

Evidence for action: A One Health learning platform on interventions to tackle antimicrobial resistance

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Summary/abstract

Improving evidence for action is critical to tackle antimicrobial resistance (AMR). The number of AMR interventions is increasing but current research has major limitations in terms of efforts, methods, scope, quality, and reporting. Moving the agenda forward requires a better understanding of the diversity of interventions, their feasibility and cost-benefit, implementation factors that shape and underpin success and failure, and ways individual interventions might interact synergistically or antagonistically to influence actions against AMR in different contexts. Within current efforts to strengthen the global governance of AMR, we advocate for the creation of an international One Health online learning platform. The platform will synthesize current evidence for actions on AMR into a fully accessible database, generate new scientific insights into the design, implementation, evaluation, and reporting of the broad range of interventions relevant to tackle AMR, and ultimately contribute to the goal of building societal resilience to this central challenge of the 21st century.

Main points

Fundamental knowledge gaps hinder effective action against AMR, but the limitations of current research on interventions serve as even bigger obstacles. Moving the agenda forward requires a better understanding of the diversity of interventions on AMR, their feasibility and cost-benefit, and the factors that shape and underpin success and failure.

To foster learning across goals, regions, levels, and sectors, current information about AMR interventions can be consolidated into a fully accessible and continuously updated One Health online platform. Its main added value would be to provide searchable evidence about what works, for whom and under what conditions.

An open access learning platform on AMR interventions should be useful to a broad range of stakeholders including healthcare professionals, public health practitioners, policymakers, industries, and consumer groups. It would not only provide the possibility of complementing published sources with new information, but also enable exchange of ideas through online community tools.

By working towards amplifying the generation of science-based and actionable knowledge, the platform would be a timely contribution to the goal of building societal resilience to the complex challenge of AMR. The integration of the 'One Health learning platform' within current governance mechanism will help to maximise its utility and sustainability.

Keywords:

Antimicrobial resistance; resilience; Global governance; Implementation science, Interventions, One Health, Global Health; Evaluation; Synthesis; Knowledge platform

Acknowledgement:

We thank all the participants in two workshops conducted in September and October 2019 in Stockholm, Sweden and Penang, Malaysia.

Funding:

This project is funded through the fifth JPIAMR call by the Swedish Research Council, the Canadian Institutes of Health Research, and the Swiss National Science Foundation. Chadag Mohan, Jerome Delamare-Deboutteville, and Patrik Henriksson were supported by the CGIAR Research Program on Fish Agri-Food Systems (FISH) led by WorldFish. Barbara Wieland was supported by the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH).

Word count:

1462 words in the main text, 44 references

The threat of antimicrobial resistance (AMR) has risen on the global agenda with a recognition that collaboration across countries and sectors (e.g. human, animals, plant, and environmental health) is needed to enhance the effectiveness and sustainability of current efforts.¹⁻³ Governments have accepted to set out national action plans (NAP) to combat AMR, but concrete action is needed at both national and international levels.⁴ The current COVID-19 pandemic further stresses the urgent need for ambitious action to tackle infectious diseases. Interventions to tackle AMR (aka 'AMR interventions'), from punctual actions to complex ones,⁵ from regulatory to behavioural approaches, and from strategies focusing on infection prevention to those focusing on responsible use,⁶ are vital to consolidate an evidence-based approach to the challenge.⁷ Within ongoing efforts, we discuss the important gaps regarding AMR interventions and the need for, and main features of, a One Health learning platform that will help to address those gaps. This online platform would synthesize current evidence for action on AMR into a fully accessible database, generate new insights into the design, implementation, evaluation and reporting of the broad range of AMR interventions, and ultimately help build resilience to this central challenge.⁸

