CONTAINING THE SILENT PANDEMIC OF ANTIMICROBIAL RESISTANCE

Key take-aways from the perspective of countries of the global south

May 2021

Report based on Africa-Asia Workshop on Containing the Silent Pandemic of Antimicrobial Resistance

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About CSE

CSE (www.cseindia.org), India is a non-profit public-interest research and advocacy organization working on issues of public health, environment and development in India and global South. The Food Safety and Toxins team at CSE has been working to address the problem of antimicrobial resistance, particularly the animal and environmental aspects of it.

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Foreword

Silent pandemic needs an agenda for change

We are living in unprecedented times. An RNA—not even DNA—has brought world economies to halt. In all this disruption, we must focus on another pandemic—not so obvious today—but one that threatens our health systems in ways that we cannot even imagine. This **silent pandemic,** or antimicrobial resistance (AMR), is as catastrophic as COVID-19 or climate change. Just imagine the scale of human tragedy if we lose the ability to get well—if the medicines stop working—if the disease cannot be treated because of antimicrobial resistance.

The fact also is that the current health crisis—the pandemic—has brought to light some key lessons. It provides us an opportunity to put our house right before it burns down.

Firstly, health is on the global agenda; today, equitable and universal access to vaccines is on the global agenda; we are realizing inter-dependence—and most importantly the cost of inaction in public health. We know today that the rich cannot be protected from the virus unless the poor have protection—inclusive and equitable health care is essential.

Secondly, **we understand more than ever the role of prevention.** COVID-19 has brought out the role of clean water as preventive agenda. The Indian government has included access to clean water and sanitation as part of the health sector's spending. Clearly, we know that prevention will be key in current and future health pandemics.

We also know that countries of the South, and I would argue also the already rich countries of the North, must realize that the approach of first chemicalizing and toxifying the environment and then investing in its repair is unaffordable and unsustainable. Our world, in particular, has many competing priorities—from health care for all to education. It is, therefore, even more critical that we learn to do things differently; we have to walk the paths that others have not taken yet—**leapfrog and reinvent pathways for growth without pollution.** This is where the environment challenge of AMR needs to be understood.

Thirdly, we also know that COVID-19 and AMR are the result of our dystopian relationship with nature; It is about the way we grow our food; manage our environment. There is massive use of antimicrobials and antibiotics in growing food—from crops to livestock and fish farming. We know this now. The problem is that this input—use of antibiotics for growth promoters to the control of diseases—has been widely abused in the 'modern' food manufacturing system. It has become part of the toolkit for enhancing productivity and is justified—as was the use of pesticides and other chemicals for many years—as critical for livelihood security of farmers. What this assertion ignores is the fact that antimicrobials are used indiscriminately in the case of what can be loosely called 'intensive' livestock farming. The use or misuse of antibiotics is then about the very system of food—how animals are reared, if they have access to the outdoors, how many are stocked (housed) in the facility, how more resilient breeds are disappearing (biodiversity in the food world), and its down to the questions of our diets. It is therefore wrong to pose this as a simple issue of productivity verses sustainability.

One Health

As environmentalists working in countries of the South, our work teaches us that the One Health approach is critical. We know that there is more than one pathway for antibiotic resistance—this is because not only are humans over-using these 'medicines' leading to them becoming ineffective, but also we are using them to grow our food; from crops, to livestock to fish farming.

Over the years, the Centre for Science and Environment (CSE) has released analyses on antibiotics in honey and then poultry; our studies have found high levels of these life-saving medicines in our food, which then adds to the challenge of antibiotic resistance. In most cases the antibiotic residue in the food we eat was there because it was given as a growth promoter. But we also recognize that in some cases it was given for disease management—a critical need for farmers to safeguard their animals.

Our studies have also pointed to the problem of waste—contaminated with antimicrobials—from pharma industry to poultry industry and sewage plants. Clearly, this food and environment pathway, which adds to antibiotic resistance, needs to be addressed and needs strategies that are preventive and affordable.

Pathways for our health security

What then is the way ahead? The world of emerging countries (our world) has double-triple challenges:

One, we have to increase health access to our people; we need access to life-saving medicines. Two, we have to increase food productivity and ensure farmers get livelihood security, which needs drugs for disease treatment. But thirdly, conversely, we cannot afford the high cost of clean up after contamination; And, we certainly cannot afford the high cost of medical treatment when basic drugs will not work. **In other words, we cannot afford antibiotic resistance.**

Re-invent the pathway

Therefore, the imperative is to discuss the ways ahead that will do the following:

Ensure that critically important for human health antimicrobials are not used for livestock/food. We call this the conservation agenda. Ensure that we can continue to increase food production without the use of indiscriminate use of antimicrobials. We call this the development agenda. Ensure that the waste from pharma/other sources is tracked and contained. The environmental agenda, which will minimize residues that contaminate the soil and water.

But all this will require serious re-invention of the way we do business with our food and environment. We have to prevent pollution and the overuse of chemicals. Therefore, for us the most critical element of the AMR and One Health agenda is the **prevention agenda.** This is what we will work on to build the understanding, the strategies for action and then of course, the engagement to make the difference on the ground.

Sunita Narain
Director General
Centre for Science and Environment

1. Introduction

Antimicrobial Resistance (AMR), in particular antibiotic resistance, is recognized as a silent pandemic with the potential to cause huge cumulative damage. If not acted upon, this global health threat will not only impact healthcare and economy, but also food safety, nutrition security, livelihood, and attainment of several Sustainable Development Goals (SDGs). Most countries across the world have developed AMR-National Action Plans (NAPs) but their effective implementation, in particular by the resource-constrained low- and middle-income countries (LMICs), is still a big concern. Another important bottleneck is the absence of a true One Health approach in practice. The AMR efforts are largely driven by the health sector stakeholders. While the animal sector stakeholders are struggling to find a sustainable solution due to food security concerns, the environmental dimension of containing AMR continues to remain the weakest link. All this is also linked to the lack of political buy-in secured for the problem of AMR. The on-going COVID-19 pandemic has further added to the challenge of prioritizing AMR containment efforts. But considering the scale of the AMR crisis, the global and national response needs to be swifter, stronger, and scaled up.

In view of these roadblocks, the Centre for Science and Environment (CSE) organized a three-day Africa-Asia virtual workshop on containing the silent pandemic of AMR from 22–24 March 2021. The workshop brought together over 125 experts from across the world, including over 100 experts from 24 African and Asian countries. These included national AMR focal points from Africa and Asia, and stakeholders from civil society, inter-governmental organizations, research and scientific organizations, and academia across human, animal, crops and environment sectors. Participating African countries included Botswana, Ethiopia, Ghana, Malawi, Mozambique, Namibia, Nigeria, South Africa, Tanzania, Uganda, Zambia and Zimbabwe. Asian representatives were from Afghanistan, Bangladesh, Bhutan, Cambodia, India, Malaysia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka and Thailand.

The workshop involved panel discussions on select key themes such as the implementation of AMR-NAPs, funding and political commitment, animal and environmental aspects of AMR, role of civil society, media and consumers, and country-level expectations. Experts discussed the realities of the Global South and the need for global guidance while deliberating upon the way-ahead. These inputs for the future agenda of containing the silent pandemic are expected to inform and shape-up global and national governance as well as policy-making and guidance-development processes. This report presents the key take-aways from the workshop. Further details related to the workshop are available at www.cseindia.org.

