Development and Implementation of an Antimicrobial Stewardship Checklist in Sub-saharan Africa: a Co-creation Consensus Approach

Diane Ashiru-Oredope (diane.ashiru-oredope@commonwealthpharmacy.org)
Commonwealth Pharmacists Association, London https://orcid.org/0000-0001-9579-2028

Frances Garraghan
Commonwealth Partnerships Program on Antimicrobial Stewardship, Commonwealth Pharmacists Association, London

Omotayo Olaoye
Commonwealth Partnerships Programme on Antimicrobial Stewardship, Commonwealth Pharmacists Association, London

Eva M. Krockow
Department of Neuroscience, Psychology and Behaviour, University of Leicester

Ayodeji Matuluko
Commonwealth Partnerships Programme on Antimicrobial Stewardship, Commonwealth Pharmacists Association, London

Winnie Nambatya
Department of Pharmacy, Makerere University, Kampala

Peter Ahabwe Babigumira
Infectious Disease Institute, Kampala

Chloe Tuck
Commonwealth Partnerships Programme on Antimicrobial Stewardship, Commonwealth Pharmacists Association, London

George Amofah
Ghana Public Health Association, Accra

Daniel Ankrah
Korle Bu Teaching Hospital, Accra, Ghana

Scott Barrett
Pharmacy Department, North Tyneside Hospital, Northumbria Healthcare NHS Foundation Trust, Rake Lane, North Shields, United Kingdom.

Peter Benedict
Pharmacy Department, Kilimanjaro Christian Medical Centre, Moshi, Tanzania.

Kwame Peprah Boaitey
Institute for Evidence Based Healthcare, Bond University, Queensland

Kwame Ohene Buabeng
Department of Pharmacy Practice, Faculty of Pharmacy and Pharmaceutical Sciences, College of Health Sciences, Kwame Nkrumah University of Science and Technology, Kumasi
Sarah Cavanagh
Commonwealth Partnerships Programme on Antimicrobial Stewardship, Commonwealth Pharmacists Association, London
Esmita Charani
Faculty of Medicine, Department of Infectious Disease. Imperial College, London
Enock Chikatula
Pharmacy Department, University Teaching Hospital, Lusaka.
Sam Ghebrehewet
UK Health Security Agency, UKHSA
Jasmin Islam
University of Sussex, Brighton and Sussex Medical School (BSMS), Brighton, East Sussex
Yogini H Jani
Centre for Medicines Optimisation, Research and Education, University College Hospitals NHS Foundation Trust, London
Esther Johnston
Norfolk and Suffolk NHS Foundation Trust, Ipdswich
Mohammed Lamorde
Infectious Disease Institute Kampala, Uganda
Augustine Malinga
The Infectious Disease Institute, Kampala
Mariyam Mirfenderesky
North Middlesex University Hospital: North Middlesex University Hospital NHS Trust
Victoria Rutter
Commonwealth Partnerships Programme on Antimicrobial Stewardship, Commonwealth Pharmacists Association, London
Jacqueline Sneddon
Scottish Antimicrobial Prescribing Group, Health Improvement Scotland, Glasgow.
Richard Skone-James
Tropical Health and Education Trust, St Andrews Place, London

---

Research Article

Keywords: AMS checklist, Antimicrobial Prescribing, CwPAMS, Global PPS, COVID-19, Antimicrobial stewardship

Posted Date: March 21st, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1455206/v1

Abstract

Background:

Antimicrobial stewardship (AMS) initiatives promote the responsible use of antimicrobials in healthcare settings as a key measure to curb the global threat of antimicrobial resistance (AMR). Defining the core elements of AMS is essential for developing and evaluating comprehensive AMS programmes. This project used co-creation and Delphi-consensus procedures to adapt and extend the existing published international AMS checklist. The overall objective was to arrive at a contextualised checklist of core AMS elements and key behaviours for use within healthcare settings in Sub-Saharan Africa as well as to implement the checklist in health institutions in four African countries.

Method:

The AMS checklist tool was developed using a modified Delphi approach to achieve local, expert consensus on items to be included on the checklist. Fourteen healthcare/public health professionals from Tanzania, Zambia, Uganda, and Ghana were invited to review, score and comment on items from a published, global AMS checklist. Following their feedback, eight items were re-phrased and 25 new items added to the checklist. The final AMS checklist tool was deployed across 19 healthcare sites and used to assess AMS programmes before and after an AMS intervention in 14 of the 19 sites.

Findings:

The final tool comprised 54 items. Across the 14 sites, the checklist consistently showed improvements for all AMS components following the intervention. The greatest improvements observed were the presence of formal multidisciplinary AMS structures (79%) and the execution of a point-prevalence survey (72%). Elements with the least improvement were access to laboratory/imaging services (7%) and the presence of adequate financial support for AMS (14%). In addition to capturing quantitative and qualitative changes associated with the AMS intervention, project evaluation suggested that administering the AMS checklist made unique contributions to ongoing AMS activities. Furthermore, 29 additional AMS activities were reported as a direct result of the prompting checklist questions.

Conclusion:

Contextualised, co-created AMS tools are necessary for managing antimicrobial use across healthcare settings and increasing local AMS ownership and commitment. This study led to the development of a new AMS checklist which proved successful in capturing AMS improvements in Tanzania, Zambia, Uganda, and Ghana. The tool also made unique contributions to furthering local AMS efforts. The study extends existing AMS materials for low and middle-income countries and provides empirical evidence for successful use in practice.