Fundamental knowledge gaps hinder action against AMR, but the limitations of current AMR interventions research serve as even bigger obstacles. While recent systematic reviews synthesized the effectiveness of some types of interventions,⁹⁻¹² a broader search and assessment of published AMR interventions provides insights into the current state of knowledge (Box 1). First, the number of published interventions and systematic reviews is increasing, with more reports coming from low- and middle-income countries (LMIC),¹³ but the understanding that informs many interventions is still biased towards those implemented in high-income countries (HIC). In addition, evidence originates dominantly from 'successful' interventions conducted in hospitals or farms, in the human health sector, and focusing on surveillance or reduction of antimicrobial use. Second, the overall quality of evidence reported in several systematic review is rather low.^{10,11,14} Third, most publications on interventions insufficiently report on the contextual factors related to intervention outcomes.¹⁵⁻¹⁷ Fourth, some implementation barriers have been identified for AMR interventions and health-care associated infections.¹⁸⁻²¹ However, our understanding of the importance and generalizability of these findings is still limited. Finally, interventions to improve sanitation, hand hygiene, and immunization are effective to prevent and control infections, but their impact on AMR is insufficiently evaluated except for some vaccines in human health.²²

Addressing the gaps described above requires increasing both the number and diversity of AMR interventions. Efforts should be encouraged in LMIC where international research collaborations can foster capacity building.²³ An additional need is to increase the number of interventions that seek to address AMR across sectors, countries, or the five objectives of the 2015 WHO Global Action Plan. Increasing the number of AMR interventions should be done in parallel with improving their quality. First, the design of interventions, particularly multifaceted ones, can be strengthened by adopting a complex adaptive systems framework which captures the context of implementation.²⁴⁻²⁶ The burden of diseases, levels of sanitation and immunization, financial and institutional capacities, awareness of the problem and attitudes toward risks, are factors often mentioned in the literature as affecting whether a country can respond to AMR.²⁷ How these factors interact to produce resilience to AMR, i.e. the capacity of health, food/agriculture/aquaculture, and environmental systems to cope and adapt in the face of AMR, is a subject of ongoing research.^{8,28} Second, incorporation of guidelines for implementation and stakeholders' involvement can enhance the implementation of interventions.^{29,30} Third, more attention should be devoted to the cost-effectiveness of AMR interventions and their

impact on sustainable development goals in terms of outcomes, and to factors affecting success and failure in terms of implementation.

The actions abovementioned will help to enhance the successful design, implementation, evaluation, and reporting of AMR interventions. As collaborative approaches between sciences and professions are critical to move the agenda forward, there is an additional need to foster synthesis of information across goals, regions, levels, and sectors while encouraging learning and sharing about AMR interventions. Current efforts can be consolidated into a fully accessible and continuously updated online learning platform. Its main added value would be to provide searchable evidence about what works, for whom and under what conditions, recognizing that interventions that work in HIC might not work in LMIC,³¹ or even in other HIC. When an intervention works in one context but not in another, the platform would allow examination of potentially relevant sources of disparity between interventions. It might also help predict conditions more likely to favour the emergence and spread of AMR. The platform should 1) serve as an evidence repository, 2) facilitate systematic reviews of interventions gathered from the platform, and 3) be a source of information for modelling the effect of interventions. Reported experiences can inspire new interventions, as well as facilitate adaptation of existing interventions to other contexts. The learning platform will provide guidance on how to successfully design, implement, evaluate, and report various types of AMR interventions.

A One Health framework with relevant variables about the biological and social components, implementation process, and evaluation of AMR interventions should guide the systematic assessment of the content inputted on the learning platform. In addition to various sectors, the platform should cover a variety of AMR interventions in terms of strategies, countries, settings, and target populations. Including AMR interventions in common pathogens and in tuberculosis, malaria, and HIV-AIDS could help identify synergies and trade-offs between different issues. However, given the broad scope of AMR, high priority resistance in bacteria would be a reasonable starting point.³² To complement information gained from published interventions, the platform should encourage sharing of knowledge about the challenges associated with implementation which are often underreported in the literature. Finally, the learning platform would benefit from linking interventions to available data about policies and AMR situations in the participating countries or regions.^{33,34}

