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One Health Action to Prevent and Contain AMR in Indian States and Union Territories

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Acknowledgement
This report is based on the multi-sectoral One Health action discussed and suggested by officials from several state government departments like health, animal husbandry, agriculture, pollution control, food and drugs, as well as scientific experts from these One Health sectors over a three-day national workshop on State Action to Contain Antimicrobial Resistance (AMR), organized by the Centre for Science and Environment (CSE) and the World Health Organization (WHO) Country Office for India in 2022.

CSE and WHO thank all stakeholders for their active participation during the workshop and contribution to this report.

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List of abbreviations

AKCDA	All Kerala Chemists and Druggists Association
AMR	Antimicrobial Resistance
AMRSN	Antimicrobial Resistance Surveillance and Research Network
AMS	Antimicrobial Stewardship
ANM	Auxilary Nurse and Midwife
API	Active Pharmaceutical Ingredient
AP-SAR	Andhra Pradesh Surveillance of Antimicrobial Resistance
ASHA	Accredited Social Health Activist
AST	Antibiotic Susceptibility Testing
BMD	Broth Microdilution
BMWM	Biomedical Waste Management
CETP	Common Effluent Treatment Plant
CIA	Critically Important Antimicrobial
CLSI	Clinical and Laboratory Standards Institute
CSE	Centre for Science and Environment
DDD	Defined Daily Dose
DeNSAR	Delhi Network for Surveillance of Antimicrobial Resistance (founded as WINSAR-D)
EVM	Ethnoveterinary Medicines
FAO	Food and Agriculture Organization of the United Nations
FHC	Family Health Centre
FPP	Finished Pharmaceutical Products
G20	Group of Twenty
GASP	Gonococcal Antimicrobial Surveillance Program
GBRC	Gujarat Biotechnology Research Centre
HICC	Hospital Infection Control Committee
HIV	Human Immunodeficiency Virus
HPCIA	Highest Priority Critically Important Antimicrobial
ICAR	Indian Council of Agricultural Research
ICMR	Indian Council of Medical Research
ICN	Infection Control Nurse
IEC	Information, Education and Communication
IMTA	Integrated MultiTrophic Aquaculture
IMTECH	Institute of Microbial Technology
INFAAR	Indian Network for Fisheries and Animal Antimicrobial Resistance
IPC	Infection Prevention and Control
IVRI	Indian Veterinary Research Institute
JETL	Jeedimetla Effluent Treatment Limited
KARS-NET	Kerala Antimicrobial Resistance Surveillance Network

KSPCB	Kerala State Pollution Control Board
LSGD	Local Self-Government Department
MAHASAR	Maharashtra Surveillance of Antimicrobial Resistance
MPEDA	Marine Products Export Development Authority
NABH	National Accreditation Board for Hospitals and Healthcare Providers
NADCP	National Animal Disease Control Program
NADRS	National Animal Disease Reporting System
NAPAMR	National Action Plan on AMR
NARS-NET	National Antimicrobial Resistance Surveillance Network
NBFGR	National Bureau of Fish Genetic Resources
NCCS	National Center for Cell Science
NCDC	National Centre for Disease Control
NDDB	National Dairy Development Board
NGO	Non-Governmental Organization
NITI	National Institution for Tranforming India
PARS-NET	Puducherry Antimicrobial Resistance Surveillance Network
PM-ABHIM	Pradhan Mantri Ayushman Bharat Health Infrastructure Mission
PMMSY	Pradhan Mantri Matsya Sampada Yojana
PPS	Point Prevalence Survey
PROUD	Programme on Removal of Unused Drugs
RDDL	Regional Disease Diagnostic Laboratory
SAP-CARD	State Action Plan to Combat Antimicrobial Resistance in Delhi
SIDA	Swedish International Development Cooperation Agency
SOP	Standard Operating Procedure
TDS	Total Dissolved Solid
TDU	Trans-Disciplinary University
UT	Union Territory
WAAW	World AMR Awareness Week
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization
WINSAR-D	WHO-IAMM Network for Surveillance of Antimicrobial Resistance in Delhi
ZLD	Zero Liquid Discharge

One Health experts and multi-sectoral stakeholders at the CSE-WHO National Workshop on State Action to Contain Antimicrobial Resistance, 2022 | Anil Agarwal Environment Training Institute, Neemli, Rajasthan

Message from Sunita Narain

Antimicrobial resistance (AMR)—antibiotic resistance in particular—is recognized as a silent pandemic. Global understanding on the scale of damage it can lead to is now more than ever. We know that this is no longer just about lifesaving antibiotics becoming ineffective, which will lead to greater human suffering. But this is also about the negative impact it will have on food security, livelihood and development challenges. We also now know the causes better. It is not just the misuse and overuse of antibiotics in the human-health sector, but also in the food-animal and crop production settings. Similarly, the role of wastes such as from farms and factories is becoming clear.

The AMR crisis certainly needs a multi-sectoral coordinated response. After the COVID-19 pandemic, the animal-human-environmental interface is getting the attention it deserved. The way ahead charted out is to prevent and respond to global health threats like pandemics, zoonotic diseases and AMR through the 'One Health' approach. The G20 leaders also recently committed to it.

India did very well to incorporate multi-sectoral intervention in its national action plan to contain AMR (2017–21). Subsequently, the Delhi Declaration on AMR also correctly emphasized on the need for action by states and Union Territories for an effective response. But like in many other countries, a lot needs to be done.

Firstly, our response should be much stronger in the food, livestock, crops as well as in the waste management sectors. It should no longer remain largely focused on human health. Secondly, as animal husbandry, fisheries, agriculture and pollution control are best managed at the local level, states and Union Territories should act through a coordinated multi-sectoral response. As of now, only few states have their plans and many others need to come forward. But all such plans or actions should be prioritized based on local context and adequately supported for effective implementation.

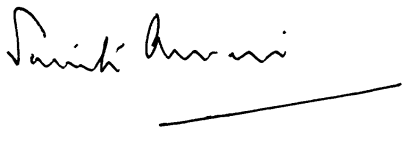
With the overall goal to keep antibiotics effective for current and future generations, specific actions in the non-human sectors should aim to fix the way we produce our food and manage the waste, while making integral the approaches that are more suited to our context.

For example, states should move towards food production systems which are less dependent on chemicals or antibiotics. This should be the '**development approach'** which could also mean more food from small and local decentralized farms than intensive industrial systems, which also add to concerns related to pollution, climate change and biodiversity. India's successful Dairy Cooperative model has shown how we can produce one-fifth of the global milk through millions of small farmers who are also supported in their livelihoods. The model also shows how the use of ethnoveterinary medicines has reduced use of antibiotics.

States also need to invest in the **'prevention approach'** so that there is less disease at farms and need for antibiotics is reduced in farms as well as the need for expensive waste management practices in farms and factories. While we need to promote animal waste as manure for better circularity of resources and their efficiency, we also need to make sure that such waste is made AMR safe. The **'conservation approach'** means that we discourage animal use of antibiotics which are critical for human health and used in hospitals to save lives. It also means that antibiotics are not used for growth promotion and in the name of disease prevention. The **'environment approach'** should include focus on monitoring, generating less waste and cost-effective waste management.

Several states in India produce huge quantity of food from animal and crops. Many also produce antibiotics. AMR in India can be effectively contained if states and Union Territories play a key role. State government departments of animal husbandry, fisheries, agriculture, food and drugs should take a lead and work together with the human-health sector.

We need a truly One Health approach in states for an effective nation-wide response to the AMR crisis that can impact all of us in future.