1. Introduction

Antimicrobial stewardship (AMS) has been recommended as a key strategy to optimise the use of antimicrobials and to reduce the global threat of antimicrobial resistance (AMR) [1]. AMS programmes have evolved in different healthcare settings [2–4]. Much success has been recorded in high-income countries, whose healthcare systems are supported by political commitment to AMS and substantial financial investments [4]. However, even high-income countries face challenges in changing deeply rooted behaviours and habitual prescribing patterns [4]. To support global and national AMS actions, learning from high-income countries should be shared and adapted for low and middle-income countries (LMICs). Initial successes provide evidence for the effectiveness of shared learning approaches [1, 5–10]. A key requirement for the success of shared learning appears to be the engagement and empowerment of frontline staff, who need to be equipped with the skills and tools to effectively carry out AMS.

In 2019, Pulcini et al, [11] developed a global checklist of the core elements of hospital AMS programmes. The checklist collates information from published literature and previously developed core elements of AMS programmes and their accompanying checklist items. However, the authors themselves identified a number of shortcomings for their tool, for example stating '…most of these checklist items may not currently exist in most hospitals in low-income countries' and suggesting 'These seven core elements and their related 29 checklist items could be adapted and adopted locally depending on factors such as clinical setting and resource availability.' [11, p.23] Subsequent efforts have addressed these suggestions and focused on developing more appropriate materials for the LMIC context [12]. In October 2019, WHO developed a toolkit of essential national core elements for AMS programmes in LMICs to guide countries in identifying the most vital elements for their national context. This was supplemented by a 28-item checklist of essential health-care facility core elements for AMS programmes in LMICs, differentiating between 'basic' and 'advanced' elements [12]. The development of materials for the context of LMIC healthcare settings was an important step towards more contextualised AMS approaches, which account for different barriers in low-resource settings and set attainable goals.

This study which commenced prior to the publication of the WHO AMS toolkit for LMICs provides an additional step towards increasing suitability and acceptance of standardised AMS tools in LMIC settings in several different ways:

1) Our narrow focus on Sub-Saharan Africa (specifically Tanzania, Zambia, Uganda and Ghana) allows for further local adaptation of the materials.

2) Our unique methodological approach uses elements of co-creation through the strong involvement of local hospital representatives during a Delphi consensus procedure.

3) We extend the number of checklist items to capture more nuanced differences in AMS elements. Additionally, we incorporate open-ended questions within the AMS checklist, to allow for more reporting flexibility.

4) We provide an initial evaluation of the checklist's effectiveness by using it to measure outcomes from an AMS intervention programme.

The checklist was developed as part of the 'Commonwealth Partnerships for antimicrobial stewardship' (CwPAMS) programme, funded by UK aid Fleming Fund and jointly managed through the Tropical Health and Education Trust (THET) and the Commonwealth Pharmacists Association (CPA) [13–16]. The CwPAMS programme ran from inception in September 2018 until June 2021 and was set up to support 12 health partnerships between teams of volunteers (including pharmacists and specialist nurses) from the UK's National Health Service (NHS) Trusts and higher education institutes and health workers in four African countries (Tanzania, Zambia, Uganda and Ghana). The CwPAMS programme provided the perfect setting for developing the AMS checklist because existing project infrastructure enabled easy identification of representative healthcare workers to be included in the consensus process. Given CwPAMS' efforts in running AMS interventions, the project further provided the ideal context for testing the newly developed checklist's success in capturing key AMS elements, and it gave the CwPAMS partnerships and funders a tool by which to measure the successes of the CwPAMS programme.

2. Materials And Methods

Checklist development

Pulcini et al.'s [11] global AMS checklist served as the baseline document for our project. The WHO AMS toolkit for LMICs had not been published at that time. Using Pulcini et al.'s original items as a starting point, we adopted a modified Delphi procedure for achieving consensus on the items to be included in our contextualised AMS checklist for the Sub-Saharan healthcare context. The consensus procedure involved rating the importance of items as well as making open-ended comments and suggestions. The CwPAMS project structure was used to engage local hospital representatives across four countries in Sub-Saharan Africa.

Fourteen healthcare representatives from the CwPAMS partnerships were invited from April 2019 to participate in the consensus process following project inception training sessions with all UK and African partnership leads involved in the CwPAMS project. The 14 representatives included eight CwPAMS health partnership leads including pharmacists, public health specialists and microbiologists from the UK, four healthcare professionals working in hospitals and national pharmacy association based in Ghana and two healthcare professionals based in Uganda (working in regional referral hospital and national research institute). The consensus process is summarised in Fig. 1. Further details on the consensus process and the development of the AMS checklist are included in supplementary materials 1 and 2.

AMS checklist implementation across 19 hospitals

Following a pilot with two partnership sites, the final AMS checklist was deployed as an online form in April 2019 across 19 sites in Sub-Saharan Africa, which included 14 CwPAMS project sites (6 Ghana, 6 Uganda, 1 Tanzania and 1 Zambia) and 5 regional referral centres in Uganda. Each hospital site provided information on the current state of their AMS activities based on the questions of the checklist. For the CwPAMS sites, the checklist was jointly completed through discussions between the respective UK and African lead partners; to facilitate this, a PDF or spreadsheet version of the checklist was made available.