The platform should be primarily managed by a small team, but users with expertise on AMR interventions should be able to contribute relevant information. As extracting information about AMR interventions is time consuming, the learning platform would also ideally take advantage of the progress in computer science (e.g. natural language processing to extract relevant information from interventions). To ensure quality, the platform requires clear guidelines and a revision system for validation of submitted interventions from the AMR community. Most importantly, AMR interventions should be graded in terms of the quality of evidence they provide based on the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system,³⁵ while considering the diversity of different sources of evidence.³⁶⁻³⁹ In particular, evaluating both the complexity of AMR interventions and the quality of reporting would be beneficial to move the science of AMR interventions forward.^{40,41}

An open access learning platform on AMR interventions might be useful to a broad range of stakeholders including healthcare professionals, public health practitioners, policymakers, industries, and consumer groups.⁴² The capacities to fully search the database and to export data in a convenient format are essential to make it a valuable tool for those involved in combatting AMR. Additional outputs related to the platform include new systematic reviews, the provision of guidelines for the design, implementation, evaluation and reporting of specific AMR interventions as well as policy briefs summarizing important findings about AMR interventions. As a tool to build our collective capacity to tackle AMR,⁴³ the learning platform would enable exchange of ideas and practice-based knowledge through online community tools (e.g. user profiles, discussion forums, activity streams, and a shared library). Interviews with those involved in the implementation of AMR interventions and/or surveys of unpublished/grey literature may be a suitable way to collect further information about the challenges associated with implementing AMR interventions.

The AMR-Resilience consortium, which is funded by the 5th JPIAMR call, is building a database of AMR interventions. The larger scope of the envisioned One Health learning platform summarized in Figure 1, associated with the growth of the literature and non-published experiences, requires further institutionalisation and support. A reasonable grant from a national, international, or non-governmental research funding source would make the development of the platform possible. As several research groups are already working on AMR interventions, a core team of researchers should provide the brainpower to cover the diversity of interventions and keep the platform up to date. The team and entity responsible for the development of the project should work with existing international networks. Within the ongoing discussion about the need for an Independent Panel of Evidence for Action against AMR,⁶ we further advocate for the integration of the 'One Health learning platform' within current governance mechanism to maximise its utility and sustainability.⁴⁴ By amplifying the generation and synthesis of evidence-informed action on AMR, the platform would be a timely contribution to the goal of building societal resilience to the complex challenge of infectious diseases.

Conflict of interest:

Dr Majowicz reports grants from Canadian Institutes for Health Research, during the conduct of the study; personal fees from Epidemiology and Infection (Associate Editor), personal fees from Attorney General of Canada (Expert evidence), outside the submitted work. Dr Harbarth reports personal fees from Sandoz and grants from the European Commission, outside the submitted work. Dr Simpson reports grants from Wellcome Trust, outside the submitted work. All other co-authors declare no conflicts of interest.

Authors' contributions:

DW initiated and drafted the paper including the figure. All other co-authors provided comments and suggestions on the manuscript. DW did a narrative review of the literature on AMR interventions from a One Health perspective for his PhD thesis. AL did a search of the literature on published AMR interventions as part of the first working package of the AMR-Resilience project (principal investigator is DW). PSJ and TG organized two workshops in September and October 2019 during which, among

other topics, the need for, and main features of, an online learning platform about AMR interventions was discussed. PSJ coordinates the AMR-Resilience project.