2. Key take-aways from Africa-Asia workshop deliberations

2.1 Setting the One Health AMR agenda in the context of COVID-19 pandemic

The opening remarks made by key Indian stakeholders were about the need for a One Health and preventive approach, and application of the learnings from the COVID-19 pandemic response. The following key points emerged from the inaugural session:

- Antimicrobial Resistance is a silent pandemic, with a potential to cause an impact which is as devastating as the present COVID-19 pandemic as well as climate change. The possibility of antibiotics not working and serious diseases becoming untreatable due to drug-resistant infections in the near future is a critical reason to look at AMR with a sense of immediate urgency.

- The on-going COVID-19 pandemic provides a unique opportunity to act on AMR. The most pressing issues such as health, need for better investments, universal and equitable access to vaccines, and role of preventive healthcare are currently on the global agenda. This provides an opportunity to upscale the action on AMR. Both AMR and the COVID-19 pandemic are a result of the dystopian relationship of humans with nature. They are linked with the way food is grown and the environment is managed.

- The present COVID-19 crisis has also demonstrated the importance of pandemic preparedness to be able to contain it. For example, the foundation of research, science and technology, and timely response of the scientific community, is helping build an ecosystem to deal with the pandemic, which can also be used to tackle the other pandemic of AMR.

- To bring sustainable change, AMR must be prioritized, and the pace of action, acceleration and collaboration must match up to that of COVID-19 response. Collective ownership and responsibility should complement this.

- The 'One Health' approach and the need for all sectors to come together for tackling AMR is critical. Apart from human health, the livestock and food production pathway and the environmental pathways contributing to AMR are of concern and need to be addressed.

- For effective AMR-NAP implementation, reimagining the pathway is the way forward. For example, in the case of India, there is need for One Health action on a mission mode, rethinking and allocating AMR budget, strengthening laboratory capacities, and developing innovative coordination mechanisms across all sectors.

- Universal antimicrobial stewardship (AMS) programs in all healthcare settings, along with a major thrust on prevention of infections, should be the key. This along with the adoption of a One Health approach should ensure that all routes of AMR receive necessary attention and resources.

- The liberal use of antibiotics in clinical settings can lead to losing the efficacy of antibiotics for future use. It is important that clinicians avoid the urge to prescribe antibiotics when not needed. We have to make sure that the infection is

treated and not the situation, that disease diagnosis is prioritized, that the select pathogen is targeted and not the 'menu of pathogens' through following of correct algorithms, and that the urge to use antibiotics unnecessarily is controlled.

- A strong ecosystem to facilitate research on AMR needs to be built. The current challenge is that there is insufficient research and innovation on AMR. Despite having prioritized the multi-sectoral nature of the issue, the AMR research space remains health sector driven. Moreover, the alignment of the push and pull factors is also necessary for AMR containment.

- Civil society is the key to bridge critical gaps, involve the community, build the momentum, and ensure sustainability of AMR-NAP implementation and the overall movement to contain AMR. Civil society has multiple roles to play in tackling AMR. These include a supportive and accountability role for governments; an advocacy role to raise concern and push for necessary action; a bridging role to help integrate top-down and bottom-up approaches; a convening role to bring perspectives from the ground; a narrative role to provide an emotional connect for the public; a developmental role for linking AMR to issues like universal health coverage, poverty reduction, sustainability and food justice; and a mainstreaming role for incorporation of AMR in health and healthcare agendas.

- LMICs are faced with multiple challenges such as access to life-saving medicines, maintaining food productivity, and ensuring farmers' livelihood security. LMICs therefore cannot afford to invest in cleaning up after polluting or the high cost of medical treatments when common antibiotics have stopped working due to rising AMR.

- LMICs therefore need to do things differently to reinvent pathways for growth without pollution. They need to have a 'conservation agenda', which means preserving critically important antimicrobials (CIAs) for human health and minimizing their use in livestock and aquaculture. Their 'development agenda' needs to ensure continued increase in food production without the use of antimicrobials. Their 'environmental agenda' must include tracking and containing the waste from point sources. Most importantly, they should have a 'prevention agenda', which means preventing pollution and overuse of chemicals.

2.2. Effective implementation of AMR National Action Plans

The deliberations reflected on issues related to effective implementation of AMR-NAPs, mainstreaming of AMR in the agendas of national healthcare and sustainable development goals, adoption of a One Health perspective, and the need for a whole-of-government and whole-of-society approach. The following key points emerged from the discussions:

- The issue of AMR is poorly understood and inadequately recognized among the stakeholders and people at large. Appropriate messaging is important while communicating so that the pandemic of AMR no longer remains silent. Moreover, AMR does not have a face. AMR champions are required to be identified at national, state/province, and community level. Stories of survivors, encouraging best practices, and information sharing will help in increasing understanding of the context specific criticality of the situation.

- The true adoption of a One Health approach is critical to AMR containment efforts at the national level. So far, AMR-NAP implementation efforts are largely driven by health sector stakeholders. The overall approach is fragmented and integration among stakeholders and sectors is missing.

- Effective One Health implementation and governance mechanisms should be constituted for securing collective ownership among human and non-human sector stakeholders. This includes mapping of all stakeholders; integrating AMR containment efforts into the actions and plans of concerned ministries and departments, including the ministry of finance; and rotating the AMR-NAP implementation secretariats among human and non-human sectors.

- Lack of funds for AMR-NAP implementation in all sectors is a big concern. Adequate domestic budgets need to be allocated, which is also linked with limited political support the issue has managed to garner. Donor funding should also be aligned with country-specific priorities. Costing of AMR-NAP implementation and making an economic case for AMR containment is essential.

- Prioritization of AMR-NAP across different sectors is the need of the hour, particularly in view of the lack of funds. This will help countries identify the low-hanging fruits in their national settings, which could be different across countries. Similarly, monitoring and evaluation of AMR-NAP implementation is important, which can further inform AMR-NAP prioritization.

- At the national level, support from the Tripartite is crucial for effective implementation of AMR-NAPs. All United Nations agencies, including the United Nations Environment Programme (UNEP), need to come together in the spirit of One Health and multi-stakeholder approach.

- AMR containment should be everybody's business. It needs human resources and capacity building, particularly in the non-human sectors such as animal, crops and the environment.

- Antimicrobial stewardship is crucial in all sectors. This should also be accompanied by stewardship in the laboratory as well as diagnostic stewardship.

- AMR needs to be mainstreamed into the healthcare agenda and sustainable developmental goals. The advocacy should be at the highest level in the country and in states/provinces.

- There is a need to reimagine the coordination and collaboration mechanisms at the national level. This includes better information sharing among stakeholders across the One Health spectrum. Just like in the case of COVID-19 pandemic, an AMR dashboard which displays updated information at national level would be very useful.

- The lessons learnt from the COVID-19 pandemic show the importance of a whole-of-government and whole-of-society approach. In addition to the need to focus on the One Health approach, the importance of Infection Prevention and Control (IPC) as a useful entry point for AMR containment has also been re-confirmed during the COVID-19 pandemic.