Sunita Narain
Director General, Centre for Science and Environment and Member, Global Leaders Group on AMR

Message from Roderico H. Ofrin

Antimicrobial resistance (AMR) is a complex multi-dimensional and inter-sectoral public health challenge that has been declared as one of the top 10 global public health threats facing humanity. In 2019, The Lancet estimated 4.95 million deaths were associated with AMR globally, of which 1.27 million deaths were attributed to bacterial AMR infections. By 2050, AMR is projected to lead to 10 million deaths globally every year. Of these AMR-related deaths, 2 million deaths are projected to occur in India every year.

Containment and prevention of AMR requires concerted efforts across sectors (human, animal health, food and environment) and levels (national, sub-national and community). AMR containment through a One Health approach is a global priority, endorsed by the World Health Assembly, United Nations, the Quadripartite, and the Global Leaders Group on AMR. India's National Action Plan on Antimicrobial Resistance (NAP-AMR) and the Delhi Declaration on AMR 2017 endorsed by 12 Union ministries underscores Government of India's commitment to address AMR using a One Health approach.

The NAP-AMR envisages the development of State Action Plans for Containment of AMR (SAPCAR) for intersectoral collaboration at the state level by bringing together human health, animal health, agriculture, fisheries, environment (water and sanitation) departments, which are state subjects under the Indian constitution. SAPCARs serve as a roadmap for state governments to address AMR by comprehensively integrating actions across human health, animal health, food safety, environmental science and the community.

These plans emphasize responsible antibiotic use, robust surveillance, infection prevention and control, research and innovations, and raising AMR awareness at the community level with active stakeholder participation. SAPCARs enable governments to allocate resources effectively, prioritize interventions, and adapt strategies to their unique local settings. They empower local stakeholders, including healthcare providers, farmers, and researchers, to take collective responsibility for curbing AMR.

As of 2023, four states have developed/implemented SAPCARs – Kerala, Madhya Pradesh, Delhi and Andhra Pradesh – and many more states are at various stages of developing their plans. To address the multiple challenges for effective state-level action, Centre for Science and Environment and WHO organized a national workshop to support state-level stakeholders for the development and implementation of SAPCAR in August 2022. The goal of the workshop was to provide evidence-based information and updates to the participants to support the development of SAPCARs in their respective states and encourage cross-learning among different sectors and states.

This report outlines the key experiences and learnings from the workshop to support states develop their respective SAPCARs. I look forward to this document serving as an important reference and guide for states; and helping them seize opportunities, preempt challenges and leverage intersectoral solutions as they progress towards developing and implementing their respective SAPCARs.

Dr Roderico H. Ofrin
World Health Organization
Representative to India

1. One Health action in states and UTs to effectively prevent and contain AMR

Approach

The report presents One Health actions that can be considered by states and UTs to prevent and contain antimicrobial resistance (AMR). These actions reflect key takeaways from the deliberations undertaken by multi-sectoral experts and stakeholders at the CSE-WHO joint workshop. The deliberations aimed at identifying actions which are not only implementable and impactful, but also cost-effective.

These actions were collectively suggested by stakeholders from four groups i.e., human health; livestock and crops; fisheries; and environment. They are presented in line with four strategic objectives of India's National Action Plan on AMR (NAP-AMR) (2017–21)[1]:

- Improve awareness and understanding of AMR through effective communication, education, and training
- Strengthen knowledge and evidence through AMR surveillance
- Reduce the incidence of infection through effective infection prevention and control
- Optimize the use of antimicrobial agents in health, animals and food

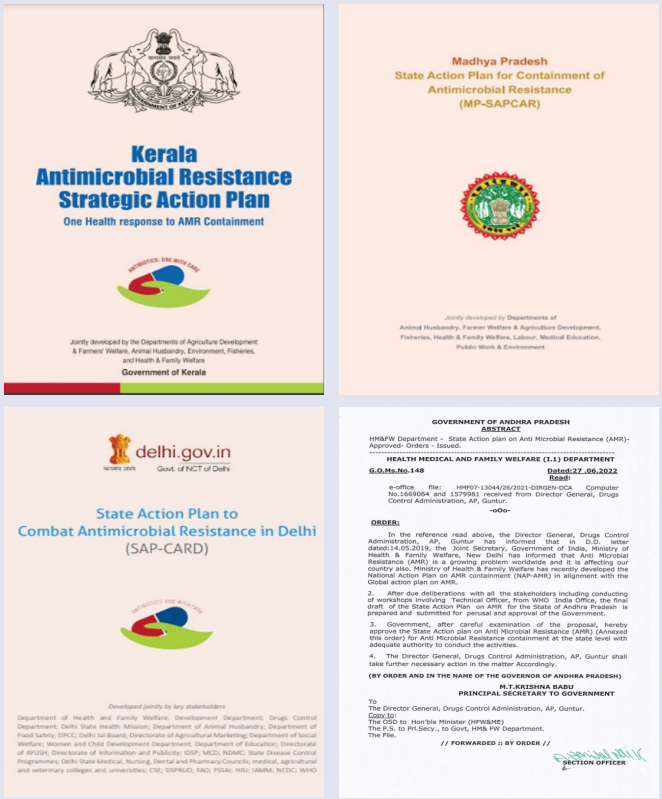
The report also highlights governance prerequisites for effective action in states and UTs and select initiatives adopted in states to prevent and contain AMR.

It should be noted that a few actions outlined by stakeholders of a particular sector are applicable to other sectors but are not repeated. A few others are similar but mentioned to reflect the group's emphasis.

State Action Plans for Containment of Antimicrobial Resistance (SAPCAR)

India's National Action Plan on AMR prioritizes the development of State Action Plans for Containment of Antimicrobial Resistance (SAPCAR) since inter-sectoral collaboration in states is essential for AMR containment at the ground level. The Ministry of Health and Family Welfare with support from WHO India, shared the Guidance to Develop State Action Plans for Containment of Antimicrobial Resistance.

Currently, four states have SAPCARs—Kerala, Madhya Pradesh, Delhi and Andhra Pradesh—based on their local needs and priorities. These plans which are at different stages of implementation, were prepared in consultation with government and non-government stakeholders from One Health sectors such as animal husbandry, agriculture, environment and health. Three more states have drafted their state action plans—Maharashtra, Rajasthan and Sikkim— and expect to launch them soon. Many other states are in various stages of developing their SAPCAR. As more states commence their journey of developing SAPCARs it is important to understand their challenges and experiences for effective state level action on AMR.



State action plans released by *Kerala*, *MP*, *Delhi* and Andhra Pradesh

2. Governance prerequisites for effective action in states and UTs

- Ensuring **greater recognition and ownership of AMR** by all relevant sector stakeholders with dedicated resources and funding, to the extent possible.

- Adoption of a **top-down approach** to enable a senior bureaucrat/policymaker to push the AMR agenda.

- **Coordination of state action plans by a higher authority** to ensure joint ownership, involvement and collaboration between all sectors, as well as between states, districts and block levels. For e.g., the NITI Aayog or the Principal Scientific Advisor or the Cabinet Secretary coordinating at the national level and Chief Minister at the state level.

- Establishment of a **One Health AMR cell** at the state level along with **development of a One Health platform** with multiple focal points from different sectors. This platform, headed by a working committee, can help overcome excess reliance on a single person for a sustained focus on AMR-related activities and withstand changes in presiding authorities.

- Optimal **utilization of existing structures** as **dynamic administrative structures** (for resource pooling and governance) and **stable institutional structures** (for sustained implementation) to drive the AMR agenda.

