What does antimicrobial stewardship look like where you are? – global narratives from participants in an online course on antimicrobial resistance

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ABSTRACT

Introduction

Whilst Antimicrobial Stewardship (AMS) is being implemented in different countries, different contexts continue to present unique challenges. We investigated the challenges to implementing AMS in different countries by examining comments from clinical, academic, and lay learners participating in a Massive Open Online Course (MOOC) on tackling antimicrobial resistance (AMR).

Methods

A 3-week MOOC titled "Tackling AMR: A social science approach" was developed with a global faculty in collaboration with the British Society of Antimicrobial Chemotherapy and Imperial College London and launched in November 2019. Learners were asked specific questions about their experiences of AMS throughout the MOOC which included 38 optional free text prompts. Learners' free text responses from first three-course runs (November 2019 – July 2020) were collated and coded in NVivo 12 using a conventional content analysis approach to identify challenges to implementing AMS across countries.

Results

Representing 114 countries, 1464 learners enrolled, with largest representation from the United Kingdom, India, Nigeria, Australia, and Pakistan. The learners described a range of AMS activities and team compositions. While recognising the importance of pharmacist and nurse roles in AMS, the learners reported that such roles remain ill-defined across countries, restricting the reach and potential of AMS strategies. A range of challenges to implementing AMS were described, including: limited awareness and engagement by the general public and healthcare workers (HCW) on the impact of AMR on human health, lack of adequate of governance and policy; inconsistencies in surveillance for antibiotic consumption and AMR, impeding feedback loops and improvement processes; human resource and technological constraints; variable access to key antibiotics; lack of ownership of antibiotic decision-making and buy-in from different clinical specialties. Patients' knowledge, experiences and perspectives were recognised as a valuable source of information that needed to be incorporated in AMS initiatives to overcome cultural barriers to the judicious use of antibiotics.

Conclusion

Analysis of learner comments and reflections identified a range of enablers and barriers to AMS implementation across different healthcare economies. Common challenges to AMS implementation included the role of non-physician health care professionals, resources, knowledge of AMR and patient engagement and involvement in AMS.

Introduction

Antimicrobial resistance (AMR) is a silent pandemic that requires urgent multisectoral action.(1) The WHO endorsed Global Action Plan on AMR provides guidance for countries to develop strategies to tackle AMR, including implementing antimicrobial stewardship (AMS) programmes. Individual countries are at different stages of implementing national action plans across sectors, driven amongst other things by existing capacity, resource limitations and political drivers.(2,3) Effective AMS is a multimodal and interdisciplinary approach to changing behaviours and aims to optimise antibiotic use and preserving their efficacy.(4)(5) Whilst most evidence continues to be generated from high-income countries (6) increasingly positive outcomes associated with AMS are being reported from low- and middle-income countries (LMICs).(7–9)

To effectively optimise antibiotic use, AMS should be implemented across primary, secondary, and tertiary sectors. Multidisciplinarity in AMS teams is important (5) as is leadership, and effective mechanisms for surveillance, access to policies and guidelines, and education and training for AMS teams as well as for other healthcare workers (HCWs).(10,11) Whilst guidelines, policies and global and national action plans exist, significant differences remain in AMS strategies, including differences in team composition, and in indicators used to measure success.(7,12–14) To facilitate effective implementation, contextualized strategies are needed.(9) The range of reported barriers to AMS include: diagnostic challenges; varied knowledge and awareness on optimal antibiotic use; access to antibiotics; healthcare facilities varying in infrastructure and patient numbers; inadequacy of information systems; lack of key personnel and funding, and the competing healthcare needs of populations which drive prioritisation of initiatives.(9,15) In many countries, AMS is led by doctors with little input from healthcare professionals like pharmacists and nurses, despite their potential for active roles in AMS. Furthermore, AMS initiatives rarely involve patients.(16)

Antibiotic prescribing, is a complex, social process reliant on different people and influenced by determinants such as the opinions of peers and hierarchies that exist within clinical teams.(17) In the last ten years a growing body of literature applying social science approaches has provided insights the impact of behaviour and social norms on antibiotic prescribing in different contexts, recognising that antibiotic prescribing is a social process.(18–20) Effective use of theories, frameworks, and methods from behavioural and psychological sciences however, remain inaccessible to most AMS practitioners.(21) Harnessing the growing body of qualitative literature on this topic, we brought together key research expertise from across social sciences, implementation science, infectious diseases (ID), and patient and public advocacy to develop a 3-week long Massive Open Online Course (MOOC) titled “Tackling AMR: A social science approach” to make such approaches more accessible to AMS practitioners. This introductory course focussed on the practical and real-world application of social science methods using examples of clinical practice and research from high-income countries and LMICs.

MOOCs have been gaining popularity to provide education to a wider audience.(22,23) In this article, we describe how use of a MOOC platform provided an opportunity to gather diverse narratives from around the world on AMS in a large number of contexts and experience of developing and implementing AMS. These narratives also gave us fresh insights into the unique challenges that HCWs face in implementing AMS across diverse cultural and economic settings.