2.3 Political commitment and funding to contain AMR

The discussion aimed to understand measures required for enhancing political commitment to contain AMR and specific steps needed to increase funding and budgets at the national, regional and global level. Key points that emerged are:

- Effective implementation of AMR-NAPs depends on a strong political buy-in. This includes a whole-of-government approach with strong governance structures, a greater investment to tackle AMR, and a greater involvement of the finance ministry.

- Leadership at the global, regional, and national level is crucial to build momentum and move from commitment to action. AMR should further be positioned as an inter-sectoral challenge, and a paradigm shift in thinking and planning across sectors is required for better inter-sectoral ownership.

- It is necessary to apply the 'triangle that moves the mountain' approach—the combination of creating knowledge, social movements and political involvement—which would further be complemented by ensuring accountability. Transparency, evidence, and effective communication of AMR concerns to public and policymakers is critical to completing the triangle.

- Governments need to apply lessons learnt from COVID-19. The present pandemic, in fact, has emerged both as a crisis and an opportunity. Governments and publics are now aware of emerging disease threats, need for pandemic preparedness and public health infrastructure, and the importance of research and development. Healthcare systems stretched by COVID-19 and economies drained by the pandemic will either leave AMR behind as a priority, or take on the opportunity of supporting aligned work on AMR. There is therefore a need to identify a common cause to build momentum on the ground.

- The current financing is not enough for effective AMR-NAP implementation in countries. While 144 countries have AMR-NAPs in place, far less have plans which are implementable or financed.

- There is a need to better align and coordinate donor funding with local priorities of countries. Collaboration and partnership among donors to prevent duplication of work and to act in concert is also important.

- It is important to develop a case for AMR, particularly for LMICs. This will help estimate the cost of tackling AMR and inform governments appropriately. Prioritization of AMR-sensitive interventions such as Water, Sanitation and Hygiene (WASH), and infection prevention and control to mobilize funds from other areas should also be considered.

- There is a need to develop relatable evidence on AMR which aligns with the language of policymakers. This includes, for example, data on impact of AMR on morbidity, mortality and economy of the country. To this end, the need for engaging with social scientists, national forums, building AMR into national research priorities, and enlisting civil society was recognized.

- Mid-term review of AMR Action Plans, such as the five-year review of the Tripartite agencies' progress on the Global Action Plan on AMR, can help in reallocation and prioritization of funds for implementation of activities. It can further help ensure the accountability that builds political commitment.

2.4 Tackling environmental AMR

The deliberations reflected upon environmental AMR in NAPs and country-level preparedness; waste management, hotspots and AMR linkages; and gaps in national or global technical guidance and standards. The key take-aways are:

- AMR determinants in the environment include antibiotic-resistant bacteria, genes conferring antibiotic resistance, and antibiotic residues. The point sources of concern regarding environmental AMR could include farms, factories and healthcare settings.

- The environment in itself could be a source of AMR because of huge genetic diversity and selection processes occurring in the environment. The environmental reservoir of AMR is likely to be increased by climate change.

- The framing of environmental AMR should be adapted to better communicate the environmental dimensions of AMR necessary to control AMR and prevent drug-resistant infections.

- Environmental AMR is covered in AMR-NAPs of most African and Asian countries. Countries are keen to address the issue, but are struggling with its management. On the one hand, the AMR issue is complex and the evidence building is in progress. On the other hand, it is heavily dependent on surveillance, which is a resource intensive and technically demanding process, and there is limited global guidance to help nations.

- However, the complexity of the issue should not be allowed to act as a barrier to action. There is therefore a need to invest in AMR-NAPs and prioritize implementation of key parts of the AMR agenda including the environmental dimension as part of true One Health action.

- There is enough evidence to justify action. Additional evidence is needed to monitor progress and effectiveness of interventions to guide and refine actions.

- There is a need to develop technical guidance and standards at the global or national level. While this may take time, the environmental agenda cannot be delayed any further. Currently, there are no standards or limits for AMR determinants in waste at the national and global level. Similarly, technical guidance is limited about how to manage waste from farms, factories, households and healthcare settings w.r.t. AMR as well as on how to monitor AMR in the environment.

- In the future, environmental surveillance should expand beyond indicator bacteria to innovative technologies and approaches including genomic research for better understanding of the dynamics of transmission of AMR.

- Controlling environmental AMR should be embedded in existing clean environment mitigation strategies. Addressing issues of basic sanitation and hygiene in healthcare facilities and community can help avoid infectious diseases and the need for antibiotics, thus minimizing antibiotic pollution. Moreover, there are synergies and connections between addressing issues of WASH, AMR, and environmental AMR.

- Since environmental AMR is cross cutting, it is important that the environmental dimensions of AMR become integrated with and strengthen a broader agenda

for preserving our environment rather than remaining siloed as a separate agenda. The consequence of environmental AMR is not specific to AMR alone, but impacts a far broader situation across environmental health.

- The immediate priority of LMICs should be managing waste effectively through affordable waste management approaches at known hotspots such as hospitals and pharmaceutical manufacturing sites. The issue of environmental surveillance, which is resource intensive and technically demanding, must not be allowed to slow down the actions required to address environmental AMR.

2.5 AMR from food production settings (livestock, aquaculture, crops)

The deliberations focussed on understanding the reality of antibiotic growth promoter use; the need to preserve critically important antimicrobials (CIAs); the imperative to address routine antibiotic use for mass disease prevention, which is currently missing; and the need for food-systems transformation and preventive approach as a sustainable solution. Important take-aways from the session are as follows:

Antibiotic use for growth promotion

- The use of antibiotics for growth promotion is a reality, specially in the poultry sector. It is happening because of inadequate regulatory framework, particularly with reference to feed, coupled with lack of awareness among farmers and veterinarians, and push from the feed and antibiotic industry. However, national governments do desire to reduce the misuse of antibiotics in food-animal production. Countries like Pakistan, Malaysia, Philippines, Nigeria, and South Africa have started taking initiatives to phase out/restrict the use of antibiotic growth promoters in food-animal production at varying levels. However, there are also concerns about effective implementation of such restrictions.

- There is also a global momentum to restrict the use of antibiotic growth promoters in food-animals. The reports of the World Organisation for Animal Health (OIE) also show that countries are moving towards banning growth promoter use of antibiotics. But it does not name the countries. There is a need for more transparency about national action which can build confidence in other countries, and allow them to discuss implementation.

Disease preventive use of antibiotics

- Another major concern is the use of antibiotics for disease prevention in food-animal production, which is inadequately addressed in the global guidance despite it being a non-therapeutic use. For example, the report of Inter-Agency Coordination Group (IACG) of 2019 recommends phasing out antibiotic growth promoters but completely misses on antibiotic use for disease prevention, which is the other part of the problem of antibiotic misuse in food-animal production settings. This is despite suggestions made by several civil society stakeholders as part of the consultative process before the recommendations were finalized. In fact, not mentioning antibiotic misuse for disease prevention has further made this misuse more acceptable. It is therefore important that the global agencies involved in shaping up and accelerating global AMR containment efforts take up this issue and suggest necessary action to phase-out disease preventive use of antibiotics.