- **Leveraging upon existing framework of e-learning platforms and other technology-based tools** like the dashboard developed during the COVID-19 pandemic, or the integrated health information platform and similar platforms, if any for livestock, fisheries, food and environment sectors.

- **Information sharing between different disease specialties or programs** in India such as national programs on leprosy, malaria, HIV, hepatitis and tuberculosis as well those related to animal health and disease surveillance.

Stakeholders attending a session at the CSE–WHO 2022 workshop

- Development of a **One Health AMR research agenda,** encompassing the role of different stakeholders and sectors.

- Mechanisms to support and ensure **implementation of policies, regulations and guidelines**.

3. Create awareness and education

3.1 Across One Health Sectors

- **Identify and map target audience groups** for awareness creation and education separately. For example, target audience for awareness creation could be consumers, antibiotic sellers, entrepreneurs, civil society organisations, community-based organisations and resident welfare associations, policy makers and bureaucrats. Target audience for education could be regulators, medical and para-medical professionals, medical councils, medical students, frontline health workers like Accredited Social Health Activists (ASHAs), Auxiliary Nurse and Midwives (ANMs), Anganwadi workers, community health officers and public health nurses; antibiotic prescribers, veterinarians, para-veterinarians, farmers and producers; drug manufacturers, researchers and waste management companies.

- Develop **precise and clear messaging for public awareness** through slogans, short films, jingles, and public interaction platforms like social media. Use survivor stories or case studies to make AMR easy to understand. Develop a repository of AMR resources at national, state and institutional levels which can be adapted for local messaging.

- Encourage **use of latest technologies and social media** for sharing of information and best practices and increasing outreach of messages and guidelines related to AMR.

- State government departments should share AMR awareness messages through use of **information, education and communication (IEC) materials** like publications and leaflets among healthcare professionals, veterinarians, extension officers, etc. and also through **advertisements** such as on radio, television, newspapers, public transport and medical stores. Awareness messages or advisories can also be displayed on **department websites** in English and/or local languages.

- State government departments, including state-level medical/veterinary hospitals or universities or training centres should run **AMR awareness, education and training programs**. These can include awareness of antibiotic

supply chain, prescription sale of antibiotics, judicious antibiotic use in farms, better farm management, AMR and food safety linkages, antibiotic residues in food, etc. These programs should also include sectoral interconnectedness of AMR and intervention needs.

- **Observe World AMR Awareness Week** (**WAAW**)—earlier known as World Antimicrobial Awareness Week—at the department, university, college and school levels. Use WAAW to involve and sensitize antibiotic supply chain partners such as manufacturers, dealers, sellers, users and consumers such as farmers and common people.

- **Mainstream AMR understanding in education** in schools, colleges and universities through sensitization campaigns and dedicated chapters.

3.2 Human health

- **Identify AMR containment with its own logo, mascot, slogan and ambassador or give AMR a "face"**. It should be considered a **Personal Social Responsibility** to build accountability in every citizen.

- Develop a **state-level behavioural change communication strategy** based on operational research and behaviour science.

- Identify **AMR focal points and AMR champions** such as influencers, celebrities, opinion leaders and government advisors at state/province/community levels to drive AMR awareness agenda.

- Establish **AMR committees** at state, district, block and institutional levels.

- Identify a **set of key AMR awareness activities for the public**. This can include making AMR slogans and posters, conducting essay competitions at school or college levels. Awareness can be raised through Integrated Child Development Services Scheme[2], Rashtriya Bal Swasthya Karyakram[3] mothers' meetings, hospital management information system for public health facilities (e.g., e-Upchaar hospital management information system of Haryana) along with outpatient ID generation.

- Identify a **set of key activities to educate and train medical and technical staff in AMR**. This can include holding continued medical education sessions on AMR for medical, nursing and pharmacy professionals; implementation of clinical pharmacology through other specialties like medicine, paediatrics,

AMR awareness among school children in Delhi[4]

The Delhi Society for Promotion of Rational Use of Drugs (DSPRUD) has been actively involved in implementation of the Strategic Objective 1 of the State Action Plan to Combat Antimicrobial Resistance (SAP-CARD) in Delhi. The society organizes awareness campaigns for school students during the WAAW. In 2019, over 600,000 students from 1,041 Delhi government schools participated in the campaign. In 2020, due to the COVID-19 pandemic, it engaged online with 3,500 teachers and 350,000 students. About 45,000 students engaged in quiz competitions and 5,000 participated in an online 'IDEAthon,' with evaluations and rewards based on content, creativity and relevance to the theme. In 2022, a targeted three-month-long online awareness campaign was launched, involving approximately 180 school teachers (47 per cent from public schools). It covered understanding of microorganisms and AMR; factors driving AMR, sanitation, hygiene, infection prevention; and optimizing antimicrobial use in humans and animals, emphasizing the One Health approach.

Online school education campaign for WAAW 2020

Source: DSPRUD

Art made by students during school education campaign for WAAW 2020

community medicine and public health; inclusion of 4–5 questions on AMR in medical and post-graduate entrance examinations, etc.

3.3 Livestock (mainly chickens, cattle, buffaloes, goats and sheep)

- Generate **awareness among farmers and farm workers on prudent use of antibiotics and AMR** in rearing animals for food. This should include aspects like biosafety, biosecurity, vaccination, infection prevention and control (IPC),

safe disposal of antibiotics and biomedical waste, farm and farm equipment hygiene, farm management practices, and benefits of using alternatives like ethnoveterinary medicines (EVMs).

- Develop a '**dos and don'ts' list as implementable action points for farmers** with a focus on aspects which can help prevent infections and reduce antimicrobial use.

- Organize **farm visits to demonstrate** best practices of reducing antibiotic use, using point of care diagnostics. If possible, **farmer visits to state laboratories** can also be considered to demonstrate residue detection and Antibiotic Susceptibility Testing (AST).

- **Include AMR as part of professional education curriculum** such as prescribed by the Veterinary Council of India and followed at national and state-level universities teaching animal husbandry.

- Train veterinarians and para-veterinarians periodically or through a **continuous veterinary education program** for refreshing and consolidating existing and new knowledge, which can be facilitated by state-level veterinary councils, agriculture universities, training centres, as well as civil society.

- Develop **IEC materials for effective communication and behavioural change** such as among livestock farmers, veterinarians, para-veterinarians and animal husbandry extension officers.

3.4 Fisheries

- **Integrate AMR in awareness programs** on good aquaculture and farm management practices.

- **Sensitize local fishermen and farmers** on side effects of antibiotic use in fish farming. Farmers should be made **aware of implications of routine and non-therapeutic use of antibiotics** in cage culture in reservoirs. Use of antibiotics for prevention (prophylactic use) should be discouraged.

- Marine sector farmers should know about **hygienic handling of fish and fishery products**. Shrimp farmers should be encouraged to **use only products which are registered for aquaculture use**.

- Farmers must be trained to **maintain logbooks or records** of aqua drugs used and farm management measures adopted.

3.5 Crops

- Farmers should be sensitized on **prudent use of chemicals, including antibiotics in crops and its implications** through state agriculture universities, Krishi Vigyan Kendras, and camps at the district, block and village levels.

- Educate **agriculture extension workers/Krishak Mitra and pesticide and insecticide dealers on AMR and the prudent use of chemicals including antibiotics** through similar training and awareness camps. **Identify master trainers** to further spread the knowledge on AMR.

- **Include AMR as part of professional education curriculum** such as prescribed by the National Institute of Agricultural Extension Management (MANAGE), and Extension Education Institute at Anand Agricultural University.