Methods

The e-learning initiative was funded by the Economic and Social Research Council (ESRC) with the aim to enhance the impact of existing ESRC-funded research to a wider global audience, including those in LMICs. Recognising that at the time the existing e-learning resources did not address the use

of social science methodologies to tackle AMR, the content was specifically developed to address this gap. The content was designed to complement the existing World Health Organisation and British Society for Antimicrobial Chemotherapy (BSAC) e-learning initiatives.(23) Drawing on from state-of-the-art evidence from application of social science research to tackling AMR across different countries, the international faculty represented expertise across social sciences, ID, implementation science, pharmacy, patient and public advocacy and nursing, general practice and knowledge mobilisation.

The open access course, hosted on an established platform with wide global reach, linked to existing BSAC MOOCs and targeted healthcare professionals, researchers, and students. It was designed as an interactive module that uses a range of techniques such as video case presentations interspersed with knowledge tests to enhance participant engagement and learning. Each week had two hours of materials which the learners could finish at their own pace. Week one of the course included in depth discussions on structure, functioning and challenges faced by AMS from experts across high-income countries and LMICs. Week two introduced how social science methodologies can be used to study AMR and included practical sessions by researchers from different parts of the world. Week three introduced the learners to implementation science and discussed the role played by patients and public in AMR. At the end of each subsection, learners were asked specific questions about AMS in their country including 38 optional free text prompts. Throughout the course, learners were encouraged/prompted to share their experiences and to ask topic specific questions. The lead educators of the course periodically responded to comments and queries from the learners.

Basic learner demographic data including country, age and occupation were collected from Future Learn database. Learners' free text responses from the three course runs were collated and coded in NVivo 12 using a conventional content analysis approach by four researchers. These codes were analysed by the researchers to identify the composition and challenges to AMS. The purpose of this paper is to provide a summary of responses and not to compare the perspectives between learners and across countries.

Results

General characteristics of learners

Between November 2019 and July 2020, 1464 learners joined the MOOC. Of the learners who indicated their ages, the largest proportion (443/1464, 30.2%) were in the 26-35 age category. There were 754/1464 (51.5%) learners from high-income countries, 646/1464 (44.1%) from LMICs, and 64/1464 (4.4%) did not register their country. Out of the total learners, 601/1464 (41%) marked at least one step as complete (active learners) and 199/1464 (14%) posted at least one comment on any step of the course (social learners). Marking steps as complete is an optional step in the MOOC, and learners could have completed the entire course without marking any step as complete. Data on which countries these social learners were from was unavailable. These social learners included healthcare professionals primarily doctors, pharmacists, and nurses; students, mainly medical, nursing and pharmacy; and researchers. The analysis of the discourse that was generated through the prompts identified key themes that impact AMS delivery: AMS teams composition and activities, ill-defined roles for nurses and pharmacists, key challenges to implementing AMS strategies, and roles of the patient and the public in AMS. In the following sections we describe the key emerging themes from the responses and comments of these learners. Additionally the learners, through their own experiences had a series of recommendations for AMS strategies could be improved. We present these at the end of the results.

Antimicrobial Stewardship (AMS) Teams: Composition and Activities

Whilst at least some components of AMS is reported to exist to varying degrees in different countries (X1, X2, X3 Table1), some learners reported the absence of stewardship programmes in the places where they work (X4, X5, X6 Table 1). Guidelines and policies do exist (X7, X8, X9 Table 1), but they are not always put into practice (X10, X11 Table 1). A lack of guidelines (X12, X13 Table 1) was also reported by some learners. The composition of AMS teams also varied. Learners described a range of AMS activities aimed to support and guide appropriate antibiotic prescribing and use through leadership and input to clinical teams as summarised in Box 1. Strategies to engage colleagues in AMS vary from scheduled antibiotic discussions in small huddles between doctors and nurses to weekly multidisciplinary stewardship rounds with input from ID specialists, infection prevention and control (IPC) teams, pharmacist, microbiologists and concerned clinicians (X1, Table 1). Other strategies reported include academic input meetings; policy development and ongoing face to face or in some settings, tele health support by ID specialists and AMS pharmacists (X2, Table 1).

Ill-defined roles for nurses and pharmacists

A recurring response from learners is that the distinct role of nurses and pharmacists in AMS remains ill defined. A summary of general findings on pharmacists and nurses reported roles and challenges in AMS across sectors is presented in Table 2. Pharmacists offer a patient-by-patient ground level view and hospital-wide perspective on antibiotic use and consumption (X14, Table 1). Acting as gatekeepers', pharmacists review and authorise antibiotic prescriptions and provide advice on the indication of restricted antibiotics in hospital (X15, X16, Table1). Some learners ascribe the lack of training and knowledge on antimicrobial drugs and AMR and the restricted/limited perception of the pharmacist's role by colleagues as barriers in their active role and contribution to AMS (X17, X18, Table 1). Gatekeeping antibiotic access is far more challenging in primary care where self-medication and over the counter sales of antibiotics are authorised. As medicines expert, pharmacists are ideal candidates to provide education to healthcare professionals and patients on the impact of antibiotic use (X19,20, Table 1).