- The disease prevention use in reality is quite common across sectors and geographies, and could possibly be a big contributor to the overall problem of AMR from the animal sector. Several antibiotics of different classes, including CIAs, are used for disease prevention in different food-animal sectors such as poultry, aquaculture, dairy, swine, etc. Such use is also bound to grow with increasing intensification and add to the growing reservoirs of antibiotic resistance.

- The European Union (EU) plans to restrict the disease prevention use of antibiotics starting January 2022, after having realized that only addressing growth promoter use even after many years of regulatory provisions has still not helped reduce the total antibiotic use. This also suggests that both types of misuse should be addressed together. While the EU step is a way ahead, there are some concerns about how effectively it would be implemented. The dependence on antibiotic use has been high as 65 per cent of antibiotics in Europe are still used in the farm sector, while 88 per cent of antibiotics are used for group treatment.

- Another concern is that an approach similar to what EU is planning requires high levels of regulatory systems and institutions for surveillance, which do not exist in most parts of the world. In practice, in the case of LMICs which typically have limited diagnostic support and weak extension systems, the preventive (prophylactic) use can invariably replace control (metaphylactic) use thereby leading to indiscriminate use of antibiotics.

- The definition of disease prevention as per global agencies such as the World Health Organization (WHO), Food and Agriculture Organization of the United Nations (FAO), OIE and Codex is not coherent. The wording varies which leads to misinterpretation and confusion at the national level and among stakeholders and is often used to support the continued use of antibiotics for disease prevention. There should be a simple and coherent definition of disease prevention (for prophylaxis and metaphylaxis/control), which reflects the need to avoid and phase out such misuse.

- Further, the differing positions of global agencies on disease preventive use of antibiotics adds to the concern. For example, the WHO recommends complete restriction on use of all classes of medically important antimicrobials in food-producing animals for prevention of infectious diseases that have not yet been clinically diagnosed. It further states that CIAs should not be used for control of the dissemination of a clinically diagnosed infectious disease identified within a group of food-producing animals. The OIE, on the other hand, considers 'prevention' and 'control' use as veterinary medical use and recommends to not use only a limited set of CIAs (fluroquinolones, 3rd and 4th generation of cephalosporins and colistin) for prevention, while giving no such recommendation for CIA use to control. There clearly is a need for a coherent and strong position by global agencies that helps phase out the use of antibiotics for disease prevention (prophylaxis and metaphylaxis) in food and livestock sectors.

Use of critically important antimicrobials

- There is not much regulatory action with regard to the use of CIAs in countries, except for colistin in a few countries. CIAs are used not only for treatment but also for non-therapeutic uses such as growth promotion and disease prevention across different sectors such as poultry, dairy, aquaculture, etc. This also includes highest priority CIAs (HPCIAs) belonging to classes such as 3rd and 4th generation cephalosporins and fluoroquinolones, which are extensively used and are increasingly becoming ineffective to treat several infections in humans caused by different bacteria due to growing antibiotic resistance.

- Part of the problem related to CIAs is linked with the lack of clarity and coherence in the message that global agencies are giving to the national governments. For instance, at the global level, there are some antibiotics or antibiotic classes, which are considered critically important both for animal health by OIE as well as human health by the WHO, which also leads to varying position on different CIAs. For example, antibiotics under classes of cephalosporins, macrolides, fluoroquinolones and penicillin are considered critically important for animals and humans. Except penicillin, the other three belong to the category of HPCIAs and, as recommended by the WHO, are not to be used for animals, including in their treatment. This incoherent messaging creates confusion at the country level and needs to be addressed.

- All attempts should be made to conserve CIAs for human health. This includes reducing the need for antibiotics in farms by measures that limit the onset and spread of infection. This also includes identifying and investing in non-chemical, non-antibiotic approaches to manage infectious diseases. Veterinarians should be made aware and enabled to effectively treat diseases, supported by appropriate diagnostics and treatment guidelines as part of stewardship approaches for the animal sector.

- There is need for monitoring the use of antibiotics in food-animal sector in LMIC settings. Countries need to know how to do it in view of different animal/food-animal sectors, crops, antibiotic classes and types of use. Global guidance can be useful.

Transformation of food systems

- There is huge concern about the intensification of agriculture. Intensive farms lead to more disease and eventually more use of antibiotics. There is ample evidence regarding this across different sectors such as poultry, dairy and swine. On the one hand, intensification is leading to more antibiotic use and on the other, the easy access and excessive use of antibiotics as a substitute to better rearing practices is supporting the intensification, which is also linked with inefficient use of land and resources to grow feed for animals. While intensification is believed to help address the future hunger and nutrition needs, excessive dependence on chemicals can jeopardize the health of people and the planet.

- The problem of overuse and misuse of antibiotics should be addressed through the holistic food systems approach. Substantial changes can be made in practice to help lower the use of antibiotics. These changes include access to outdoors, lower stocking densities, use of disease resilient breeds, changing diets, etc. There is evidence in published literature that farming systems with higher animal health and welfare can eliminate most of the antibiotic use. For example,

slower growing broiler breeds (45–49 days of growth) reared with lower stocking density were shown to require much lesser antibiotics as compared to standard broilers (32–40 days of growth) in Netherlands. In Denmark, antibiotic use in organic or free-range pig production was much lesser when compared to intensive production. Similarly, later weaning and less intensive husbandry help achieve much lower antibiotic use in Swedish pigs.

- Further, disease prevention is actually about not allowing the onset of disease in farm animals and focusing on animal health. This is possible without the use of antibiotics through measures such as better housekeeping, use of alternatives, using breeds which are not just meant for productivity, etc. Additionally, factors like appropriate famer education, awareness on good agricultural practices and good veterinary standards for developing countries, incentivization of farmers growing safe food, etc. also play an important role. Veterinarians, paraprofessionals and last mile health workers in animal sector should also be made part of the solution through necessary AMR education and training.

- Alternative options to the use of antibiotics are being explored in different countries. Examples include use of probiotics in Nigeria and use of ethnoveterinary medicines in the Indian dairy sector by the National Dairy Development Board. However, this needs to be supported by good animal care practices and use of disease resilient breeds, among other measures.

- Consumer organizations can also have a greater part to play in pushing for the reduction of antibiotics in intensive food systems. For example, several consumer organizations in the USA came together to put pressure on fast-food multinationals by ranking or scoring them on their antibiotic use in meat supply chain and availability of related policies. This has led to changes and public commitments by several fast-food multinationals to eliminate or reduce the use of certain antimicrobials.

- The debate has now shifted to 'use antibiotics only where it is necessary' and as 'last resort' in animals. It is also evident that the complicated wordings or messages are paving the way for misuse and therefore there is a need to simplify the message. Therefore, in the context of LMICs, regulations need to be made keeping in mind the limited resources in the developing part of the world. The emerging economies must therefore work towards systems that minimize usage of antibiotics, as they do not have resources to enforce complicated regulatory mechanisms that check for zero antibiotic use for growth promotion or disease prevention. Simultaneously, there is a need to transform the food system. It will also help the farmers get the right price.