3.6 Waste and environment

- Create **awareness** on point and non-point sources that can contribute to AMR and role of waste management and IPC to limit environmental dissemination of AMR determinants (resistant bacteria, resistance conferring genes, antibiotics).

- Create **public campaign on segregation and safe disposal of unused/ expired medicines/antibiotics** (such as through instructions on medicine package).

- Create awareness among pharmaceutical manufacturers about **waste management strategies for eliminating antibiotic pollution.** For example, medium and large manufacturers are sensitized about true zero liquid discharge (ZLD) approach, while small players are conveyed the importance of sending effluents to common effluent treatment plants (CETPs) after primary treatment (such as through sodium hydroxide-based deactivation in the case of β-lactam antibiotics).

The Antibiotic Literate Kerala Campaign

Kerala is campaigning to become an antibiotic literate state. Towards this, the state is taking several initiatives, which include IEC activities such as preparing awareness messages in Malayalam, releasing an AMR flip book and IEC dossier, media engagement through visual and print mediums, and trainings. As part of this campaign, the departments of animal husbandry and fisheries have also released their messages for farmers. A drug inspector has been identified as the nodal officer in each district to coordinate awareness creation among pharmacists. Indian Medical Association, Association of Physicians of India and Indian Academy of Paediatrics are also actively engaged in this campaign. A special fast-track plan has been formulated to make Kerala a fully antibiotic literate state.

In August 2023, Kerala became the first state in India to establish block-level AMR Committees in all 191 blocks. Earlier, district-level AMR committees had been established in all districts. These block level committees have been formed in collaboration with the departments of health, animal husbandry, fisheries, agriculture and environment, with support from the WHO. They are sub-district bodies to disseminate the mandates on AMR programs in the field and among healthcare professionals. The committees will also monitor AMR related activities happening in local self-government departments (LSGD) under the block, including in urban areas. Block medical officers will serve as the focal points of these committees.

SOURCE: KERALA GOVERNMENT

AMR classes at antibiotic-smart family health centre (FHC), Kerala as part of the Antibiotic Literate Kerala campaign

Launch of AMR resources for IEC by Kerala Health Minister Veena George (Source: WHO India)

4. Conduct surveillance—antibiotic resistance and antibiotic residues

4.1 Across One Health Sectors

- **Periodic monitoring and reporting of antibiotic resistance and antibiotic residues, wherever applicable** by concerned state government departments should be the aim. Data from monitoring can be analysed with respect to different parameters such as quantum of use, pattern of usage (misuse, abuse), method of usage (with or without prescription), species specific usage in livestock or aquaculture and correlated with current antibiotic resistance trends in humans and animals. The data may also be used to understand the transmission patterns of AMR determinants.

- **Identify state-level or reference laboratories** to conduct monitoring; develop **state-level surveillance networks** which include both public and private laboratories. **Strengthen microbiology laboratories** in all sectors to facilitate antibiotic resistance surveillance. Separate budgets should be allocated to strengthen district laboratories with necessary equipment.

- **Train human resources** across different sectors on sampling and sample analysis, antibiotic susceptibility testing (AST) and antibiotic residue monitoring and on the use of latest laboratory techniques.

- Make **monitoring data available publicly**. At the district level, monitoring information can be included in the monthly reporting system, and shared with the state for appropriate decision-making.

4.2 Human health

- Conduct sentinel antibiotic resistance surveillance with a **focus on priority pathogens for surveillance** as compiled by the National Centre for Disease Control (NCDC). Community surveys should be conducted to know antibiotic resistance levels in healthy population.

- **Strengthen existing laboratory networks** by establishing linkages with private sector hospitals, academic institutions and laboratory networks

A Network Program on Antimicrobial Resistance, Superbugs and One Health, Gujarat

A Network Program on Antimicrobial Resistance, Superbugs and One Health has been developed under the Gujarat State Biotechnology Mission to address AMR and related challenges.[5] The program involves 100 researchers from three sectors (human health, animal husbandry and environment) across 28 institutions in the state and has been allotted Rs 20 crores for three years. Proposals were invited from the researchers in the state working in the field on AMR and One Health focusing on human health, veterinary, poultry, fisheries, wildlife, food and environment. The program is implemented in a hub-spoke model, where Gujarat Biotechnology Research Centre (GBRC) is the central coordinating agency. Access with respect to shared laboratory facilities of GBRC is provided to all nodes.

of vertical programs like Tuberculosis, HIV, malaria, sexually transmitted infections and leprosy. Engage with laboratories accredited by the National Accreditation Board for Testing and Calibration Laboratories. Consider the utilization of upgraded laboratories and additional manpower developed during the COVID-19 pandemic for surveillance. Collaborate with academic institutions for routine testing and surveillance.

- At the district level, **strengthen and use the public health laboratory network** for antibiotic resistance surveillance. In places with limited laboratories, a hub and spoke model can be established or public-private partnerships explored. Augment district-level surveillance through Integrated Health Information Platform and Integrated Public Health Laboratories under the Pradhan Mantri Ayushman Bharat Health Infrastructure Mission (PM-ABHIM).[6]

- **Develop and adhere to uniform standard operating procedures** (**SOPs**) at the state level, which are aligned with the national SOPs. Classify biological samples by source (location) and type (specimen) for a better understanding of the epidemiology of antibiotic resistance in institutions.

- Establish systems for **data quality checks and validation**; establish a common platform for **data sharing** as well as state/district level dashboards for sharing of information.

4.3 Livestock

- **Develop species-specific surveillance strategies** such as for poultry and dairy animals. Target bacteria for surveillance could be identified along the lines of priority pathogens or ESKAPE pathogens identified for antibiotic resistance surveillance in humans.

State AMR surveillance networks

AMR surveillance is a strategic priority under global, national, and state action plans on AMR. Maharashtra, Kerala and Delhi have state AMR surveillance networks established with support from WHO India, with strong state ownership, and oversight of NCDC. All networks have been trained on AST/BMD, WHONET and annual review meetings organized to facilitate information sharing. All sites under the three networks have public as well as private microbiology laboratories, follow the NARS-NET standard operating procedures and use WHONET for sharing data every month. Data from the three networks is also shared with NCDC, who submits it to WHO Global AMR Surveillance System (GLASS), along with data from NARS-NET, AMRSN and GASP network in India. The data from these networks is also crystalized into annual reports which are shared with the state health department for benchmarking AMR in the states, as well as for advocacy and policymaking.

Maharashtra Surveillance of Antimicrobial Resistance (MAHASAR)
Established in 2018 through a collaboration of IAMM Maharashtra Chapter, state health department, and WHO India, with oversight of NCDC. Nodal/coordinating centre is GMC Aurangabad, and MAHASAR has 19 surveillance sites currently.

Kerala Antimicrobial Resistance Surveillance Network (KARS-NET)
Formalized in 2019 through a collaboration between Government Medical College Thiruvananthapuram, state health department, WHO India. Nodal/coordinating centre is GMC Thiruvananthapuram and KARS-NET has 31 surveillance sites currently.

Delhi Network for Surveillance of Antimicrobial Resistance (DeNSAR)
Established in 2019 as the WHO-IAMM Network for Surveillance of Antimicrobial Resistance in Delhi (WINSAR-D), through a collaboration between Indian Association of Medical Microbiologists (Delhi Chapter), and WHO India, with oversight of NCDC. Nodal/coordinating centre is Maulana Azad Medical College Delhi, and DeNSAR has 24 sites currently.