For the additional sites in Uganda, pharmacists at each institution completed the checklist with support from independent colleagues with AMS expertise to discuss and complete the form with relevant individuals. Each CwPAMS site completed the checklist again to provide updated information on the state of their AMS activities post CwPAMS intervention. Respondents were also asked to include information on the members of their multidisciplinary AMS teams pre and post CwPAMS intervention.

Demographics of study sites

Across the 19 study sites, hospitals averaged 536 in-patient beds, with the lowest number of hospital beds reported as 100 and the highest as 2000 in-patient beds (both in Ghana). Eight out of 19 hospitals (42%) were tertiary hospitals, five (26%) were secondary hospitals and five (26%) were regional referral hospitals. Only one site (5%) was a primary care institution. 12 out of 19 sites (63%) were teaching hospitals. Names of all participating hospital sites can be found in the supplementary materials 3.

3. Results

Checklist development

The final AMS checklist contained 54 items across eight main sections (Supplementary 2). These included seven sections on the core elements of hospital AMS programmes (senior management and leadership towards AMS; accountability and responsibilities; available expertise on infection management and stewardship; education and practical training; continual monitoring and surveillance; regular reporting and feedback and other actions aiming at responsible antimicrobial use) and the concluding section. It differed from the original checklist by Pulcini et al. [11] in several important ways.

New items added: 24 new items were added to Pulicini et al.'s [11] original checklist. Most items were added in the sub-sections on accountability and responsibilities, education and practical training and other actions aiming at responsible antimicrobial use. The added items reflected a stronger focus on details around the AMS team, a more detailed assessment around induction training for clinical staff, and questions around local prescribing and Infection Prevention and Control (IPC) protocols. The new items also included different question formats compared to Pulcini et al.'s [11] binary choice questions. Examples were open-ended questions (e.g. 'Please provide more details about the AMS leader e.g. main role, how much time is available to dedicate to AMS activities etc.'), numerical questions (e.g. 'What was the total number of each clinical staff trained in the last year') and multiple-choice questions (e.g. 'How is the training delivered? (Select all that apply)').

Items removed: Eight items were removed from the original checklist. Almost all of these items were part of the section on other actions aiming at responsible antimicrobial use. Item removal was determined by their relevance to Sub-Saharan healthcare settings and limited availability of resources. An example of a deleted item includes: 'Does your hospital support the antimicrobial stewardship activities/strategy with adequate information technology services?'

Items re-phrased: Eight original checklist items were rephrased to increase understanding and better reflect the local healthcare contexts. For example, the original question 'Are clinicians, other than those part of the antimicrobial stewardship team (e.g. from the ICU, Internal Medicine and Surgery) involved in the antimicrobial stewardship committee?' was extended by specifically including a focus on nurses and pharmacists (i.e., 'Are clinicians, nurses or pharmacists, other than those part of the AMS team…').

Checklist implementation

Quantitative improvements following the AMS intervention

Table 1 shows a comparison of the core checklist results pre and post the CwPAMS AMS strengthening intervention, delivered through the partnerships. The five additional sites in Uganda (without CwPAMS project interventions) only completed the checklist once and are therefore excluded from this comparison. Their checklist results can be found in a separate table in the supplementary data 4.

Improvements were reported across all core indicators of the AMS checklist. The largest improvements pertained to the core AMS checklist element on organisational multidisciplinary structures responsible for AMS. Before the AMS intervention, only three healthcare sites reported having such a formal AMS structure. After the intervention, all 14 sites gave positive answers to this question, indicating a 79% increase. Other notable improvements were observed with regard to the conduct of point prevalence surveys for antimicrobial use and the availability of multidisciplinary AMS teams to support the implementation of the AMS strategy.

Smaller improvements were reported on the elements of access to laboratory or imaging services (7%) and the existence of a dedicated, sustainable, and sufficient AMS budget (14%), with overall numbers of healthcare sites remaining low even after the intervention. Lesser improvements were also observed for some items that ranked high prior to the intervention (e.g., the availability of published IPC protocols). This may be explained by a ceiling effect, whereby little further improvement could be obtained on those comparatively well-established items.

Table 2 shows a detailed breakdown of the number of members (by professions) that formed part of multidisciplinary AMS teams pre and post intervention. Apart from one exception (intensive care (ITU) consultants), increases could be observed across all professional categories. The largest increase was reported in the involvement of nurses and pharmacists, with 21 new members of those professions joining the multidisciplinary AMS teams over the course of the intervention.

Table 1

Comparison of selected AMS checklist results pre and post AMS intervention that formed part of the CwPAMS projects. The numbers indicate the total number of sites that agreed with the item in question. Percentages (out of 14 sites) are provided alongside the numbers. The final column shows post-intervention improvement through the percentage increase.