Antibiotic use in crops

- The use of antibiotics in crops is another big concern. This is happening in many parts of the world but is more prevalent in the United States and in South-east Asia. The antibiotics used are mostly for prophylactic purposes to prevent diseases, and vary according to region. For example, kasugamycin and oxytetracycline were mostly used in South America, whereas tetracycline and streptocycline were the main antibiotics used in South-east Asia. Kasugamycin and oxonilic acid were commonly used in the Western Pacific region. Rice was the most common crop for antibiotic spraying.

2.6 Role of civil society, consumers and media in containing AMR

The deliberations emphasised the critical role civil society, media and consumers can play in influencing the global and national fight against AMR. Key points deliberated upon include:

- Civil society has a catalytic role to play in AMR response w.r.t. policy making and implementation. As they can engage with governments and multiple stakeholders, they can play a significant role in dissemination of information, advocating for change, and creation of awareness across geographies and sectors.

- Civil society holds a unique position in its ability to create positive pressure on governments and also effectively operate under push and pull circumstances. For example: civil society has worked as an important partner with the governments and influenced global governance mechanisms in the context of One Health response to AMR.

- Civil society has a role in bringing credible and verifiable evidence on the table related to topics which are cutting across sectors. Verifiable evidence can form the basis of new networks and partnerships. It can also change consumer behaviour positively.

- Considering the important role of civil society and their contribution to the AMR space, the global civil society community needs to be empowered more as we move ahead in our fight against AMR.

- Schools, colleges, universities, the general public and consumer groups can work as effective catalysts for action. They can act as force multipliers for advocating the need for change and action against AMR.

- The role of media is crucial in generating evidence, informing and engaging with a large audience, and in the dissemination of evidence/information in a credible manner. The media is a powerful ally, provided they are supported and treated with respect. It is therefore necessary to educate and build an important cadre of journalists and provide them with credible information so that they can do justice by the faceless but critical issues like AMR.

- It is important that media communicates AMR in a way such that the issue is not sensationalized. Instead, the focus should be on sensitizing the public. To this end, easy and simple messaging instead of complex jargon can be a useful tool to get the message across. Social media is also a powerful communication tool but needs to be used carefully. Creating fear through public messaging can be counter-productive.

- It is important that media remains sensitive to the cause of AMR once the current wave of pandemic subsides. The media presently is riding on the waves of the ongoing pandemic to take the AMR message across. However, it is important that the media remains mature enough to keep talking and sensitizing the public in the future too.

- Both media and civil society can elevate the perception of risk from AMR among consumers, which is currently low. Building of social trust is crucial to change consumer behavior.

2.7 Country-level expectations from global governance

The deliberations covered several aspects of global governance and national action, including the role Global Leader's Group (GLG) on AMR should play in taking the AMR fight forward. Key points that came up include:

- With health priorities directed towards COVID-19, the already silent pandemic of AMR has now been muted. It is time that the momentum for addressing AMR is re-gained. Learnings from COVID-19 should be leveraged upon to reinstate AMR and shape up future action rather than delaying it further. The 'whole-of-society' and 'whole-of-government' approach adopted in COVID-19 response should be followed.

- AMR should not be seen as only just a health agenda, but more importantly also promoted as a development issue, which if not adequately addressed can jeopardize the attainment of several SDGs. AMR containment therefore requires a larger systems solution and engagement of several UN bodies.

- There is a need for a strong global governance mechanism to stimulate action on AMR. The Tripartite organizations—WHO-FAO-OIE—have taken several initiatives and come out with several plans and evidence-backed guidance as part of their AMR containment efforts since 2015. However effective implementation of such guidance as well as AMR-NAPs at the country level remains sub-optimal, particularly in LMICs. A sustained political will, financial resources, and technical knowhow at the national, regional and global level will be critical.

- Advocacy at the highest level is needed to drive the immediate AMR agenda. Global governance bodies such as the GLG should take a front-facing role in order to promote greater political will and support national level action. The GLG should assume leadership in pushing for a One Heath response to AMR through appropriate collaboration and coordination. It should also work towards integrating stakeholders across the human, animal and environment sectors for this purpose, while also holding actors accountable. All this will further help in exchange among countries, which could be customized as per local context.

- The GLG should seek and ensure that AMR is aligned with other international policies or frameworks on pandemic response. It should weigh in on whether including it as part of pandemic treaty is of strategic value, or whether this could put AMR at risk by making this critical health emergency not visible enough. The need for an effective, ethically fair, and politically feasible AMR treaty was also proposed. This would help incentivize national action and institutionalize accountability for future action. However, the readiness of the world for such a treaty is also a concern.

- The GLG should push for swifter creation and functioning of the Independent Panel on Evidence for Action Against AMR and the Multi-stakeholder Partnership Platform.

- Consistent and coordinated financial support is needed for national action across each of the One Health sectors. Funding allocation needs to be tied up with country needs and prioritized accordingly. Efforts to mobilize existing funding should be made. AMR is a universal health coverage issue, and cannot be addressed without appropriate healthcare financing. A needs-based approach to global financing models, such as the Multi-Partner Trust Fund, should also be considered.

- There is an urgent need to prioritize IPC, AMS and WASH as a majority of infections and need for antimicrobials can be reduced by these approaches. The GLG should heavy-lift these areas and push for integrated action. It should help identify and share best practices related to IPC, AMS and WASH, and also create necessary awareness for bringing about behavior change.

- Capacity building on how to go about developing context-specific, locally relevant interventions to mitigate AMR should also be carried out. This should be coupled with necessary implementation research to facilitate step-wise change in effective implementation of AMR-NAPs. Sharing learnings, data, best-practices and expertise is also important. The GLG should use its convening power to bring people together and facilitate this. In the case of LMICs, such sharing of best practices, technical expertise, and knowledge should be carried out up to district or provincial level. Continued professional development of stakeholders in non-human sectors should also be ensured.

- AMR containment would also benefit from health systems leapfrogging in the area of innovation. This could include innovation in vaccines, environmental issues, diagnostics, as well as participatory approaches to address issues related to behaviour change.

- The global governance bodies should involve and engage civil society organizations. Civil societies have the ability to bring a bottom-up perspective and provide access to people in the community. If embraced, civil societies can help global governance bodies go a long way in supporting effective action on AMR containment.

- The importance of each sector generating their own evidence base is a crucial aspect of One Health response to AMR. This will help stakeholders in each sector understand the issue better and inform policy making appropriately.

- Universal and internationally accepted standards for residual antibiotics in the environment w.r.t. pharmaceutical industry should be developed.

- The importance of surveillance of antimicrobial use and AMR was reiterated. Towards this, there is a need for increased surveillance and better diagnostic tests such that data generated can be used to inform action and make an impact, without allowing it to remain as a research thesis or on paper. Sought funding for such activities should also ask for the use and impact of such data. In addition, there is need for a transparent digital supply chain management system at the country level to help track antimicrobials till their origin. This will not only aid monitoring of antimicrobial use, but also help in preventing misuse of poor-quality antimicrobials.