New AMR surveillance networks have recently been established in Andhra Pradesh and Puducherry with state government ownership and technical support of WHO. These are named Andhra Pradesh Surveillance of Antimicrobial Resistance (AP-SAR) and Puducherry Antimicrobial Resistance Surveillance Network (PARS-NET).

- **Develop Standard Operating Procedures** (**SOPs**) (such as related to Veterinary Clinical and Laboratory Standards Institute (CLSI) standards and breakpoints), which are harmonized at the regional disease diagnostic laboratories (RDDL) and shared up to the district level. Utilize SOPs of existing Indian Network for Fisheries and Animal Antimicrobial Resistance (INFAAR) to formulate strategies.

- **Identify and map a network of public and private laboratories within the state** with respect to their capabilities. Reference laboratories like National Center for Cell Science (NCCS), Pune and Institute of Microbial Technology (IMTECH), Chandigarh can be utilized. Leverage existing laboratory facilities, data or studies within each sector as well as from other sectors. Laboratories

Antibiotic resistance surveillance in livestock and training, Madhya Pradesh

The Directorate of Animal Husbandry and Dairying, Government of Madhya Pradesh is working on generating surveillance data from antibiotic susceptibility testing conducted on clinical samples, with a focus on mastitis in dairy animals. The data is analysed to decipher current effectiveness of antibiotic or resistance against them, as well as resistance trends in isolates. This information is also circulated up to the field level. Few divisional and district level labs are also being roped in to decentralize this model. In addition, the state department is focusing on raising awareness on AMR and judicious antibiotic use among veterinarians, para-veterinarians, animal owners and veterinary college students through customized training programs, lectures and awareness initiatives. Stakeholder trainees are also sent outside the state for training.

SOURCE: DAHD, MP

AMR awareness workshop organized by Department of Animal Husbandry and Dairy, Madhya Pradesh

can consider incorporating WHONET microbiology laboratory database software.

- **Strengthen capacity of state animal husbandry laboratories** for antibiotic resistance surveillance. Ensure accreditation of all laboratories and their uniform reporting to the nodal facilities. Ensure quality control and harmonization such as for testing, result interpretation and reporting.

- Consider **residue testing in food** that is not only cost-effective but has a focus on quality assessment (external and internal); explore provisions of long-term equipment maintenance.

4.4 Fisheries

- Develop **disease diagnostic and antibiotic resistance surveillance laboratories** under Pradhan Mantri Matsya Sampada Yojana (PMMSY).[7] Involve ICAR fisheries institutes, state agricultural universities and fisheries colleges.

Indian Network of Fisheries and Animal Antimicrobial Resistance (INFAAR)[8,9,10]

INFAAR is a program of the Indian Council of Agricultural Research (ICAR), being implemented with support from the Food and Agriculture Organization of the United Nations (FAO) and USAID since August 2018. A network of several institutes aims to document trends in antibiotic resistance and resistance genes in different production systems, through a structured national surveillance program. The ICAR-National Bureau of Fish Genetic Resources (NBFGR), Lucknow, is the lead institution for fisheries and ICAR-Indian Veterinary Research Institute (IVRI), Bareilly, for animal science. It is currently operational through 18 organizations (15 ICAR institutions and three State Agriculture Universities) in about 22 centres (nine centres from fisheries and 11 from the livestock sector) across the country. While surveillance under INFAAR is often referred to by stakeholders, a concern remains that the results are not put out in the public domain. .

- Establish **antibiotic residue analysis facilities** in the country. Result of antibiotic residue surveillance should be reported to a nodal agency such as the state fisheries department. Consider expansion of the National Residual Control Program[11] of the Marine Products Export Development Authority (MPEDA) to include antibiotic consumption and residue monitoring in aquaculture for domestic use.

4.5 Crops

- **Initiate residue surveillance by identifying few antibiotics** (e.g., tetracycline and streptomycin, which are more expected to be used in crops) and resistance surveillance in **a few bacteria**.

- **Utilize existing laboratory infrastructure meant for surveillance** of insecticides, pesticides and soil microorganisms in crops. States should also collaborate with the network of ICAR laboratories.

4.6 Waste and environment

- Identify **state nodal laboratories, state pollution control board laboratories, and district-level laboratories** for antibiotic resistance surveillance. For antibiotic residues analysis, a select few can be upgraded.

- Aim to conduct **periodic surveillance of relevant AMR determinants** from potential point sources. Identify **targeted sampling sources** at first. These sampling sources can be outlet of pharmaceutical manufacturing effluent treatment plants, nearby waterbodies and common effluent treatment plants connected to them; hospital waste and sewage; farm wastes; sewage treatment plants, mass gathering locations and solid waste dumpsites.

State level stakeholders engage in brainstorming and discussion during CSE–WHO 2022 workshop

- **Develop required guidelines, SOPs and standards, and enforce regulations.** Encourage collaboration at national and regional levels.

- **Tracking and operating systems** should be put in place and IT-enabled. Analytical equipment for residue analysis may require additional investment.

- Build a **data platform with facilities** for data management and quality checks. Results should be disseminated to the public, enforcement agencies and policy makers.

- **Continue to build on evidence** through operational research on environmental aspects of AMR.

AMR laboratory by State Pollution Control Board, Kerala[12]

The Kerala State Pollution Control Board (KSPCB) inaugurated an AMR laboratory for environmental surveillance of AMR in August 2023. The laboratory functions as a component within the central laboratory of the KSPCB. The AMR lab plays a crucial role in furthering the KSPCB's objective of safeguarding and conserving the environment, with focus on AMR. The laboratory will help in identifying sources of pollution, respond promptly to any irregularities and provide dependable data for making informed decisions. The laboratory has several advanced instruments like liquid chromatography-mass spectrometry, biosafety cabinet, real-time PCR, nano-drop spectrophotometer, gel electrophoresis unit and gel documentation system, and an ELISA reader which can be used to monitor AMR determinants like resistant bacteria, antibiotic residues, antibiotic resistance genes in the environment, etc. In addition, there are currently two ongoing projects on environmental AMR surveillance in Kerala. One is on AMR surveillance in selected surface bodies of Thiruvananthapuram by Department of Environmental Sciences, University of Kerala, and the other is monitoring of AMR in wastewater by the College of Engineering, Thiruvananthapuram. Kerala also has an intergated AMR surveillance plan developed in 2018–19.

SOURCE: KERALA SPCB

Inauguration of the Kerala State Pollution Control Board Central Laboratory and AMR laboratory

5. Prevent and control AMR

5.1 Human health

- Develop a **state-level infection prevention and control** (**IPC**) **program**; develop a case and demand for IPC in the state through support from civil society/NGOs or patient support organizations.

- **Align IPC strategy with lessons from biomedical waste management** (**BMWM**), including enacting a legislation on IPC implementation at the national, state and institutional levels. Ensure adherence to national IPC guidelines.

- Identify **state IPC focal points** from microbiology or infectious diseases department of a public tertiary care hospital. Focal points may also act as IPC Master Trainers for healthcare facilities.

- Carry out **certification/accreditation of all healthcare facilities** as a five-year plan, through Kayakalp[13], LaQshya[14], National Quality Assurance Standard, or National Accreditation Board for Hospitals & Healthcare Providers (NABH).

- Strengthen IPC activities by **leveraging the Kayakalp program and infrastructure developed during the COVID-19 pandemic**. Develop infrastructure for effective triaging at healthcare facilities. Develop basic infrastructure for IPC including autoclaves, and chemical and biological indicators.