	Pre AMS intervention *N* = 14		Post AMS intervention *N* = 14		Percentage difference
Has your hospital management formally identified AMS as a priority objective for the institution and included it in its key performance indicators?	2	14%	10	71%	+ 57%
Is there dedicated, sustainable and sufficient budgeted financial support for AMS activities (e.g., support for salary, training, or IT (information technology) support)?	1	7%	3	21%	+ 14%
Does your hospital have a formal organisational multidisciplinary structure responsible for AMS?	3	21%	14	100%	+ 79%
Does your hospital have a dedicated committee focussed on antimicrobial use?	2	14%	8	57%	+ 43%
Is there a healthcare professional identified as a leader for AMS activities at your hospital and responsible for implementing the programme?	4	29%	12	86%	+ 57%
Is a multidisciplinary AMS team available at your hospital (e.g., greater than one trained staff member supporting clinical decisions to ensure appropriate antimicrobial use) to implement your stewardship strategy?	1	7%	10	71%	+ 64%
Are clinicians, nurses or pharmacists, other than those part of the AMS team (e.g. from the ICU, Internal Medicine and Surgery) involved in the AMS committee?	1	7%	9	64%	+ 57%
Do you have access to laboratory/imaging services to be able to support the diagnosis of the most common infections at your hospital?	8	57%	9	64%	+ 7%
Are the results available in a timely manner to be able to support diagnosis of most common infections?	3	21%	6	43%	+ 22%
In your hospital are there, or do you have access to healthcare professionals in infection management and stewardship willing to constitute an antimicrobial stewardship team?	9	64%	12	86%	+ 22%
Does your hospital offer access to educational resources to support staff training on how to optimise antimicrobial prescribing?	2	14%	6	43%	+ 29%
Does your hospital monitor the quantity of antimicrobials prescribed/ dispensed/purchased at the unit and/or hospital wide level?	5	36%	9	64%	+ 28%

	Pre AMS intervention *N* = 14		Post AMS intervention *N* = 14		Percentage difference
Does your stewardship programme monitor compliance with one or more of the specific interventions put in place by the stewardship team (e.g. indication captured in the medical record for all antimicrobial prescriptions, or antibiotic prescribed follows hospital guidelines)?	1	7%	7	50%	+ 43%
Has your hospital conducted a point prevalence survey (PPS) for antimicrobial use in the last year?	1	7%	11	79%	+ 72%
Are hospital-specific reports on the quantity of antimicrobials prescribed/dispensed/purchased shared with/ fed back to prescribers?	3	21%	7	50%	+ 29%
Does your stewardship programme share facility-specific reports on antibiotic susceptibility rates with prescribers?	3	21%	5	36%	+ 15%
Are results of audits/reviews of the quality/appropriateness of antimicrobial use communicated directly with prescribers?	1	7%	7	50%	+ 43%
Does your hospital have available and up-to-date recommendations for infection management (diagnosis, prevention and treatment)?	7	50%	10	71%	+ 21%
Do you have any published AMS protocols e.g. restricted antimicrobial list, IV to oral policy (that have been ratified for use within your organisation)?	0	0%	5	36%	+ 36%
Do you have any published Infection Prevention and Control protocols e.g. hand hygiene, WASH (that have been ratified for use in your health institution)?	7	50%	12	86%	+ 36%
Are there regular infection and antimicrobial prescribing focused ward rounds in specific departments in your hospital?	0	0%	3	21%	+ 21%
Does the organisation have local/hospital specific antimicrobial prescribing guidelines? This may be included as part of a wider drug formulary.	3	21%	7	50%	+ 29%

Table 2
Number of members by profession of multidisciplinary AMS teams pre and post AMS intervention at CwPAMS project sites

AMS team members	Pre AMS intervention	Post AMS intervention	Total increase post intervention
Pharmacists	3	13	10
Nurses	3	14	11
Clinicians	3	11	8
Infectious Disease doctors	2	6	4
Surgeons	0	6	6
Clinical microbiologists	1	2	1
Laboratory microbiologists	0	9	9
ITU consultants	0	0	0
Data analysts	1	3	2
Infection control staff	2	7	5

Development and review of guidelines/policies

The checklist also captured new guideline development that resulted locally as a result of the CwPAMS intervention: Eight projects reported developing new documents (guidelines/policies/posters etc) focused on either AMS or antibiotic prescribing as a result of CwPAMS. Four of these projects reported developing two or more new AMS documents. Three projects reported that they had revised, or updated documents (guidelines/policies/posters etc) focused on either AMS or antibiotic prescribing as a result of CwPAMS. Five projects reported that they had developed new documents (guidelines/policies/posters etc) focused on IPC as a result of CwPAMS with 3 of these projects developing 2 or more new IPC documents. Three projects reported that they had revised, or updated documents (guidelines/policies/posters etc) focused on IPC as a result of CwPAMS.

Raising Awareness of WHO AWaRe categories

AMS checklist reports indicated that 79% (11 out of 14) of projects had increased awareness of WHO AWaRE antibiotic categories among healthcare staff during the CwPAMS project. Means used to introduce the principles of WHO AWaRe included AMS train the trainer workshops; specific hospital meeting on the principles; AMS workshops; and Medicines and Therapeutic Committee (MTC) meetings.

Other AMS activities:

Respondents were asked to report any other actions related to AMS which were ongoing within their organisation. The following responses were received: Accreditation and implementation of the AMS training modules as CPD for healthcare workers; Training both in hospital and national; training, drug audits and surveillance; Implementation of the antibiogram; plans to engage hospital management and carry out Global Point Prevalence Survey (GPPS); Medicines Therapeutic Committee (MTC) formation; establishment of community of practices; plans to resume implementation of the AMS strategy and workplan that have been on hold since the pandemic, development of guidelines, and Publication of AMS manuscripts.

Barriers to AMS implementation

The AMS checklist required participants to select a maximum of six specified barriers to effective stewardship in their organisation. This also included an option for participants to specify their own barrier if it wasn't listed. Table 3 shows the most important barriers selected by participants. The same top five barriers were identified in both surveys from a list of 18 options. Two sites listed additional barriers including: Hierarchical barriers to pharmacists making interventions and lack of resources.