The role of nursing in AMS is not clearly defined in policies or guidelines. Even though the nurses' role in AMS is perceived to be limited to antibiotic administration (X18, Table 1), routine nursing roles also include monitoring and reporting response to antimicrobial treatment and early signs of infection as well as obtaining relevant samples in a timely manner (X21, Table 1). Learners report that nurses play an active role educating patients about the use of antibiotics and ensure that courses of antimicrobials are completed while in hospital (X19, X22, Table 1).

Challenges to implementing AMS across settings

Figure 1 depicts a summary of responses from learners on the perceived challenges of implementing AMS across different contexts, grouped into team- and systems-based challenges.

In general, learners perceived that the public and HCWs have limited awareness on the impact of AMR on human health (X23, Table 1). The impact of AMR is under prioritized in some settings where learners describe a lack of emphasis, awareness, and priority from national, state, and local authorities. Discrepancies exist between National Action Plans and actual interventions to combat AMR (X24,X25,X26 Table1). While AMS specific policies and protocols are unavailable in some countries, where they do exist policies are not always targeted to effectively inform antibiotic prescribing across both primary and secondary care (X27, Table 1). AMS support to rural hospitals is described as limited. The shortage of clinical pharmacists and the lack of leadership and expertise on

AMS highlights human resource and capacity challenges while technological constraints include the absence of electronic prescription systems (X9, Table 1).

Whilst unreliable access to antibiotics is a recognised concern, where and when they are available, a myriad of other factors impacts on their optimised use. Some learners observe a lack of ownership of antibiotic stewardship practices by prescribers and members of their healthcare teams and list among others, several behavioural approaches/challenges to antibiotic prescribing that affect decision making (X28, Table 1). The gap in the clarity of roles and expectations by other healthcare teams of AMS teams, together with how the interface between these two groups is described, points towards elements of challenge to AMS which include varied prescribing practices and buy-in (X29, X30, Table 1).

A variability of surveillance and AMR is reported by learners. Surveillance data on antibiotic consumption, healthcare associated infections and resistance patterns to inform or improve infection management practices are infrequent, poorly captured, or absent (X31, X32, Table 1). These inconsistencies are further challenged by limited/ inadequate or absent audit and feedback loops to improve processes. While there are many serious short- and long-term repercussions on patient outcomes and AMR resulting from sub-optimal surveillance, learners also highlight the hidden financial implications of infections due to the absence of economic data and analysis (X33, Table 1).

The role of patients and the public in AMS and the wider AMR landscape

Learners acknowledged that patients have a key role to play in AMS as they are the consumers of antibiotics and beneficiaries of health services (X34, Table 1). As the main source of continuity, a patient's perspective can provide invaluable insight into past treatment plans and contribute knowledge that can potentially enhance the success of future treatment options identified by the clinician (X35, Table 1). There is also a need to explore how much patients understand their own care needs so that health communication can be tailored to their needs (X36, Table 1). As well as involving patients in their care, patient involvement in the wider development and evaluation of interventions is essential as it will highlight needs that health care professionals haven't considered (e.g. communication, risks, etc) (X37, Table 1). With unregulated access to antibiotics a concern in many countries, learners suggest that education on the adverse effects of the unnecessary use of antibiotics should be provided to patients to tackle AMR (X38, Table 1).

Recommendations for Improvement

Learners have put forth various recommendations for how antimicrobial prescribing and AMS can be improved. Box 3 summarises these recommendations.

Discussion

In this article we analysed responses from learners around the world who enrolled in a 3-week long Massive Open Online Courses (MOOC) on applying social science methods to tackle antimicrobial resistance (AMR). The reponses yielded rich data on the unique challenges and experiences of developing and implementing AMS across different countries. The reported challenges to implementing AMS strategies include: limited awareness on the impact of AMR on human health; lack of governance and policy; insufficient surveillance for antibiotic consumption and AMR; human resource and technological constraints; variable access to essential antibiotics; lack of ownership of antibiotic decision-making and buy-in from different clinical specialties. Patient's knowledge,

experiences and perspectives were recognised as valuable in the consideration of AMS initiatives.(24)

Even though AMS is a universal concept, there is a difference in the way it is implemented in different settings as evident from the responses from our learners. Delivering AMS through a multidisciplinary team is desirable; however, it may not be feasible in all contexts especially due to resource constraints. Pharmacist driven or led AMS programs have shown to improve antimicrobial prescriptions where there is a lack of availability of ID specialists.(25,26) While it was recognized by the learners that involving pharmacists and nurses in AMS is beneficial, their distinct roles remain ill-defined in many countries, offering a potential problem in implementation of global AMR priorities. Published evidence also suggest that the extent to which these professionals are involved remains to be a barrier. (27,28) Patient education on rational antibiotic use was an area that the learners acknowledged pharmacist and nurses to have an important role.