- Identify key **monitoring indicators for IPC** such as number of catheter-associated urinary tract infections, central line-associated bloodstream infections, ventilator-associated pneumonia, surgical site/blood-stream infections, hospital infection control committee meetings, functional linked nurses involved in IPC, healthcare workers trained in IPC, healthcare workers immunized, trainings in biomedical waste management, and infection control nurse (ICN) to patient bed ratio.

- **Establish a dashboard for monthly tracking and monitoring of these key indicators** by all tertiary care centres across public and private sectors. Benchmark and compare key indicators at intra-facility, inter-facility, district, state and national levels. Health facilities may be ranked based on these IPC parameters.

- **Prioritize hand hygiene and sanitation** through activities such as celebration of global hand washing day among healthcare workers and the public. Conduct compliance audits for surgical safety check-list and hand hygiene.

- In all healthcare facilities, **operationalize hospital infection control committees** (HICCs); ensure monthly meetings, active participation of housekeeping staff, documentation of minutes and regular reporting to state IPC cell.

- Establish **Central Sterile Supply Department** at all facilities (>100 beds) under supervision of the microbiology department. Consider upgradation to modular operation theatres.

- **Involve link nurses** for AMR surveillance in admitted patients, intensive care units, and monitoring for BMWM. Ensure infection control nurse to patient bed ratio of at least 1:200. Develop and implement **laundry handling SOPs** in all facilities including outsourced laundry facility.

- **Train all clinicians and nurses** on microbiology and sample collection methods; designate one trained laboratory technician to ensure proper blood sample collection. Train all nurses from medical colleges and tertiary care hospitals in IPC and surveillance methodology. Conduct regular capacity building of all staff (including housekeeping and sanitation staff) in all IPC activities with focus on sterilization, disinfection, and BMWM. Immunize and train all food handlers including cooks and food distributors (in-house/ outsourced kitchen).

- **Outsource environmental/engineering control monitoring** where in-house facility is unavailable.

- Ensure **provision of WASH facilities** (e.g., clean water, improved sanitation and hygiene) along with necessary infrastructure (e.g., running water, soap) in healthcare facilities, communities and schools. Leverage national programs like the Jal Jeevan Mission[15] and Swachh Bharat Mission.[16]

5.2 Livestock

- **Integrate IPC as part of the National Animal Disease Control Program** (NADCP)[17]; accordingly strengthen the National Animal Disease Reporting System (NADRS).[18]

Experts and stakeholders from One Health sectors and departments at the Centre and state levels discussing challenges and way ahead

- Develop **state-level IPC action plans** and IPC units at various facility levels with veterinary aid. Develop and follow SOPs such as on correct disposal of dead animals for better carcass management; ensure compliance related to poultry and dairy farms, veterinary facilities, and slaughterhouses with biomedical waste disposal methods.

- Ensure **regular vaccination in livestock** (e.g., foot and mouth disease, brucellosis, heamorrhagic septicemia, black quarter and enterotoxaemia) by professionals trained in IPC practices. Necessary vaccinator training and availability of SOPs should be ensured to facilitate this. For animal diseases with no vaccines (e.g., mastitis), AST should be carried out for disease diagnosis and treated accordingly.

- Encourage availability of quarantine facilities and proper documentation at checkpoints to **prevent disease spread during cross-border animal transfer.**

5.3 Fisheries

- Encourage **proper diagnosis of fish diseases**. Develop an **inventory of fish diseases** in India such as with respect to species-specific diseases, commonly prevalent diseases across different sectors (inland, marine, brackish water,

Integrated MultiTrophic Aquaculture

The Integrated MultiTrophic Aquaculture (IMTA) is an approach positioned to increase sustainability of intensive aquaculture systems. It aims at the integrated production of aquaculture species of different trophic levels under a circular economy approach, minimizing energy losses and environmental deterioration. Under IMTA production, the uneaten feed and wastes of one species are recaptured and converted into feed, fertilizers, and energy to another species. It is said that apart from aquaculture sustainability, IMTA can help with nutrient cycling, increased economic resilience arising from improved production efficiency, product diversification, and potential price premiums.

freshwater, etc.), diseases of national and international importance, and treatable and non-treatable diseases. Share inventories with all fishery departments, extension officers, etc.

- Develop **standard SOPs for farmers** to maintain appropriate water quality parameters and good farm management practices. Encourage adoption of these SOPs on hatchery production and grow out farm production operations.

- Adopt **biosecurity in hatchery and grow out farms** in case of high-value fish species.

- Encourage **treatment of farm effluents** before their discharge.

- Designate **specific areas** (**e.g., less disease prone areas**) **for fish culture**.

- Ensure an **appropriately functioning cold chain** from capture to marketing to prevent the unnecessary breeding of pathogens such as resistant bacteria.

- **Discourage the culture of banned species**. Handle transboundary fish diseases from exotic species with caution; conduct risk assessment of imported live fish (e.g., ornamental fish) and quarantine when necessary.

- **Integrated MultiTrophic Aquaculture** (**IMTA**) should be promoted but with caution, as it can be a potential spreader for AMR. Similarly, poultry litter or waste from food animal setting can also spread AMR if used in fisheries.

Programme on Removal of Unused Drugs (PROUD), Kerala

The Programme on Removal of Unused Drugs (PROUD) is a drug take-back program piloted in 2019 in the district of Thiruvananthapuram in Kerala. PROUD began as a collaborative initiative of the state's Drug Control Department and the All Kerala Chemists and Druggists Association (AKCDA). To begin with, about 200–300 locked collection boxes were placed near select pharmacies, bus terminals and markets in Thiruvananthapuram where people are encouraged to deposit unused pharmaceutical products. The waste is then sent to a common biomedical waste treatment facility run by Ramky Energy and Environment Ltd in Mangalore for incineration. The program collected about 15 tonnes of drugs in the first year of operation. The costs incurred in drug take-back under PROUD were dependent on the volume of drugs collected periodically. While initially the program was funded by the AKCDA (about Rs 25 lakh), later an annual government funding of Rs 4 crore was allocated for the year 2020–2021. Operation of the program saw loss of momentum due to change of leadership at the departmental level as well as the state level. Recently, with the initiative of the Principal Scientific Adviser to the Chief Minister, PROUD is currently under discussion for being revived again under a "public private partnership" model.

SOURCE: KERALA DRUG CONTROL DEPARTMENT

Drug collection boxes placed outside pharmacy stores in Thiruvananthapuram district as part of PROUD

5.4 Crops

- Ensure **timely weed control** and **plant nutrient management** to prevent and reduce bacterial diseases.

- Develop and promote appropriate **diagnostic tools and techniques for bacterial and fungal disease diagnosis** and confirmation; train personnel accordingly.

- **Avoid application of undecomposed/untreated organic manure** (e.g., poultry litter) on crops; **train farmers** on manure treatment methods to reduce the spread of AMR from farm to field.

Waste management by CETPs in states and what needs to be done

The discharge from manufacturing companies that contain antibiotics can increase the risk of the development and spread of antibiotic resistance in the environment. Antibiotic manufacturing is therefore often referred to as a 'hotspot' for effective action.

In India, the major antibiotic manufacturing is largely spread across 25 locations/hubs across nine states—Punjab, Himachal Pradesh, Telangana, Andhra Pradesh, Karnataka, Gujarat, Maharashtra, Goa and Sikkim. Small and medium-scale companies in these states usually send primary treated waste to CETPs while some also opt for deactivation and primary treatment before sending to CETPs.