Table 3
Top Five barriers to AMS pre and post AMS intervention

Priority	Top 5 barriers to AMS (Pre AMS intervention)	Top 5 barriers to AMS (Post AMS intervention)
1	Lack of funding	
2	Insufficient microbiology lab capacity	
3	Qualified personnel do not have enough time to perform stewardship	
4	Lack of motivated or engaged staff	Inadequate use of the microbiology laboratory
5	Inadequate use of the microbiology laboratory	Lack of motivated or engaged staff

Unique contribution of implementing the AMS checklist

In the post CwPAMS checklist, 10 sites provided further information in response to open-ended questions which indicated that the checklist had prompted them to take additional actions that were not part of the original AMS intervention plan of the CwPAMS project. Participants were invited to report up to five additional activities that they had engaged in based on the checklist. Across all sites, 29 additional AMS activities were listed. Examples included: Development of empirical guidelines; GPPS completion; GPPS training; establishment of a multidisciplinary AMS team; collection of baseline data on antimicrobial use; and the conduct of an AWaRe analysis of antibiotic prescribing patterns at their hospital. The complete list is provided in supplementary data 5.

4. Discussion

Contextualised, co-created AMS tools are necessary for managing the use of antimicrobials across different healthcare settings. Our work set out to develop and implement a new checklist of core AMS elements with a regional focus on Sub-Saharan Africa.

Development of the AMS checklist

A modified Delphi process that included participants involved in partnerships of UK institutions with hospitals in Tanzania, Zambia, Uganda and Ghana was used to ensure that the final AMS checklist was relevant and understandable for local healthcare staff in Sub-Saharan Africa. The final tool was cognizant of the unique settings in which they operate, and differences in practice from high income settings. Compared to the original global checklist by Pulcini et al [11], the AMS checklist developed in this study included a combination of closed-ended and open-ended questions that give room to a more comprehensive exploration of AMS activities.

The consensus process was targeted to the lower resource settings of LMICs in Sub-Saharan Africa through consideration of context-specific information and involvement of experts from a broad range of specialties. Our work extends ongoing attempts to develop baseline assessment tools in Africa. This includes a Kenyan study in 2020 investigating the AMS policies and structures in 16 Kenyan hospitals, while adapting the UK NICE AMS system to the Kenyan healthcare system. [17] Another study developed a survey questionnaire to investigate existing AMS activities for learners of a Massive Online Open Course (MOOC) [18, 19].

By involving local healthcare staff in the development of our checklist, we also fostered a sense of ownership and commitment, thus serving as an example of successful co-creation. Compared to the LMIC AMS checklist contained within the WHO Practical Toolkit for healthcare facilities [20], which comprises 28 elements across six sections, our newly developed checklist contains 54 checklist items across eight (8) main sections. While both checklists cover the most essential core elements for National Antimicrobial Stewardship Programmes including policy, guidelines and governance, awareness, education and training, IPC and surveillance, our newly developed tool was co-created and tested in the specific healthcare setting of Sub-Saharan Africa, thus increasing its acceptability amongst hospital staff and its level of contextualisation. Additional checklist variations with adaptations to local healthcare settings could be developed following the modified Delphi consensus procedure employed in our study.

AMS checklist implementation

The initial results obtained from use of our AMS checklist across 19 sites revealed large variations in AMS capacities and local needs of support. Comparatively, large numbers of healthcare sites had available expertise on infection management and stewardship, education and practical training, up-to-date recommendations for infection management, national antimicrobial prescribing guidelines, and continual monitoring and surveillance. Comparatively few sites, however, reported the presence of senior

management leadership towards AMS, published AMS protocols, accountability structures, regular reporting and feedback, and routine ward rounds focused on infection and antimicrobial prescribing.

The findings obtained through our contextualised AMS checklist mirror published AMS reports in LMICs, which highlight the presence of national antimicrobial prescribing guidelines in the countries where the sites are located [21–24] but identify challenges in AMR-specific education and training, diagnostic facilities, regulation of safety and efficacy of medications and shortages of healthcare personnel and expertise [25–28]. Although these studies highlight overall gaps in AMS implementation in LMICs, the differences observed across regions, hospitals and sites also demonstrate the need for case-by-case evaluations of AMS programmes for the development of appropriate and sustainable solutions. Our study suggests that the newly developed AMS checklist will enhance such evaluations across the wider region of Sub-Saharan Africa.

In addition to identifying local AMS capacities and needs, our new checklist was successful in capturing post-intervention changes in local programmes. Our results indicate that the greatest improvements were observed in core elements relating to senior AMS leadership, accountability and responsibility. Smaller improvements were reported with regard to the availability of AMS expertise, education and practical training, monitoring and surveillance, and other AMS actions. Stand-out items included the availability of formal, organisational multidisciplinary structures responsible for AMS and the conduct of point-prevalence surveys (79% and 71% improvements respectively). At the other end of the spectrum were the availability of laboratory and imaging services and the presence of financial support for AMS activities, which only showed 7% and 14% improvements respectively. The post intervention checklist also demonstrated better integration of pharmacists, nurses and all clinical staff groups in AMS committees across the project sites. Local variations in improvements could be attributed to several factors including political and administrative will, workforce capacity and importantly funding.