In general, the public and HCWs have limited awareness of the impact of AMR on human health. This may be due to many reasons, and may be linked to the ripple of effect of the lack of government leadership. In some countries, the impact and effect of AMR are perceived as not being prioritised and learners describe a lack of emphasis, awareness, and significance attributed to this from national, state, and local authorities. A qualitative study investigating cultural and contextual determinants of AMS across different countries found that government or state involvement could be both a help or hindrance to effective AMS e.g. in high-income countries, too much interference caused conflicting messages and a disruption to AMS,(29) leading to uncoordinated and unfocused messages risking 'AMR-fatigue'. Conversely in LMICs the lack of government support and poor infrastructure were considered barriers to AMS. An interesting outcome was that irrespective of income status or central governance endorsement, local championing and leadership was considered a key facilitator to successful AMS implementation.(29)

Difficulty in implementing AMS in rural areas is a thread that has been reported in other studies.(30)(31) In a mixed methods study to identify barriers and enablers for implementing AMS in regional and rural hospitals in Australia, barriers include lack of access to education, resources and specialist support.(30) To re-iterate the influence of resource availability on AMS in rural district facilities, a situational analysis reviewing existing AMS facilities in a South African province reported that AMS was less likely to be established in rural districts with smaller facilities and smaller staff complements.(31) Specialist onsite support which includes ID, clinical microbiology and pharmacy (30,32,33) is deemed key to success for the development of AMS programs but may not be feasible or possible in many settings. However outcomes from pharmacists-led interventions conducted in several countries in Africa have demonstrated improvements including in better hang-time compliance and a reduction in surgical site infections, and antibiotic use, demonstrating that AMS can be implemented with limited specialist resources and extended to remote areas. (26,34,35) Whilst a multidisciplinary AMS team remains the gold standard, existing evidence suggests having the right person lead the AMS programme may be sufficient to making a measurable difference.

The influence of the health-care system, availability of antibiotics and diagnostic capability; and IPC practices on AMS interventions is well described, where the discrepancies between income status is often highlighted.(6,9,36) However, when considering antibiotic decision making, associated behaviours linked with prescribing practices seem universal and less linked to the country's income status.(17–19,37) Rather, prescribing practices are influenced by cultural and contextual boundaries and practices.(4) Learners further highlight challenges in stewardship emphasising gaps between AMS teams and the healthcare teams they consult. Published literature confirms learner experiences

including that AMS teams can work in isolation often with limited engagement with other specialties (4,38); roles and expectations in AMS from the wider multidisciplinary team are unclear(18,19,37); lack of buy-in from clinicians from various departments in AMS.(37)

Surveillance data on antibiotic consumption, HAI and resistance patterns to inform or improve prescribing and clinical outcomes are infrequent, poorly captured, or absent. The benefits of surveillance are well described in the literature and Brink et al (26) report an overall reduction in mean antibiotic use when prospective audit is applied in combination with intervention and feedback.(39) Essentially, surveillance is a means to audit behavior change. Effective, relevant and timely feedback of behaviours to measure change are recommended by Singh et al as one of the components on a framework to improve integrated care in infection management.(19)

Patient and the publics' role in and contribution to AMS is recognized by the learners. Value is placed on how the patient's perspective can usefully calibrate and widen HCWs views on AMS to improve outcomes. A gap exists both in the active engagement of patients in decision-making to ameliorate demands for unregulated antibiotics as well as greater awareness of their own infection care. Although much is written about engaging patients on IPC and AMS in policies and guidelines, a recent scoping review suggests that, current infection-related patient participation measures are limited, emphasising the many missed opportunities for patient engagement.(Mbamalu et al, under review, (40) (41)

This study has limitations. Even though this MOOC enabled gathering insights about AMS from across the world, responses could not be linked to the learners' specific country as not all indicated this information in their comments. Despite that, this platform provides insights from across diverse cultural and economic contexts. The findings represent the experiences of individual learners participating in a MOOC and may not be generalisable to the wider context of the countries of the participants.

Conclusion

This analysis of experiences of AMS in different countries provided insights on unique challenges present in different contexts spanning teams and systems considerations. There needs to be greater efforts in recognising the role of non-physician health care professionals in AMS as well as seeking greater active patient and public involvement. Customising AMS programmes to account for contextual drivers such as local leadership structures, and access to antibiotics can facilitate the adoption of sustainable interventions.