Out of 25 hubs in 9 states, 16 hubs across six states have a total of 35 CETPs of varying capacities ranging from 0.5–55 million litres per day. While many hubs have multiple CETPs, Sikkim, Punjab and Goa do not have any CETP in their hubs. Out of 35 CETPs, only four have wastewater recovery systems which are similar to ZLD systems with no external water discharge. As per information from the Central Pollution Control Board, there are overall 196 CETPs operational in the country, two of which cater solely to effluents from the pharmaceutical industry and 45 are equipped with water recovery systems.

The Baddi CETP, located in Baddi-Barotiwala-Nalagarh (BBN) area of Himachal Pradesh (a FPP producing hub) segregates wastewater based on the type of industry and treats it separately. It uses a cost-effective approach to treat the pharmaceutical effluent twice. However, the Jeedimetla Effluent Treatment Limited (JETL) in Telangana, which largely caters to API producers, distributes waste streams irrespective of industry into high and low total dissolved solids (TDS) and treats it as per the TDS. It has modified its infrastructure to include multiple effect evaporators, agitated thin film dryers and reverse osmosis, such that it can operate as a ZLD facility and treat high and low TDS effluents. The cost involved and its calculation is also different in both cases.

State governments through their relevant departments should work towards upgrading and enabling capability of CETPs to address antibiotic degradation and minimize their discharge in the environment, based on appropriate assessment and gap identification. All small-and medium-scale manufacturing units across the country should be appropriately connected to CETPs. Advanced treatment systems should be considered and invested upon, if needed.

- In view of growing momentum on organic and natural agriculture practices, it is important to **make guidelines for risk assessment, monitoring, treatment and management, and application of litter/animal waste in agriculture fields** to prevent AMR spread from animal farms to crop farms.

5.5 Waste and environment

- In collaboration with state drug control department, develop a **drug take back policy/program for unused/expired antibiotics** at household and farm levels. **Create a take-back facility** and establish necessary systems for segregation and correct disposal. Explore the incentivization mechanism for take back across the supply chain.

- Ensure **effective implementation of waste management** regulations such as biomedical waste management rules, hazardous waste management rules and those related to effluents from the bulk and formulation antibiotic/ pharmaceutical industry.

- Encourage **adoption of process control measures and good waste management practices in pharmaceutical manufacturing** to eliminate antibiotic pollution.

- **Identify and map** antibiotic manufacturing companies, common effluent treatment plants (CETPs) connected to them and monitor antibiotic residues in treated effluents of those. Develop data and put it in public domain.

- **Support development and periodic monitoring** of CETPs with treatment technologies that are effective in mitigating antibiotic pollution from manufacturing discharges.

- Ensure **proper waste collection and scientific sewage treatment at the community level**. Examine efficiency of existing sewage treatment plants with respect to antibiotic removal; conduct research to assess impact of existing interventions and identify solutions with respect to AMR.

6. Optimize antibiotic use

6.1 Human health

- Develop and implement **antibiotic policy at the clinician level** to minimize antibiotic misuse. Optimize antibiotic use based on the AWaRe (Access, Watch and Reserve) classification.

- Ensure **effective implementation and enforcement of Schedule H and H1** of the Drugs and Cosmetics Act to prevent over-the-counter sale and make 'Access' antibiotics available.

- Leverage the National Medical Commission advisory to ensure all medical colleges have an **antimicrobial stewardship** (**AMS**) **committee** and introduce this further at the district level (especially district hospitals being converted to medical colleges) and healthcare facilities with 100 or more beds. Ensure regular reporting by AMS committees. Simultaneous meeting of IPC and AMS committees should be considered for effective implementation. Explore use of advanced methods such as antimicrobial stewardship software or artificial intelligence for prescribing antimicrobials using digital applications.

- Include **AMS in medical/nursing/pharmacy curriculum**. Encourage knowledge sharing and identification of best practices among all healthcare facilities.

- **Train clinicians on AMS** including restricting use, de-escalation, diagnostic stewardship, adjusting treatment according to culture and sensitivity report, shifting from broad spectrum to narrow spectrum antibiotics, and quarterly prescription audit activities and regular reporting, with the involvement of the quality officer. Augmentation of services of departments of microbiology and clinical pharmacology for regular antibiograms and antimicrobial consumption/use reports.

- **Train pharmacists on AMS actions** such as ensuring correct sourcing and quality of medicines, safe storage and correct dispensing of antimicrobials, cold chain maintenance, and disposal of unused/expired medicines. Explore stamping 'filled' (as per rules) on the prescription at the pharmacy so that the prescription cannot be used again to procure antibiotics.

- **Train nurses on AMS actions** such as dispensing and administration of antimicrobials to the patients, implementation and initiation of care bundles, specific patient care, patient monitoring for adverse drug reactions, and patient discharge process.

- Conduct **empanelment of laboratories for quality assurance** testing. Quality assurance may be included in pre-qualification criteria for drug procurement. Operationalization of mobile drug quality testing laboratory can be considered.

- **Monitor usage of commonly used antibiotics** through defined daily doses (DDD), point prevalence survey (PPS) methodology or prescription audits.

6.2 Livestock

- Develop **standard treatment guidelines** for the food-animal sectors to recommend antibiotics that can/cannot be used for a particular disease. It should aim to phase out use of critically important antimicrobials (CIAs) for all non-therapeutic purposes, with priority given to highest priority critically important antimicrobials (HPCIAs). Such guidelines should be made available to all veterinarians, para-vets, extension officers and field staff who work on the ground.

- **Regulate antibiotic use and develop a roadmap/policy framework** to discontinue their use as growth promoters, discourage their disease preventative use and conserve CIAs in food-animal production. Ensure antibiotics are not sold over the counter and withdrawal periods for veterinary products are followed. There should also be a control on availability of certain antibiotic classes—such as CIAs or those which are last resort for humans—with the pharmacists. Monitor availability of irrational fixed dose combinations of antibiotics for animal treatment.

- **Revise and/or clarify the definition of "drug" in the Drugs and Cosmetics Act, 1940** which includes the word "prevention". It is important to ensure that this definition is not used to justify non-therapeutic use in food-producing animals. As most antibiotics are cheaply available for use in animals, such misuse is common in the name of disease prevention and disease control. Such use is a substitute for good animal rearing practices.

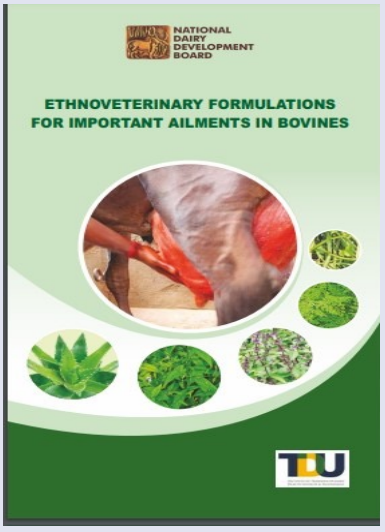
- **Register feed, feed manufacturers and dealers**, and **regulate feeds** containing antibiotics. Only registered inputs (with known and approved contents sold with appropriate labelling) should be allowed for sale and use.

Ethnoveterinary medicines as a cost-effective and simple solution to reduce antibiotic use, led by NDDB in Gujarat and implemented in several states[19]

Ethnoveterinary medicines (EVMs) are proving to be a viable solution to reduce antibiotic use in the Indian dairy sector, particularly for treatment of mastitis. There are several herbal formulations such as a mixture of *Aloe vera*, turmeric, lime (calcium hydroxide) and mustard oil, which can be made by the farmer himself from ingredients mostly available in the household. Spearheaded by the National Dairy Development Board (NDDB), the Sabar Dairy in Gujarat is pioneering EVM activity in India with the support of the Trans-Disciplinary University (TDU). The NDDB is working with 16 milk unions across eight states in India under its Mastitis Control Popularisation Project. Until October 2022, NDDB treated about 7.8 lakh cases with an 80.4 per cent cure rate. Out of this, 2.5 lakh cases of mastitis were treated with 78.4 per cent cure rate. This project includes various additional aspects such as awareness generation (information brochure, social media awareness), training and demonstration on use of EVM, and monitoring. Since 2016–17, it has trained more than 6,000 animal husbandry personnel in EVMs.