While some of the improvements noted above are the results of a funded AMS intervention that was part of the CwPAMS project, our end-of-project survey noted results that were not attributable to the initial CwPAMS project plans. Indeed, healthcare staff reported that the mere completion of our AMS checklist prompted them to engage in a revision of their AMS activities and led to important changes in their daily practice. Twenty-nine additional AMS activities were listed by participating healthcare sites as having resulted from the completion of the checklist. While some of these activities (notably improved recommendations around infection control) may be explained by the global pressures of healthcare associated infections and latterly the COVID-19 pandemic, other activities (e.g., the development of empirical guidelines around antibiotic prescribing) were directly related to AMS. Our results thus suggest that the newly developed, contextualised AMS checklist has the potential to make a positive impact on the effectiveness of AMS interventions in Sub-Saharan Africa.

5. Strengths And Limitations

A key strength of this work was the study employed a modified Delphi consensus process, which is a standard method of developing checklists or similar tools and has been widely used for designing AMS programmes in hospitals. We engaged local stakeholders including senior management, frontline healthcare professionals and public health specialists in the consensus process, thus increasing elements of co-creation and a subsequent sense of ownership for the materials. This also meant that checklist modifications were context-specific and relevant to health institutions. The Delphi process was limited by not having an opportunity for face-to-face discussions about specific items. The small number of study sites could be considered a limitation, however, the similarity of results across multiple countries suggests the results are transferable and the approach can be implemented within other countries.

6. Conclusion

Our study has tested a successful methodology for making regional adaptations to global AMS tools and demonstrated the effectiveness of a contextualised AMS checklist in the challenging healthcare setting of Sub-Saharan Africa. This effectiveness was shown to go beyond mere capture of AMS changes following an intervention. Indeed, our results suggested that completing the checklist prompted local healthcare providers to review their initiatives and increase AMS efforts. Our AMS checklist is widely available for use across health partnerships and institutions and extends existing tools such as Pulcini et al.'s [11] global AMS checklist and the WHO LMIC toolkit [20].

Declarations

Ethics approval and consent to participate: Not Applicable

Consent for publication: Not Applicable

Availability of data and materials: All data generated or analysed during this study are included in this published article [and its supplementary information files].

Competing interests: The authors declare that they have no competing interests.

Funding: This research was funded by UK aid Fleming Fund. The Fleming Fund is a £265 million UK aid investment to tackle antimicrobial resistance by supporting low- and middle-income countries to generate, use and share data on AMR. The programme is managed by the UK Department of Health and Social Care. The views expressed in this publication are those of the authors and not necessarily those of the Department of Health and Social Care.

Authors' contributions: The study was conceptualised by DAO. Methodology was developed by DAO, CT, AM, WN, PAB, ML, AM, EC ; Delphi participants included: WN, PAB, CT, GA, DA, SB, KPB, KOB, EC, SG, JI, YHJ, EJ, MM, JS. Data analysis and interpretation was conducted by DAO, FG, OO, EMK and AM. The manuscript was drafted by DAO, FG, OO, EMK and AM. All authors participated in the revision of the manuscript. All authors read and approved the final manuscript.

Acknowledgments: The authors would like to acknowledge the following lead persons who completed the checklist from the UK partnership team: Louise Ackers, Dr Sam Ghebrehewet, Gillian Taylor, Esther Johnston, Mariyam Mirfenderesky, Yogini Jani, Corina Weir, Niall Anderson, Scott Barrett, James Whitehorn, Jacqueline Sneddon, Fran Garraghan,, Anja St. Claire-Jones, Evelyn Brealey, Joseph Brayson, Preet Panesar, Jenny Westad, Clare Chandler, Claire Brandish, Bee Yean Ng, Jasmin Islam. We would also like to thank the lead persons who completed the checklist from the partnership teams at the hospitals in Africa: Dorothy Gashuga, Juliana Ameh, Samuel Odonkor, Jean Young, Daniel Ankrah, Isaac Folitse, Cornelius Dodoo, Freddy Kitutu, Ismail Kizito Musoke, Amos Mutebi, Peter Benedict, Musa Sekikubo, Israel Sefah, Daniel Kwame Afriyie, Sr Josephine Mary Oyella, Zainab Akello, Fred Kitutu, Aubrey Kalungia, Joe Odur, George Amofah, Jean Anne Young, Israel Sefah, Jonathan Jato, William Olu, and Enock Chikatula.

Finally, we would also like to acknowledge the following people who completed the checklist from the 5 Regional Referral Hospitals in Uganda: Manzi, Rodney, Tabaruka Tibaruha, Patrick Opio, Amandu Christopher, and Sande Alex