Annexure

Workshop programme and panel discussants

Inaugural session

Sunita Narain, Director General, Centre for Science and Environment, India
Roderico H Ofrin, WHO Representative to India
Renu Swarup, Secretary, Department of Biotechnology, Ministry of Science and Technology, Government of India
Vinod Paul, Member, NITI Aayog (National Institution for Transforming India), Government of India
Sujith Chandy, Professor, Department of Pharmacology and Clinical Pharmacology, Christian Medical College, India
Amit Khurana, Director, Food Safety and Toxins Programme, Centre for Science and Environment, India

Session: Effective implementation of National Action Plans

Chair: **Anuj Sharma**, Technical Officer-AMR, Lab and IPC, WHO Country Office for India

Lead presenter: **Marc Mendelson**, Chairperson of the Ministerial Advisory Committee on Antimicrobial Resistance, South Africa

Panel discussants:
Tapfumanei Mashe, AMR Coordinator, Medical Laboratory Scientist, National Microbiology Reference Laboratory, Zimbabwe
Otridah Kapona, Head/Technical Manager-Zambia National Public Health Reference Laboratory, AMR National Focal Point & Coordinator, Laboratory Systems & Networks, Zambia National Public Health Institute, Zambia
Rajeshwari Sinha, Programme Manager, Food Safety and Toxins Programme, Centre for Science and Environment, India
Nithima Sumpradit, National AMR Focal Point, Food and Drug Administration, Ministry of Public Health, Thailand
Tep Bengthay, Deputy Director, Department of Animal Health and Veterinary Public Health, General Directorate of Animal Health and Production, Ministry of Agriculture, Forestry and Fisheries, Cambodia
Jyoti Acharya, National Public Health Laboratory, Department of Health Services, Nepal
Wande Alimi, AMR Program Coordinator, Africa Centres for Disease Control and Prevention
Sujith Chandy, Professor, Department of Pharmacology and Clinical Pharmacology, Christian Medical College, India
Chadia Wannous, Regional One Health Officer, OIE Regional Representation for Africa

Session: Political commitment and funding to contain AMR

Chair: **Anthony D So**, Professor of the Practice, Director, IDEA Initiative and ReACT Strategic Policy Program, Department of International Health, Johns Hopkins Bloomberg School of Public Health, USA

Panel discussants:
Mirfin Mpundu, Director, ReAct Africa and ICARS Partnership & Stakeholder Engagement Lead for Africa, Zambia
Markus Moll, Research Advisor and AMR Focal Point, Swedish International Development Cooperation Agency
Sundeep Sarin, Scientist G, Department of Biotechnology, Government of India, India
Suriya Wongkongkathep, Senior Advisor on AMR for the FDA, Senior Expert Committee Member in National Committee on AMR Policy, Ministry of Public Health, Thailand
Suraya Amir Husin, Senior Principal Assistant Director and Head, Infection Control Unit, Medical Development Division, Ministry of Health, Malaysia
Aninda Rahman, Deputy Program Manager-Antimicrobial Resistance, Viral Hepatitis, Diarrhoeal Diseases Control, Communicable Disease Control, Directorate General of Health Services, Bangladesh

Session: Tackling environmental AMR

Chair: **Timothy Jinks**, Head of Drug Resistant Infections Priority Program, Wellcome Trust

Lead presenter: **Rajeshwari Sinha**, Programme Manager, Food Safety and Toxins Programme, Centre for Science and Environment, India

Panel discussants:
Slyvia Yomisi, Head, Environmental Management Agency Laboratory, AMR Focal Point for Environment, Zimbabwe
Jewel Kudjawu, Acting Director, Natural Resource Department, National AMR Focal Point, Environmental Protection Agency, Ghana
Noor Haza Fazlin Hashim, Research Officer, National Water Research Institute Malaysia, Ministry of Environment and Water, Malaysia
Jackie Miamin, Chief Executive Officer, Independent Community Pharmacy Association, South Africa
Will Gaze, Professor of Microbiology, European Centre for Environment and Human Health, University of Exter Medical School, UK
Jacqueline Alvarez, Head, Knowledge and Risk Unit, Chemicals and Health Branch, Economy Division, United Nations Environment Programme
Kate Medlicott, Team Leader - Sanitation and Wastewater, Water, Sanitation, Hygiene and Health Unit, WHO
Shaikh Z Ahammad, Associate Professor, Department of Biochemical Engineering and Biotechnology, IIT Delhi, India
Nicolai Schaaf, Programme Manager, Stockholm International Water Institute, Sweden
Suman Sharma, Director, Sustainable Antibiotics and Brand Communications, Centrient Pharmaceuticals, India

Session: AMR from food-production settings (livestock, aquaculture, crops)—Part 1

Chair: **Sunita Narain**, Director General, Centre for Science and Environment, India

Lead presenter: **Cóilín Nunan**, Scientific Adviser, Alliance to Save Our Antibiotics, UK

Panel discussants:
Varsha Joshi, Chairperson, National Dairy Development Board, India
Moritz van Vuuren, Co-chairperson of the Ministerial Advisory Committee on Antimicrobial Resistance, South Africa
Mwapu Ndahi, National AMR Focal Point, Department of Veterinary and Pest Control Services, Federal Ministry of Agriculture and Rural Development, Nigeria
Alicia A Layson, Head, Registration, Licensing and Certification Section, Animal Feeds, Veterinary Drugs and Biologics Control Division, Bureau of Animal Industry, Philippines
Muhammad Abubakar, National AMR focal point, Ministry of National Food Security and Research, Pakistan
Rohaya binti Mohd Ali, National AMR Focal Point, Ministry of Agriculture and Food Industries, Malaysia
Deepak Bhati, Programme Officer, Food Safety and Toxins Programme, Centre for Science and Environment, India
Sagari Ramdas, Food Sovereignty Alliance, India
Gyanendra Gongal, WHO Regional Adviser for Food Safety, WHO Regional Office for SouthEast Asia
Kinzang Dukpa, Regional Project Coordinator, OIE Regional Representation for Asia and the Pacific
Philip Taylor, Center for Agriculture and Bioscience International, UK
Nimal Jayaweera, Registrar/Veterinary Drugs, National AMR Focal Point, Department of Animal Production and Health, Sri Lanka

Session: AMR from food-production settings (livestock, aquaculture, crops)—Part 2
Chair: **Varsha Joshi**, Chairperson, National Dairy Development Board, India

Lead presenter: **Amit Khurana**, Director, Food Safety and Toxins Programme, Centre for Science and Environment, India

Panel discussants:
Steven Roach, Food Safety Program Director, Food Animal Concerns Trust, USA
Karl Pedersen, Head of Section, Department of Animal Health and Antimicrobial Strategies, National Veterinary Institute, Sweden
Nitya Ghotge, Director, Anthra, India
Cóilín Nunan, Scientific Adviser, Alliance to Save Our Antibiotics, UK
Habibar Rahman, Regional Representative, South Asia, International Livestock Research Institute
Alexandra Vokaty, Team Lead, Communicable Diseases, WHO Country Office for India
Ólafur Valsson, AMR Liaison Officer, Antimicrobial Resistance and Veterinary Products Department, OIE
Emmanuel Kabali, AMR project coordination and technical support specialist, FAO
Amit Balyan, Associate Professor, Sardar Vallabh Bhai Patel University of Agriculture and Technology, Uttar Pradesh, India
Canaan Tinashe Hodobo, Molecular Biology, TBD Vaccine Research & Production, Coordinator of AMR surveillance, AMR focal point for Animal health, Central Veterinary Laboratory, Zimbabwe
Michael Hansen, Senior Scientist, Advocacy, Consumer Reports