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Table 1: Excerpts from responses on MOOC platform

ID	Quote
X1	Weekly Friday morning AMS meeting with Clinical microbiologist, Physicians, Pediatricians, IPC Senior, Clinical Pharmacist, intensive care unit staff, nursing infection control champions and Nursing Education Department. Strategies include antimicrobial prescription chart, audits and monthly antibiogram presentation.
X2	AMS for regional and remote communities without ID/Microbiology. Delivered via tele health rounds and a phone hot line to an ID doctor or AMS pharmacist. Interventions include consulting AMS if intravenous (IV) antibiotics prescribed over 48 hours, IV to oral switch procedures etc.
X3	Tertiary care hospitals generally have AMS but programs in long-term care or community practice lag. Provinces like Alberta have a provincial AMS. They also have the community-based 'Do Bugs Need Drugs' program, as does British Columbia which does some great public education and hosts an online dashboard display for AMR and antibiotic utilisation data. Ontario has a gold standard AMS scaled-up in hospitals across the province, which began in intensive care units. 'Rx Files' is an academic detailing program from Saskatchewan which supports stewardship decision making through consultations with physicians using the nudge method. Some jurisdictions are looking at systems for audit and feedback for prescribers.
X4	AMS in my country, Nigeria, has been underestimated in the past, only until recently that the Global Action plan to reduce antimicrobial resistance was published and became a template which various countries around the world adopted and constitute the national version of the plan. AMS is not a term often used in this country, because, not so many even know about it.
X5	As far as I am aware, there are no stewardship activities happening in my city at any hospitals. Only IPC activities are in practice that too only at large corporate hospitals who are forced to implement IPC for accreditation purposes like the Indian NABH (National Accreditation Board for Hospitals). Data collection not done expect at certain research institutes.
X6	Very little is being done or practically there are no existing structures/interventions in my environment to regulate or optimise prescription of antibiotics.
X7	The AMS committee developed the antibiotics guidelines based on local antibiogram. Every year the committee update the antibiotics guidelines. The application of antibiotics guidelines was assessed by doing a small research of the junior doctor and reported to the committee.
X8	We have empirical treatment and prophylaxis guidelines and an antibiotic prescribing policy which encourages the start smart then focus approach to prescribing as well as encouraging use of narrow spectrum antibiotics.
X9	Antimicrobial resistant microorganisms are increasing in our setting as the people can buy the antibiotics from the pharmaceutical shop without prescription. Our hospital has the yearly local antibiogram depending on the culture isolates from microbiology department. All the head of specialist involved in the antimicrobial stewardship committee. And the antimicrobial stewardship committee developed the antibiotics guidelines based on local antibiogram. Every year the committee update the antibiotics guidelines. The application of antibiotics guidelines was assessed by doing a small research of the junior doctor and reported to the committee. We don't have electronic prescription systems and clinical decision support systems. The committee tried to check the antibiotics utilisation by global point prevalence surveys even though we don't have a clinical pharmacist. The senior nurse is involved in the infections control committee. And continuing monitoring and education is held monthly in the hospital to improve the knowledge and current trend of antibiotics, outbreak tracing and to solve some problem. With the help of all department participating, we can make a system to encourage the judicious use of antibiotics.
X10	At the setting that I work, there is an AMS committee. There is an antibiotic policy which is under utilised. There are physicians who aspire to rationalise antibiotic use. Still unable to implement it due to multiple factors. I would like to see a change in attitude towards prescription of antimicrobials.
X11	Several policies and guidelines do exist, but they play little role in informing antibiotics prescription by clinicians both in rural and urban settings. The gap