References

1. World Health Organization (WHO). Global Action Plan on Antimicrobial Resistance. WHO. Geneva, Switzerland, 2015. Available online: http://www.who.int/antimicrobial-resistance/publications/global-action-plan/en/
2. Davey P, Marwick CA, Scott CL et al. Interventions to improve antibiotic prescribing practices for hospital inpatients. Cochrane Database of Systematic Reviews 2017, Issue 2. Art. No.: CD003543. DOI: 10.1002/14651858.CD003543.pub4.
3. Charani E, Holmes AH Antimicrobial stewardship programmes: the need for wider engagement BMJ Quality & Safety 2013;22:885-887.
4. Charani E, Holmes A. Antibiotic Stewardship—Twenty Years in the Making. Antibiotics. 2019; 8(1):7.
5. CDC. Core Elements of Hospital Antibiotic Stewardship Programs | Get Smart for Healthcare | CDC. Centers for Disease Control and Prevention 2016. [Online]. pp.1–25. Available from: https://www.cdc.gov/antibiotic-use/healthcare/implementation/core-elements.html
6. GOV.UK. Tackling antimicrobial resistance 2019–2024: The UK's five-year national action plan. 2019. Available from: https://www.gov.uk/government/publications/uk-5-year-action-plan-for-antimicrobial-resistance-2019-to-2024.
7. Goff, DA, Ashiru-Oredope, D, Cairns, KA, et al. Global contributions of pharmacists during the COVID-19 pandemic. J Am Coll Clin Pharm. 2020; 3: 1480– 1492. https://doi.org/10.1002/jac5.1329.
8. Kerr F, Sefah IA, Essah DO, Cockburn A, Afriyie D, Mahungu J, Mirfenderesky M, Ankrah D, Aggor A, Barrett S, Brayson J, Muro E, Benedict P, Santos R, Kanturegye R, Onegwa R, Sekikubo M, Rees F, Banda D, Kalungia AC, Alutuli L, Chikatula E, Ashiru-Oredope D. Practical Pharmacist-Led Interventions to Improve Antimicrobial Stewardship in Ghana, Tanzania, Uganda and Zambia. Pharmacy. 2021; 9(3):124. https://doi.org/10.3390/pharmacy9030124.

9. Brandish, C., Garraghan, F., Ng, B. Y., Russell-Hobbs, K., Olaoye, O., & Ashiru-Oredope, D. (2021). Assessing the Impact of a Global Health Fellowship on Pharmacists' Leadership Skills and Consideration of Benefits to the National Health Service (NHS) in the United Kingdom. Healthcare (Basel, Switzerland), 9(7), 890. https://doi.org/10.3390/healthcare9070890.
10. Eneyi E. Kpokiri, Misha Ladva, Cornelius C. Dodoo, Emmanuel Orman, Thelma Alalbila, Adelaide Mensah, Jonathan Jato, Kwadwo A. Mfoafo, Isaac Folitse, Araba Hutton-Nyameaye, Inemesit Okon-Ben, Paapa Mensah-Kane, Emmanuel Sarkodie, Benedict Awadzi, Yogini Jani. Knowledge awareness and practice with antimicrobial stewardship programmes among healthcare providers in a Ghanaian Tertiary Hospital. medRxiv 2021.11.14.21266285; doi: https://doi.org/10.1101/2021.11.14.21266285.
11. Pulcini C, Binda F, Lamkang AS, et al. Developing core elements and checklist items for global hospital antimicrobial stewardship programmes: a consensus approach. Clin Microbiol Infect 2019;25:20
12. World Health Organization. (2019). Antimicrobial stewardship programmes in health-care facilities in low- and middle-income countries: a WHO practical toolkit. World Health Organization. https://apps.who.int/iris/handle/10665/329404. License: CC BY-NC-SA 3.0 IGO
13. The Fleming Fund. Commonwealth health partnerships to improve antimicrobial stewardship announced! 2019. Available online: https://www.flemingfund.org/publications/commonwealth-health-partnerships-to-improve-antimicrobial-stewardship-announced/
14. THET partnerships for global health. Commonwealth Partnerships for Antimicrobial Stewardship Scheme. 2019. Available online: https://www.thet.org/our-work/grants/cwpams/
15. Commonwealth Pharmacists Association. Commonwealth Partnerships for Antimicrobial Stewardship. 2019. Available online: https://commonwealthpharmacy.org/commonwealth-partnerships-for-antimicrobial-stewardship/
16. GOV.UK. Funding for Commonwealth partnerships to improve antimicrobial stewardship. 2019. Available from: https://www.gov.uk/government/news/funding-for-commonwealth-partnerships-to-improve-antimicrobial-stewardship
17. McKnight J, Maina M, Zosi M, et al. Evaluating hospital performance in antibiotic stewardship to guide action at national and local levels in a lower-middle income setting. Global Health Action 2019, Vol 12. https://www.tandfonline.com/doi/full/10.1080/16549716.2020.1761657
18. Charani E, Castro-Sanches E, Bradley S, et al. Implementation of antibiotic stewardship in different settings – results of an international survey. Antimicrobial resistance and Infection Control, 2019 Feb 12;8:34. https://pubmed.ncbi.nlm.nih.gov/30805181/
19. Charani E, Castro-Sanchez E, Sevadalis N, et al. Understanding the determinants of antimicrobial prescribing within hospitals: The role of “Prescribing etiquete”. Clinical Infectious Diseases 2013, volume 57, 188-196. https://academic.oup.com/cid/article/57/2/188/312770.
20. World Health Organisation, 2019. Antimicrobial stewardship programmes in healthcare facilities in low-and middle-income countries. A WHO practical toolkit.

https://apps.who.int/iris/bitstream/handle/10665/329404/9789241515481-eng.pdf.