Session: Role of civil society, consumers and media in containing AMR
Chair: **Rajeev Sadanandan**, Chief Executive Officer, Health Systems Transformation Platform; Former Additional Chief Secretary (Health), Kerala

Panel discussants:
Johanna B Mallari, Pharmacist IV, Pharmaceutical Division, Health Regulation Team, Department of Health, Philippines
Dooshima Kwange, CEO, Tesedona Foundation for Animal Health, Nigeria
Tapiwanashe Kujinga, Director of the Pan-African Treatment Access Movement & Chair, Technical Working Group on Education and Awareness, AMR Core Group, Zimbabwe
Souparno Banerjee, Senior Director, Outreach and Publications, Centre for Science and Environment, India
Viviana Muñoz-Tellez, Coordinator, Development, Innovation and Intellectual Property Programme, South Centre, Switzerland
Nafis Faizi, Assistant Professor, Department of Community Medicine, Aligarh Muslim University, India
Jyoti Joshi, Head-South Asia, Center for Disease Dynamics, Economics and Policy and Adjunct Professor, Amity Institute of Public Health, Amity University, Noida, India
Niyada Kiatying-Angsulee, Drug System Monitoring & Development Program, Chulalongkorn University, Thailand
Ashok J Tamhankar, National Coordinator, Indian Initiative for Management of Antimicrobial Resistance, India

Session: Country-level expectations from global governance
Chair: **Carlos Correa**, Executive Director, South Centre, Switzerland

Panel discussants:
Sabiha Essack, South African Research Chair in Antibiotic Resistance & One Health, Professor of Pharmaceutical Sciences and Director, AMR Unit, College of Health Sciences, University of KwaZulu-Natal, South Africa
Lata Kapoor, Joint Director, Division of Microbiology, National Center for Disease Control, India
Tochi Okwor, Programme Coordinator, Antimicrobial Resistance and Infection Prevention and Control, Head Special Programs Division, Prevention Programs and Knowledge Management Department, Nigeria Centre for Disease Control, Nigeria
Joseph Nkhoma, Department of Animal Health, Ministry of Agriculture, Irrigation and Water Development, Malawi
Andreas Sandgren, Director, ReAct Europe
Niniola Williams, Managing Director, Dr Ameyo Stella Adadevoh Health Trust, Nigeria
Aitziber Echeverria, Programme Management Officer, Knowledge and Risk Unit, Chemicals and Health Branch, Economy Division, United Nations Environment Programme
Divya Singh, Programme Officer, Food Safety and Toxins Programme, Centre for Science and Environment, India
Wendmnew Abrie Mekonnen, Senior Expert, Biosafety Regulation Directorate, AMR Focal Point for Environment, Environment, Forest and Climate Change Commission, Ethiopia

Concluding session

Anuj Sharma, Technical Officer-AMR, Lab and IPC, WHO Country Office for India
Anthony D So, Professor of the Practice, Director, IDEA Initiative and ReACT Strategic Policy Program, Department of International Health, Johns Hopkins Bloomberg School of Public Health, USA
Timothy Jinks, Head of Drug Resistant Infections Priority Program, Wellcome Trust
Sunita Narain, Director General, Centre for Science and Environment, India
Amit Khurana, Director, Food Safety and Toxins Programme, Centre for Science and Environment, India
Ólafur Valsson, AMR Liaison Officer, Antimicrobial Resistance and Veterinary Products Department, OIE

Expert discussants

Abiodun Eegwuenu, Field Epidemiologist, Nigeria Center for Disease Control, Nigeria
Aravind R, Head, Department of Infectious Diseases, Government Medical College, India
Asnakech Alemu, Director, Product Safety Directorate, Ethiopian Food and Drug Authority, Ethiopia
Ayomikun Fatoki, Programme Associate, Dr. Ameyo Stella, Adadevoh Health Trust, Nigeria
Bashiru Boi Kikimoto, Veterinary Public Health Specialist Consultant, Head of National Food Safety/AMR Reference Lab for Animal Health, AMR Technical Lead for Animal Health, Veterinary Services, Ministry of Food and Agriculture, Ghana
Celda Tiroyakgosi, AMR Focal Point, Ministry of Health and Wellness, Botswana
Chee Liung Wun, Malaysian Veterinary Medical Association, Malaysia
Cristiano Macuamule, Lecturer, Veterinary Faculty, Eduardo Mondlane University, Mozambique
Edmund Choo, Assistant Director, Regulatory Policy Department, Food Regulatory Management Division, Singapore
Estelle Mbadiwe, Founding Partner, Ducit Blue Solutions, Nigeria
Farzana Altaf, Director General, Environment Protection Agency, Pakistan
Fernando Rodrigues, Head, Veterinary Public Health, AMR Focal Point for Animal Health, National Veterinary Directorate, The Ministry of Agriculture and Rural Development, Mozambique
Firdaus Jahan, Technical Officer (Science & Standards), Food Safety and Standards Authority of India, India
Fransina Nambahu, National AMR Focal Points on AMR, Ministry of Health and Social Services, Namibia
Hazimah Hashim, Senior Principal Assistant Director (Pharmacist), Pharmacy Practice & Development Division, Ministry of Health, Malaysia
Inder Jeet, PhD Scholar, Department of Medical Microbiology, PGIMER, Chandigarh, India
Irene Ouoba, Regional Antimicrobial Resistance (AMR) Coordinator and FAO AMR Focal Person, Sub-Saharan Africa, FAO Regional Office for Africa
Janine Jugathpal, Deputy Director, Essential Drug Programme, National Department of Health, South Africa, South Africa
Japheth Opintan, Senior Lecturer, Department of Medical Microbiology, National AMR Focal Points for Human Health, University of Ghana, Ghana
Jitendra Sharma, Associate Programme Management Officer, UNEP India
Juline Chua, Veterinarian, Animal and Veterinary Service, National Parks Board, Singapore

