosafety measures for the animal sector.

Amongst the 20 countries that participated at the LLW, we surveyed different elements of antimicrobial stewardship interventions including availability of standard treatment guidelines, restriction list on critically important antimicrobials for human use only, essential medicines list with categorization into WHO access, watch and reserve groups of antibiotics, and organizational or system-wide strategy antimicrobial stewardship programs. Nineteen (19) countries have an updated national essential medicines list that includes antimicrobials. In 2017, the 20th WHO Model List of Essential Medicines (EML) introduced the biggest revision in the 40-year history of EML with a new antibiotic classification known as the AWaRe classification that recognizes Access, Watch and Reserve groups.²⁰ AWaRe classification is an easy-to-use indicator that helps to identify issues of inappropriate antibiotic use and inform specific interventions including improved access to antimicrobials. Only five of the 20 countries in the LLW survey within Africa including Republic of Congo, Gabon and Namibia⁹ have incorporated AWaRe classification as an instrument to optimize antibiotic use at the national level. A disproportionate small number, 3 out of 20 countries, have a restriction list on *critically important antimicrobials for human use only*. The WHO list of Critically Important Antimicrobials (CIA) for Human Medicine was first published in 2005, with the sixth and most recent revision in 2019.²¹ All antimicrobials used in human medicine are categorized into one of “Critically important”, “Highly important”, or “Important” agents. A fourth category, “Antimicrobial classes currently not used in humans” are listed as Annex 2 in the WHO CIA. In the same direction, antibiotics use as growth

promoters in food animals is the norm within the region as 16 (80%) of the countries reported such usage. The Global Action Plan on AMR recommends phasing out of antimicrobials for growth promotion without risk analysis. This requirement is more compelling as up to 73% of global antimicrobials are used to raise animals for food.²² Historically, AMS programs were mostly limited to hospitals. However, similar programs on improving antimicrobial use exist in other contexts such as community settings or in livestock. Only eight (40%) of all the countries surveyed reported implementation of human health antimicrobial stewardship programs in hospitals. In order to provide guidance on antibiotic stewardship interventions that are applicable to low- and middle-income settings, the WHO has recently developed a practical toolkit,¹¹ which defines core structures to support stewardship. Presently, veterinary antimicrobial stewardship programs were essentially non-existent in all the countries as only two (2) had developed AMS.

Multi-sectoral collaborations to tackle AMR can only be achieved by strong leadership and established governance that utilize a One Health approach.²³ Presently, up to a third of the 20 countries surveyed are yet to have in place a functional AMR coordinating centre. At the global level, need for strong governance on AMR is recognized and being addressed with the approval and constitution of the recommendation of the Ad Hoc Interagency Group on Antimicrobial Resistance (IACG) for a One Health Global Leadership Group²⁴ to maintain urgency, political momentum and advocacy for action.

Conclusions

Concerted national and regional efforts towards implementation of action plans to control AMR within African continent began less than five years ago. Findings from Lessons Learning Workshop have identified critical gaps in the progress in the control of AMR within Africa. Governance structures for control of AMR require strengthening and visibility beyond signatures present on the National Action Plans. Essential Medicines Lists are almost universal in all the countries, however, systems to implement and monitoring indicators that show optimal use of antimicrobials are almost always not in place. Most countries are neither AWaRe²⁰ nor have restriction lists of critically important antimicrobials²¹ as well as antibiotic treatment guidelines.

A number of African countries following outbreaks of epidemic diseases includ-

ing Ebola or Lassa viral diseases have in place, Infection Prevention and Control (IPC) as well as WASH interventions. Considering the primary role of infection prevention in AMR control, the important pillars of IPC and WASH need prioritization across Africa. Promoting use of relevant existing tools IPC as guide and starting point towards implementation of WHO core components will reduce risk of development and transmission of susceptible and drug-resistant pathogens in healthcare facilities. Training of stakeholders across the healthcare continuum using quality improvement strategies as well as healthcare provider education curricula is essential to facilitating behavior change incorporating prevention of transmission of healthcare-associated pathogens including as multidrug-resistant organisms.

There are 5.7 million annual deaths mainly in LMICs as result of inaccessibility to life-saving antimicrobial medicines.²⁵ Despite the documented benefits of antimicrobial stewardship programs, they are uncommon within Africa. Initiatives to optimize use of antimicrobial medicines including that by WHO, ReAct Africa and the Medicines, Technologies and Pharmaceutical Services (MTaPS) program funded by USAID in selected African countries need to be reproduced across the continent. Initial capacity building and funding by many more state actors and partners to support wider uptake of initiatives should be prioritized.

Only very few countries in Africa like Ghana²⁶ have positioned AMR at the highest possible political level with parliamentary approval of Action Plan and One Health platform for engagement. At the global level, there is a clear model with the adoption and implementation of IACG recommendations on governance and accountability to constitute a One Health Global Leaders Group on Antimicrobial Resistance²³ to maintain highest levels of global momentum and engagement.

Coordinated African regional level governance and accountability is budding with the collaboration and cooperation of the African Union and UN tripartite organizations (FAO, OIE and WHO with UNEP) during the World Antibiotic Awareness Week (WAAW) 2020 and Joint Tripartite Plus, African Union Commission (AUC) and Regional Economic Committees (RECs) Regional AMR Virtual Training and Consultative meeting in February 2021. Beyond WAAW activities and the current self-reporting by member states to the Tripartite AMR Country Self-Assessment¹⁶ the tripartite should provide support to improve policy implementation and robust

context-driven one-health implementation at country level taking into account the specificities and peculiarities of the systems inherent to the respective member states.