21. Yevutsey SK, Buabeng KO, Aikins M, et al. Situational analysis of antibiotic use and resistance in Ghana: policy and regulation. BMC Public Health. 2017;17(1):896. Published 2017 Nov 23. doi:10.1186/s12889-017-4910-7
22. Haldeman MS, Kishimbo P, Seddon M, Sangare A, Mwasomola D, Hall J, Shaffer M, Leclair R, Caulder C, Bookstaver PB, Nsojo A. Evaluation of Antimicrobial Utilization and Concordance with National Guidelines at a Tertiary Hospital in the Southern Highlands Zone of Tanzania. Am J Trop Med Hyg. 2020 Feb;102(2):370-376. doi: 10.4269/ajtmh.19-0231. PMID: 31802729; PMCID: PMC7008321.
23. Nambasa V, Ndagije HB, Serwanga A, et al. Prescription of Levofloxacin and Moxifloxacin in Select Hospitals in Uganda: A Pilot Study to Assess Guideline Concordance. Antibiotics (Basel). 2020;9(8):439. Published 2020 Jul 23. doi:10.3390/antibiotics9080439.
24. Olaoye, O., Tuck, C., Khor, W. P., McMenamin, R., Hudson, L., Northall, M., Panford-Quainoo, E., Asima, D. M., & Ashiru-Oredope, D. (2020). Improving Access to Antimicrobial Prescribing Guidelines in 4 African Countries: Development and Pilot Implementation of an App and Cross-Sectional Assessment of Attitudes and Behaviour Survey of Healthcare Workers and Patients. Antibiotics (Basel, Switzerland), 9(9), 555. https://doi.org/10.3390/antibiotics9090555.
25. Thriemer K, Katuala Y, Batoko B, Alworonga JP, Devlieger H, Van Geet C, Ngbonda D, Jacobs J. Antibiotic prescribing in DR Congo: a knowledge, attitude and practice survey among medical doctors and students. PLoS One. 2013;8(2):e55495. doi: 10.1371/journal.pone.0055495. Epub 2013 Feb 18. PMID: 23441152; PMCID: PMC3575397.
26. Quet F, Vlieghe E, Leyer C, Buisson Y, Newton PN, Naphayvong P, Keoluangkhot V, Chomarat M, Longuet C, Steenkeste N, Jacobs J. Antibiotic prescription behaviours in Lao People's Democratic Republic: a knowledge, attitude and practice survey. Bull World Health Organ. 2015 Apr 1;93(4):219-27. doi: 10.2471/BLT.14.142844. Epub 2015 Mar 3. PMID: 26229186; PMCID: PMC4431558.
27. Tadeg H, Berhane Y. Substandard and counterfeit antimicrobials: recent trends and implications to key public health interventions in developing countries. East Afr J Public Health. 2012;9(2):85-89.
28. Kinfu Y, Dal Poz MR, Mercer H, Evans DB. The health worker shortage in Africa: are enough physicians and nurses being trained? Bull World Health Organ. 2009 Mar;87(3):225-30. doi: 10.2471/blt.08.051599. PMID: 19377719; PMCID: PMC2654639.

Figures

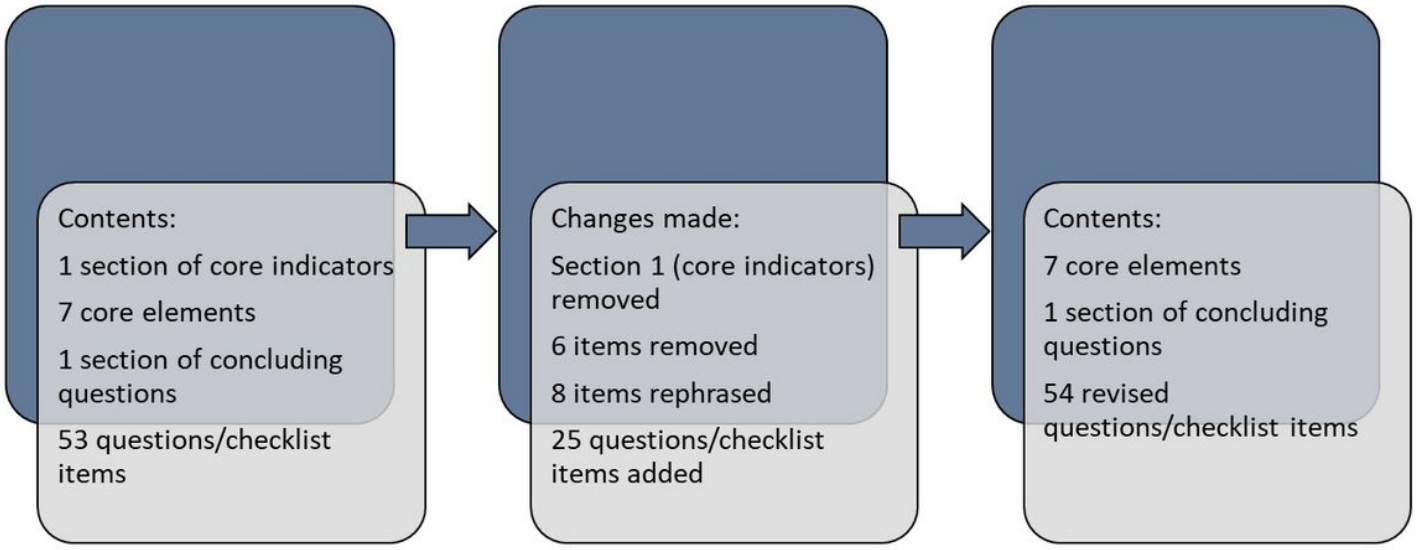

Figure 1

Consensus procedure (modified Delphi approach)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementarymaterialsAMSchecklistfinalsubmitted.pdf