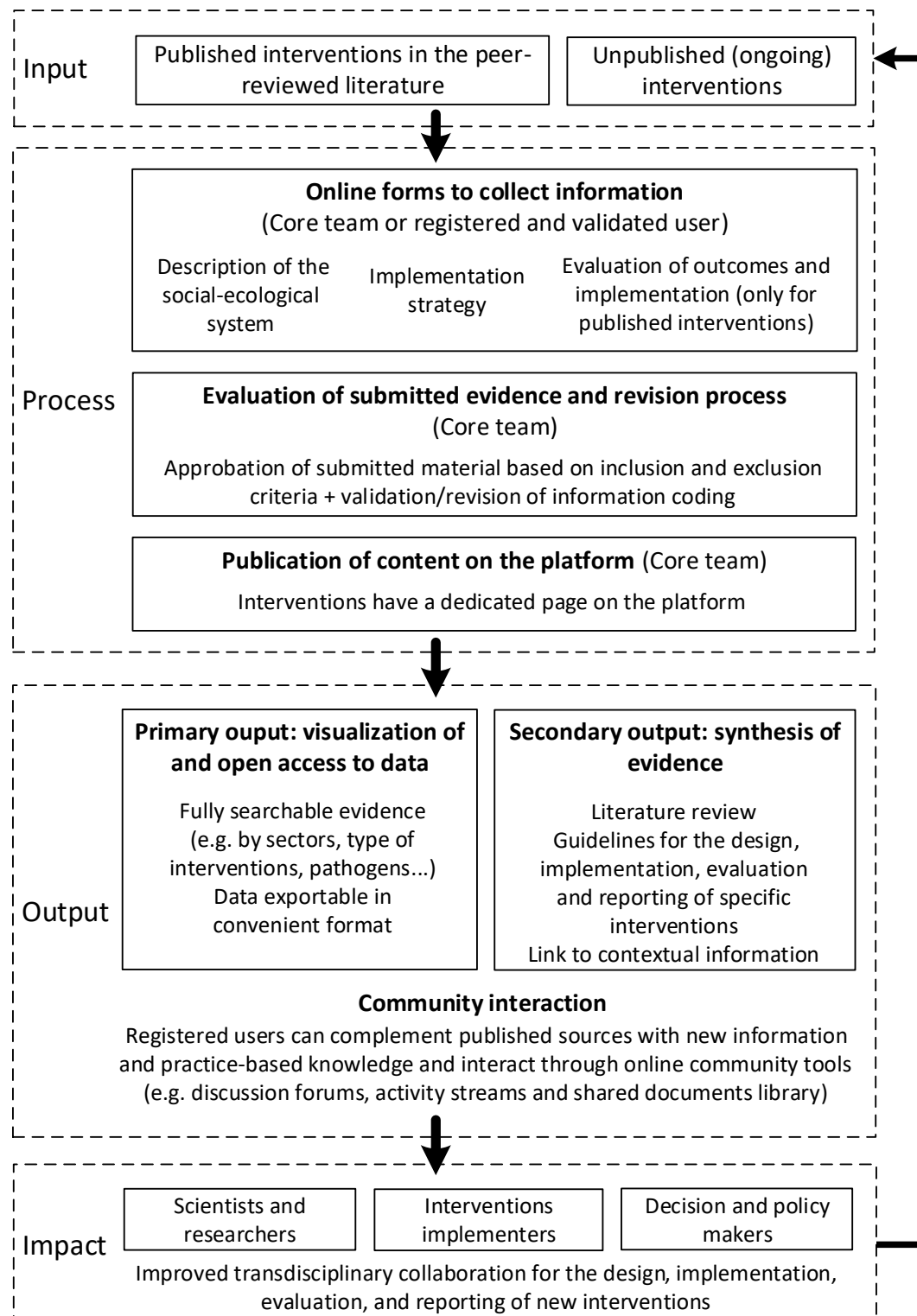
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Figure 1. One Health online learning platform on AMR



Box 1. Additional information about the search strategy

Within the scope of the AMR-Resilience project, we did a scoping review of the published literature on AMR interventions between June 2018 and March 2019. It was restricted to peer-reviewed documents, written in English which have been published until March 2019. The search sought to identify interventions targeting AMR in human health, animal health including veterinary health and aquaculture, or the environment. Several keywords related to interventions were used (e.g. awareness campaign, training, education, stewardship, campaign, communication, regulation, policy, legislation) in combination with terms related to AMR. Interventions comparing the efficacy of new clinical treatment were not considered. In addition, a snowball methodology was used to retrieve interventions already included in published systematic reviews about AMR interventions. After title and abstract screening, 669 individual scientific studies, describing and/or assessing AMR interventions were identified and organized using a qualitative analysis software. Finally, a literature review was done on One Health, implementation science and complex interventions to further inform the selection of the variables that should be evaluated with the scope of a One Health Learning platform.