Finally, the disparity in implementation progress within the Africa region, possibly a reflection of disparity in funding needs to be addressed especially in the context of AMR pandemic, as countries within the region lagging behind will put the continental and global fight against AMR in peril.

References

1. Drug-Resistant Infections: A Threat to Our Economic Future. World Bank Group. 2017. <http://documents1.worldbank.org/curated/en/323311493396993758/pdf/final-report.pdf>
2. Resolution WHA 68-7. Global action plan on antimicrobial resistance. In: Sixty-eighth World Health Assembly, Geneva, 26 May 2015. Annex 3. Geneva: World Health Organization; 2015.
3. O'Neill J, 2016 Tackling drug-resistant infections globally: final report and recommendations The review on antimicrobial resistance http://amr-review.org/sites/default/files/160525_Final%20paper_with%20cover.pdf.
4. Williams PCM, Isaacs D, Berkley JA. Antimicrobial resistance among children in sub-Saharan Africa. *Lancet Infect Dis*. 2018 Feb;18(2):e33-e44. doi: 10.1016/S1473-3099(17)30467-X. Epub 2017 Oct 9. PMID: 29033034; PMCID: PMC5805911.
5. Leopold SJ, van Leth F, Tarekegn H, Schultsz C. Antimicrobial drug resistance among clinically relevant bacterial isolates in sub-Saharan Africa: a systematic review. *J Antimicrob Chemother*. 2014 Sep;69(9):2337-53.
6. Tadesse BT, Ashley EA, Ongarello S, et al. Antimicrobial resistance in Africa: a systematic review. *BMC Infect Dis* 2017;17:616.
7. Lester R, Musicha P, van Ginneken N, et al. Prevalence and outcome of bloodstream infections due to third-generation cephalosporin-resistant Enterobacteriaceae in sub-Saharan Africa: a systematic review. *J Antimicrob Chemother* 2020;75:492-507.
8. A/RES/71/3. Political declaration of the high-level meeting of the General Assembly on antimicrobial resistance. New York: United Nations; 2016.
9. The Work of the World Health Organization in the African Region. Report of the Regional Director 1 July 2019–30 June 2020. Brazzaville: WHO Regional Office for Africa; 2020.
10. WHO. WHO methodology for point prevalence survey on antibiotic use in hospitals. Geneva: World Health Organization; 2018. Licence: CC BY-NC-SA 3.0 IGO. 2018.
11. Antimicrobial stewardship programmes in health-care facilities in low- and middle-income countries. A practical toolkit. Geneva: World Health Organization; 2019.
12. Global Antimicrobial Resistance Surveillance System (GLASS). Country participation. WHO. 2020. <https://www.who.int/glass/country-participation/en/>.
13. The Work of the World Health Organization in the African Region. 2016-2017 Biennial Report of the Regional Director. Geneva: World Health Organization; 2017.
14. The Work of the World Health Organization in the African Region. Report of the Regional Director: 2017–2018.
15. The Work of the World Health Organization in the African Region. Report of the Regional Director 1 July 2018–30 June 2019. Brazzaville: WHO Regional Office for Africa; 2019.
16. Global Database for Antimicrobial Resistance Country Self-Assessment. WHO, FAO, OIE. 2020. <https://amr-countryprogress.org/>.
17. Allegranzi B, Bagheri Nejad S, Combescure C, et al. Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. *Lancet* 2011;377:228-41.
18. Bagheri Nejad S, Allegranzi B, Syed SB, et al. Health-care-associated infection in Africa: a systematic review. *Bull World Health Organ* 2011;89:757-65.
19. Irek EO, Amupitan AA, Obadare TO, Aboderin AO. A systematic review of healthcare-associated infections in Africa: An antimicrobial resistance perspective. *Afr J Lab Med* 2018;7:796.
20. Sharland M, Pulcini C, Harbarth S, et al. Classifying antibiotics in the WHO Essential Medicines List for optimal use-be AWARe. *Lancet Infect Dis* 2018;18:18-20.
21. Critically Important Antimicrobials for Human Medicine. 6th Revision, 2019. <https://www.who.int/foodsafety/publications/antimicrobials-sixth/en/>.
22. Van Boeckel TP, Brower C, Gilbert M, et al. Global trends in antimicrobial use in food animals. *Proc Natl Acad Sci USA* 2015;112:5649-54.
23. UN Interagency Coordination Group on Antimicrobial Resistance: No Time to Wait: Securing the future from drug-resistant infections. Report to the Secretary-General of the United Nations. 2019.
24. One Health Global Leaders Group on Antimicrobial Resistance. <https://www.who.int/groups/one-health-global-leaders-group-on-antimicrobial-resistance>.
25. Daulaire N, Bang A, Tomson G, et al. Universal Access to Effective Antibiotics is Essential for Tackling Antibiotic Resistance. *J Law Med Ethics* 2015;43:17-21.
26. Ministry of Health. Ministry of Food and Agriculture, Ministry of Environment, Science, Technology and Innovation, Ministry of Fisheries and Aquaculture Development. Ghana National Action Plan on Antimicrobial Resistance. https://www.moh.gov.gh/wp-content/uploads/2018/04/NAP_FINAL_PDF_A4_19.03.2018-SIGNED-1.pdf.