	between policy making and implementation of guidelines should therefore be bridged by the motivated healthcare team involving the nurses and doctors and pharmacists.
X12	There are no strict measures as regard the prescription and usage of antibiotics in my country. there are only unimplemented policies. Nurses and pharmacist actively get involved in the prescription of antibiotics. I look forward to a setting where everything will be orderly. With me and other people taking this course.
X13	There are no clear policies or guidelines regarding antibiotics prescribing or purchasing and doctors recommend the antibiotics as a dose to every person for effective results and get a lot of commission by prescribing the antibiotics.
X14	Pharmacist have the role of monitoring of the use of antibiotics and biologist the role of monitoring of antimicrobial resistance. Data provide by pharmacist and biologist are included in a national Survey about consumption of antibiotic and antimicrobial resistance.
X15	Pharmacists validate each prescription of antibiotics and advise on the indication of restricted antibiotics.
X16	Pharmacists do play a key role in AMS because they are one of the gatekeepers in terms of community's antimicrobial access.
X17	Pharmaceutical staff often lack training and knowledge on antimicrobial drugs and AMR which exacerbates the issue of over-prescribing.
X18	Nurses and pharmacists have a limited role, which does not include the authority to make decisions regarding the person's intake of antibiotics, but only for the nurses to administer it and for the pharmacist to provide it.
X19	Nurses and pharmacists have a role to play which is basically to educate the patient.
X20	Pharmacist are trying hard to educate the healthcare professionals and patients that misuse of antibiotics will develop resistance against bacteria.
X21	The role of nurses is not explicit. They are expected to warn of signs of infection, response to treatment, to obtain the relevant samples in a timely manner. But it has not been reflected in any document or policy. In fact, the infection control team seems to also fight against this circumstance to get the nurses involved.
X22	The nurse has a role to educate patient about the use of antibiotics, they actively remind the patient to take their medication (in the hospital).
X23	People laugh at the statistics that by 2050, 10 million people will be dying every year... And I think that's my biggest risk right now, that people still don't take AMR as seriously as they should. The problem is not close enough to them, personally, for most people to engage with it properly. Also, there is a lack of understanding that each of us is what - 10% mammalian DNA and 90% microbial? Every creature has its own microbiome, which differs according to site. At each site it serves a defensive purpose. Disrupt it, and new problems emerge. Maybe a new perspective is required, that each of us must care for our microbial cells as well as the mammalian ones of each organ system.
X24	No clear policies or guidelines regarding antibiotics prescribing or purchasing and doctors recommend the antibiotics as a dose to every person for effective results and get a lot of commission by prescribing on the antibiotics.
X25	There is a national action plan to combat AMR, yet, the campaign is at zero level
X26	Some countries in the region do have guidelines but it's the implementation where the problem lies. Most of these guidelines are focused on public health and not much on animal health
X27	Several policies and guidelines do exist, but they play little role in informing antibiotics prescription by clinicians both in rural and urban settings. The gap between policy making and implementation of guidelines should therefore be bridged by the motivated healthcare team involving the nurses and doctors and pharmacists.
X28	Many of the challenges in Uganda are not more different than in other countries: lack of leadership, the lack of expertise at health centres and problems with tracking and reporting.
X29	A lot of practices described are familiar. Surgeons like to outsource antibiotic prescribing to others like internal medicine specialists, anaesthesiologists, or IDs. Once, when being consulted about a patient, the resident surgeon even said to me: we operate, but don't know anything about the antibiotics. That's your job to

	figure out which antibiotic to give, not ours.
X30	There are antibiotic stewardship rounds in surgical departments, but internal medicine etc are still not on-board with this
X31	Healthcare associated infection data are poorly captured. Improvements needed in communication and understanding of differences in team dynamics and AMS in different clinical areas
X32	At present, reports from the AMS committee for our hospital is not readily available. As mentioned by the Uganda AMS scientists, we cannot work on AMR or AMS without data. I now have the buy-in from my hospital's infection control team to work on prevention and surveillance on MRSA, and will try to get to know the AMS team of my hospital better to get the buy-in to work together.
X33	Economic analysis has not been done in my setting hence impact not realised. Also, inconsistent antibiotic ward rounds noted.
X34	I think, patients view or experiences are important in carrying on with a successful intervention or modifying it. Patients perspective can add to the knowledge of prescribing or a treatment plan as the one going through the experience is the patient and not the healthcare professional.
X35	End-users of AM drugs are a fundamental part of the whole AMS process so yes, their input must be included wherever possible, as part of understanding the context in which interventions are to operate. I think that this would alter the perspective and focus of some decisions. Policies and guidelines are all very well but they have to have the desired effect, so it seems relevant to assess key performance indicators and then work backwards using social science methods to identify which changes can be made which could have the biggest positive effect.
X36	The answer for using more patient's knowledge and experience in my daily practise is yes, I would. Beside good medical records of each patients, it’s also needed to explore more about how much they understand their issue/case so we can fill the gap of the missing essential information for them.
X37	Patient involved would be vital for designing and reviewing interventions and materials that are directly targeted at patients and citizens. Patient involvement in wider interventions could also throw up useful questions that health professionals haven't considered (e.g. communication, risks, etc). This information could be gathered at intervention design meetings, through consultation, and direct discussions with expert patients.
X38	My local GP practice has been very ahead of its time when it comes to AMR and has put in place strategies to avoid over prescription of them. I have heard of stories in the past of patients requesting antibiotics and sometimes even requesting them 'just in case' they're infection became worsened, sometimes people would request them to take abroad if they were prone to some infection. Therefore, in the waiting room there are posters placed to educate people of the potential risks to unnecessary prescription of antibiotics. The people in my community have started to understand the issue with AMR. The GPs now avoid their prescription unless in dire need.

Box 1: AMS activities reported by learners on the MOOC*

- Weekly academic presentations by microbiologist, physicians, clinical pharmacists, or academic guests of treatment guidelines.
- Weekly morning AMS meeting with clinical microbiologist, physicians, paediatricians, IPC nurse, clinical pharmacist, Intensive care unit staff, nursing infection control champions and nursing education department. AMS strategies include a dedicated antimicrobial prescription chart, audits and monthly antibiogram reports.
- Weekly AMS rounds with pharmacist, microbiologist, IPC and concerned clinicians.
- Antibiotic rounds at certain wards (mostly surgical) and antibiotic consultation by ID specialist available at all times.
- Advising prescribing physician in the use of antibiotics by ID specialists and focus on intensive care and other specialties where they have identified opportunity for improvement.
- Collaborative policy development involving pharmacists, microbiologists, and clinicians.
- AMS delivered via tele health rounds and phone hot line by an ID doctor or AMS Pharmacist to regional and remote communities without ID specialist or Microbiologist.