Kefentse Motshegwa, Focal point on Veterinary products and AMR, Department of Veterinary Services, Ministry of Agricultural Development and Food Security, Botswana
Kornelia Kandjumbwa, National Animal Health AMR-Focal Point, Chief Veterinarian: Food Science Subdivision, Central Veterinary Laboratory, Division of Diagnostic Services, Directorate of Veterinary Services, Ministry of Agriculture, Water and Land Reforms, Namibia
Kumar Rajan, Consultant-AMR and IPC, WHO Country Office India
Lukas Lipumbu, Head of Toxicology and Residues Analysis Section at CVL, Diagnostic Services Division, Khomas Region, Namibia
M N Balakrirshan Nair, Emeritus Professor, School of Health Sciences, TransDisciplinary University, India
Mark Obonyo, AMR Regional Coordinator and Technical Consultant for Zimbabwe, FAO Sub-regional Office for Southern Africa
Mary Gordoncillo, Regional Project Coordinator, FAO Regional Office for Asia and the Pacific
Miguel Salazar, UNEP Regional Consultant for AMR for Asia and the Pacific
Mira Shiva, Initiative for Health & Equity in Society, All India Drug Action Network, India
Mirza Alas, Programme Officer, Health, Intellectual Property and Biodiversity, South Centre, Switzerland
Moreen Muluti, Veterinarian in Food Hygiene Section at CVL, Diagnostic Services Division, Khomas Region, Namibia
Noor Amelia Abd Rasid, Principal Assistant Director, AMR Secretariat, Medical Development Division, Ministry of Health, Malaysia
Okea Rita, Assistant Director and Head, Environmental Health and Sanitation, Federal Ministry of Environment, Nigeria
Pidemnewe Pato, OIE Africa Regional One Health Officer and Regional Coordinator of the REDISSE Project
Prateek Sharma, Research Associate, IDEA Initiative and ReAct Strategic Policy Program, Department of International Health - Health Systems, Johns Hopkins Bloomberg School of Public Health, USA
Ravneet Kaur, Centre for One Health, GADVASU, India
Renatus Shilangale, Diagnostic Division, Head of Food Hygiene Section at CVL, Khomas Region, Namibia
Robin Paul, Quality Manager, State Laboratory for Livestock, Marine and Agri Products, Department of Animal Husbandry, India
Ruth Lancaster, Essential Drugs Programme, National Department of Health, South Africa
Sabah Courage, University for Development Studies, Department of Biotechnology, Ghana
Salina Manandhar, Chief and Senior Veterinary Doctor, Veterinary Public Health Office, Department of Livestock Services, Nepal
Samir Kumar Rana, General Manager (Animal Health), National Dairy Development Board, India
Sangay Norbu, Environment Officer, Environment Assessment and Compliance Division, Bhutan
Sangeeta Sharma, Professor and Head, Department of Neuropsychopharmacology, Institute of Human Behaviour & Allied Sciences, President (Honorary), DSPRUD, India
Shivam Kapoor, Technical Advisor-M&E, International Union Against Tuberculosis and Lung Disease, India
Shujaullah Dost, Head of AVPL, Focal Point for AMR, Afghanistan

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Siswanto S, Senior Advisor on AMR, WHO SEARO
Sokerya Seng, National Project Coordinator on AMR, Emergency Center for Transboundary Animal Diseases, FAO, Cambodia
Sonam Wangda, Deputy Chief Laboratory Officer, Health Care & Diagnostic Division, Department of Medical Services, Ministry of Health, Bhutan
Sweety Behera, Director(Science & Standards), Food Safety and Standards Authority of India, India
T Tenzin, OIE Sub-Regional Representation for Southern Africa, Botswana
Tebogo P Madidimalo, National Professional Officer (HIV, TB, STI, Hepatitis, AMR), WHO Botswana Country Office, Botswana
Tracey Mubambi, Laboratory Scientist, Environmental Management Agency, Zimbabwe
Tulsi Ram Gompo, Veterinary officer, Department of Livestock Services, Nepal
Varghese C Thomas, Chief sub-editor, Malayala Manorama, Kottayam, Kerala, India
Watipaso Kasambara, Antimicrobial Resistance Coordinator, Public Health Institute of Malawi, Ministry of Health, Malawi
Yann Ferrisse, Business Development Head Global Antibiotic Research & Development Partnership, Switzerland
Yeshi Dorji, Assistant Environment Officer, BLUD, Bhutan

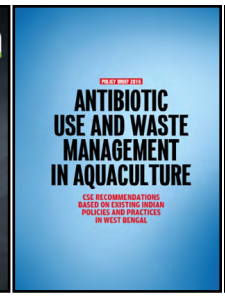
Workshop, research, and report compilation and writing

Amit Khurana, Programme Director, Food Safety and Toxins, Centre for Science and Environment, India
Rajeshwari Sinha, Programme Manager, Food Safety and Toxins, Centre for Science and Environment, India
Deepak Bhati, Programme Officer, Food Safety and Toxins, Centre for Science and Environment, India
Divya Singh, Programme Officer, Food Safety and Toxins, Centre for Science and Environment, India

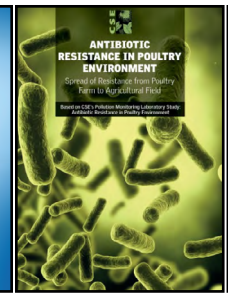
CSE's work on AMR in food systems and environment: India

Antibiotics in honey, 2010

Antibiotic use in poultry, 2014



Antibiotic use in aquaculture, 2016



AMR in poultry environment, 2017

Antibiotic use in fast food supply chain, 2017

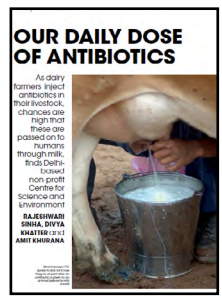
Disposal of pharma manufacturing waste, 2017

Antibiotic use in crops, 2019

Disposal of unwanted drugs, 2019

Antibiotic use in feed, 2020

Antibiotic use in fast food supply chain, 2020

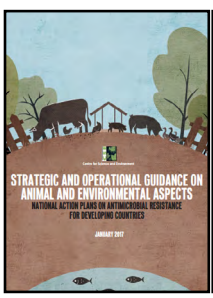


Antibiotic use in dairy, 2020

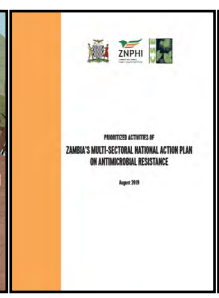
Body Burden, 2020

Use of ethnoveterinary medicines in dairy sector, 2021

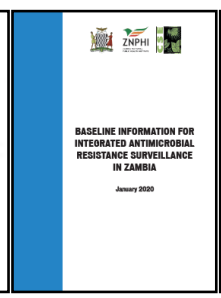
CSE's work on AMR in food systems and environment: Global



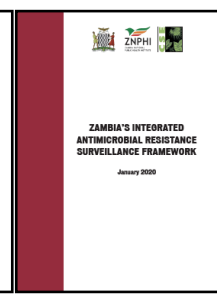
Strategic guidance for NAP for developing countries, 2016



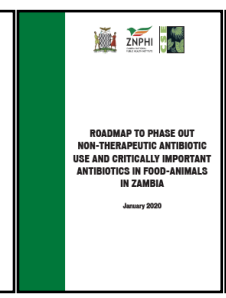
Prioritized NAP-AMR (Zambia, 2019)



Baseline information for Integrated AMR surveillance (Zambia, 2020)

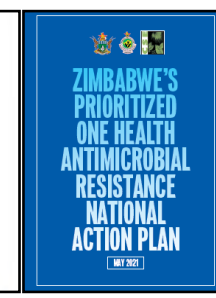


Framework for Integrated AMR surveillance (Zambia, 2020)



Roadmap to phase out antibiotic misuse in food-animals (Zambia, 2020)

Framework for drug take-back and EPR (Zambia, 2021)



Prioritized NAP-AMR (Zimbabwe, 2021)

The report presents key take-aways from the deliberations held at the Africa-Asia Virtual Workshop on Containing the Silent Pandemic, organized by the Centre for Science and Environment in March 2021. It provides the perspective of countries of the Global South, and is expected to inform and shape-up the governance as well as policy-making processes at the global and national level.

A publication of CSE

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