*These report on responses by the learners and may be limited in detail to provide insight into specific contexts.

Fig 1: Reported challenges and limitations to AMS

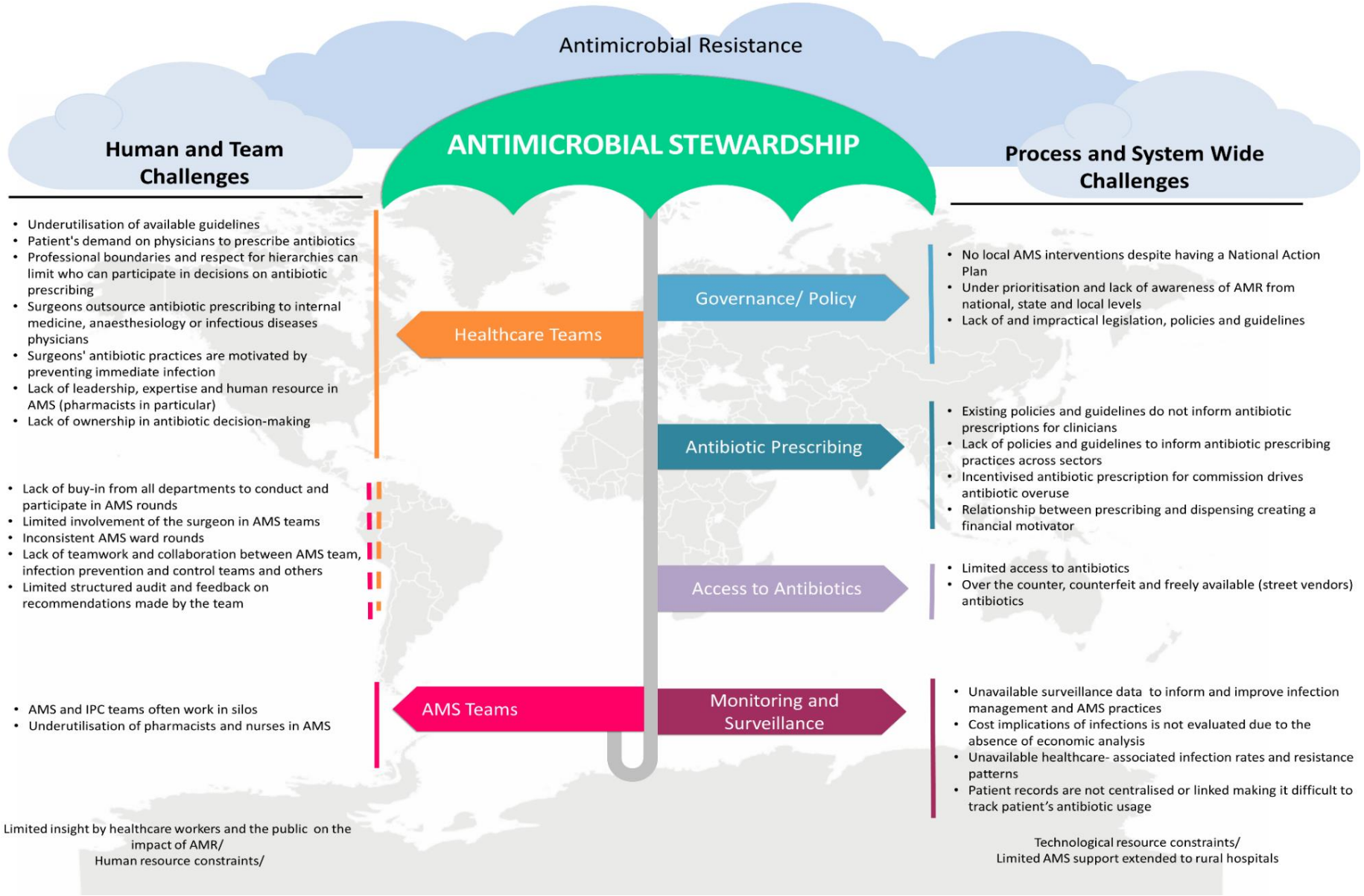

Table 2: Reported roles and challenges of pharmacists and nurses in AMS across sectors*

	Profession	
	Pharmacists	**Nurses**
Roles	• Prescribing and optimising antibiotic use. • Educate and advice HCW about the rational use of antibiotics and AMS. • Collect data on AMS performance indicators and provide feedback to stakeholders. Monitor antibiotic use and provide data on antibiotic consumption. • Monitor antibiotic use and provide data on antibiotic consumption. • Act as gatekeepers for antimicrobial access in the community. • Review and validate each prescription of antibiotics and advise on the appropriate use of restricted antibiotics. • Authorise use of restricted antibiotic for hospital inpatients. Educate healthcare professionals and patients on the impact of antibiotic misuse on resistance. • Facilitate communication between a doctor and a patient. • Lead patient education around AMR/AMS. Review indications for prescribed medicines with prescribers (weekly review).	• Administer antibiotics. • Prescribe antibiotics in contexts where it is permitted. • Monitor patients and respond to signs of infection. • Educate patient about the use of antibiotics and ensure that prescribed courses are completed by patients in hospital.
Challenges	• Lack of training and knowledge on antimicrobials and AMR which exacerbates the issue of over-prescribing. • Perception that pharmacists have a limited role in antibiotic decision making as their role is restricted to dispensing antibiotics. • Providing antibiotics without a prescription to patients who are unable to see a doctor.	• Perception that nurse's role in AMS is limited to antibiotic administration. • Perception that nursing does not have a role in AMS. • Despite nursing unit managers and ward champions attending AMS rounds, their roles are not defined. • Apart from IPC nurses, the general nursing body are not involved in AMS. • Role of nursing in AMS (generally) is not defined in hospital policy and guidelines. • The role of nurses is not explicit. They are expected to warn of signs of infection, response to treatment, to obtain the relevant samples in a timely manner. These have not been reflected in any document or policy.

*****These report on responses by the learners and may be limited in detail to provide insight into specific contexts.

Box 2: Recommendations for improvement

Governance, policies, and guidelines

- Improved leadership and support from governments and local authorities to provide contextually fit guidelines and policies that include regional and current data, not just theoretical suggestions.
- Regulations to restrict sale of antibiotics without a prescription in pharmacies and from street vendors thereby ameliorating irrational use of antibiotics.
- Bridge the gap between policy making and implementation of guidelines by involving motivated HCWs which include nurses, doctors and pharmacists in the policy design and roll out.
- Streamline government regulations and support to ensure dedicated prescribing guidelines to facilitate optimum decision making.

AMS across all health sectors

- Improve engagement strategies to optimise AMS across all health sectors.

Diagnostics to guide targeted antibiotic prescription

- Patients to undergo diagnostic tests for microbial sensitivity before being prescribed an antibiotic drug to facilitate subsequent. tailoring and optimisation of antibiotic as appropriate.

Teamwork and communication /Team practices/ routines

- Improve communication and understanding of differences in team dynamics and AMS in different clinical areas.
- Daily antibiotic rounds with the pharmacist and clinical infection specialist.

Roles/ responsibilities/ ownership

- Establish teams in each ward to monitor and manage antibiotic use.
- Expand AMS teams to include members from other specialties such as medical and surgical to ensure optimal antimicrobial use across patient pathway.
- Select champions from the respective fields. Those persons will be responsible in spreading the information among their colleagues and when they will limit antibiotics prescription themselves others will see and learn.
- Involve surgeons in AMS team to improve patient outcomes post-operatively.
- Increase involvement of pharmacists and nurses in AMS.
- Participation in AMS to be a shared goal by all HCWs and staff in the hospital.
- Clearly defined AMS role of all nurses' categories (as defined in hospital policy)
- Develop or enhance independent prescribing by nurses to support management of specific infections, especially in remote settings and/or where it may be advantageous to reduce physician workload (in primary or secondary care).

Approaches to tackling change:

- Develop AMS to consider context and differences between departments, and tailored to support the specific requirements of each e.g. individualism in surgical teams
- Consider local context when looking to bring about a change in behaviour.

Surveillance to inform practice

- Provide a system with evidence-based prescribing, strong data collection system and responsible use of antibiotics
- Utilise data on 'bacterial patterns' to inform antibiotic guidelines for clinicians.

- Utilise outcomes data to inform different antibiotic regimens
- Utilise surveillance data on antibiotic consumption and infections such as bacteraemia.

Patient and public Awareness AMR and education

- Improve population awareness of AMR and how they can self-manage certain infections without antibiotics or improve patient adherence to antibiotic courses when prescribed.
- Co-ordinate approach and education campaigns across human, environmental, and veterinary (including vets and farmers) sectors (OneHealth).
- Use public health campaign to educate the public on how to improve the gut microbiome and support better health overall.
- Improve public and patient education on antibiotic use to enable engagement with the practitioner when they are prescribed antibiotics.
- Using patient's personal experiences could be used as relatable examples for other patients and public on the challenges of AMR.
- Improve patients' trust in the treatment (antibiotics) prescribed to them
- Age-appropriate education of the general population at all ages and stages to improve awareness of AMS issues using innovative and creative interventions such as 'YouTube' animations.
- Intentional educational outreach especially to 'underprivileged' communities
- Targeted student education: Increase awareness on AMR and inform them on policies or legislation tackling the issue in their countries country, and believe that antibiotics are overused in many situations, particularly for agricultural productivity.