SOURCE: NBBD

EVM preparation and application at a demonstration camp in Gerua, Kamrup



Information brochure for ethnoveterinary formulations for treatment of important ailments in bovines developed jointly by NDDB and TDU[20]

- **Promote use of alternatives to antibiotics** such as probiotics and ethnoveterinary practices. This should be coupled with a long-term research agenda to understand the effectiveness of such non-antimicrobial alternatives in improving health and managing animal diseases.

- **Research on the nature of disease resilience of native breeds** should also be carried out and such resilient breeds should be promoted, if possible.

Regulation of animal feed by Andhra Pradesh

The Government of Andhra Pradesh notified the Andhra Pradesh Animal Feed (Regulation of Manufacture, Quality Control, Sale and Distribution) Act, 2020 and the Andhra Pradesh Animal Feed (Regulation of Manufacture, Quality Control, Sale and Distribution) Rules, 2021.[21] As per the Act, all animal feed/mineral mixture business operators should be licensed/registered for manufacture, sale and distribution of animal feed and mineral mixture. No person can carry on business of manufacture, sale or distribution of feed without a license certificate issued by the licensing authority. A separate registration shall be necessary for each place of business or manufacture. With regard to antibiotics, the Act mentions that the animal feed shall not contain any prohibited antibiotic or pharmacologically active substances under any circumstances and shall be certified accordingly on every animal feed bag. In addition, the Rules require that every animal feed bag sold or intended to be sold in the state shall contain, among others, an 'antibiotic, hormones & pharmacologically active substances free certificate', printed legibly.

- Explore developing a **traceability and/or certification system for eggs and meat grown without the use of antibiotics** and sold accordingly, so that greater trust and demand among consumers is created**.**

- **Create programs to support and incentivize farmers** for practicing antibiotic free food-animal farming.

- **Monitor antibiotic usage** in different food-animal production sectors with a goal to analyse results with resistance trends in animals and humans. Put in place necessary mechanisms (e.g., veterinary prescription audits). Make results publicly available for greater stakeholder understanding.

6.3 Fisheries

- Develop a definite **action plan on fish health**. Develop **policy and regulation on use of antimicrobials** in the fisheries sector. Develop **necessary regulation or guideline to authorize fishery professionals to prescribe** medicines or aqua drugs for fish.

- Develop an **inventory of chemicals or aqua drugs** (including antibiotics) with dose/dosage that could be used for the treatment of different diseases in fish. These should be shared with all fishery departments, extension officers, etc.

- Develop **reporting mechanism of fish diseases** to fishery extension officers or inspectors, and then to district level officers. Provide regular feedback to the fishery inspectors, fishery extension officers and assistant director of fisheries.

Misuse of critically important antibiotics in the Indian food-animal production sector[22]

In 2021, CSE published a report on "Conserving the Use of Critically Important Antimicrobials in Food-producing Animals". It was found that critically important antimicrobials (CIAs) are misused and overused in the Indian food-animal production sector, particularly the dairy, poultry and aquaculture sectors. These are used for non-therapeutic purposes like prevention and control of diseases, growth promotion and in case of non-bacterial diseases/infections.

Overall, 27 CIAs from seven classes were found to be used for both therapeutic and nontherapeutic purposes, of which 18 were from three highest priority critically important antimicrobial classes, i.e., macrolides and ketolides; third-, fourth- and fifth-generation cephalosporins; and quinolones and fluoroquinolones. In the dairy sector, 21 CIAs from six classes were used. In the poultry sector, 14 CIAs from four classes and in the aquaculture sector, three CIAs from one class were used. The report also highlighted several gaps and possibilities identified in the policy framework related to antimicrobial use in food-producing animals.

The report outlines the need for a roadmap and necessary policy framework to conserve the use of CIAs. This can include steps like the development of standard treatment guidelines for the veterinary sector; prohibiting food-animal use of antibiotic growth promoters; setting up systems to gather data on use of critically important antimicrobial use and resistance in food-producing animals; and routine monitoring by the central and state food regulators on antimicrobial use and residues to ensure that withdrawal periods are followed and residue standards are met.

Make farmers and all field stakeholders accountable to the nodal fisheries department.

- Identify and **register aqua drug dealers/sellers** under state fisheries act. They must be mandated to sell only registered products. Seed/hatchery certification must be made mandatory.

- Consider **selective breeding** of fish for resilience and productivity.

- Promote **greater research and development** on fish health, disease resilience in fish species, use of animal waste as fish or pond fertilizer and their impact on spread of AMR, etc.

- **Establish an R&D unit** under the fisheries department.

6.4 Crops

- **Assess types of diseases affecting crops** and types of crops on which antibiotics are used, commonly used antimicrobials in crops, volume of such use, and availability of disease diagnostic kits.

- Develop **antibiotic use guidelines** for crops. Ensure only approved antibiotic use on crops under strict supervision of agricultural extension workers; antibiotics meant for use in human health should not be used.

- Carry out **soil treatment and vector control measures** to limit the spread of bacterial diseases in crops.

- Develop **low-cost affordable tools to detect antibiotics in produce** (e.g., grains, pulses, cereals). Also map and engage with diagnostic laboratories for detection of antibiotics in produce.

Annexure: List of One Health stakeholders and experts

Ajeet Nair, Pashu Chikitsa Sahayak, Department of Animal Husbandry, Chhattisgarh

Amit Khurana, Program Director, Sustainable Food Systems, Centre for Science and Environment, New Delhi

Anil Rao, Assistant Environmental Engineer, Himachal Pradesh State Pollution Control Board

Anuj Sharma, National Professional Officer (AMR, Labs, IPC), WHO India

Aravind R, Assistant Professor, Infectious Disease Department, Government Medical College, Kerala

Arghya Pradhan, Joint Director, Tuberculosis, Directorate of Public Health, Odisha

Bharat R Desai, Consultant-Best Practice and Innovation, State Health System Resource Centre, Gujarat

Brijesh Kumar, Fisheries Development Officer, Department of Fisheries, Rajasthan

D Mohana Krishna, Joint Director CDP, Department of Health and Family Welfare, Andhra Pradesh

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Divya Datt, Program Management Officer, United Nations Environment Program India

Durgam Narender, Senior Environment Engineer, Telangana State Pollution Control Board

G Sunitha, Deputy Director (V&AH), Telangana State Veterinary Biological Research Institute, Department of Animal Husbandry, Telangana

Gagan Bajaj, Veterinary officer (Microbiologist), Veterinary Polyclinic, Punjab

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Jay Kishor Sharma, Joint Director, Plant Pathology, Department of Agriculture, Rajasthan

Jayant Tapase, Additional Deputy Director, Department of Animal Husbandry and Dairying, Madhya Pradesh

Joachim Lakra, Deputy Director of Fisheries (Plan), Department of Fisheries, Odisha

Jyoti Toppo, Deputy Director, Department of Fisheries, Madhya Pradesh

K B Gurung, Principal director cum Medical Superintendent, STNM Hospital, Sikkim

K Sreenivas, Joint Chief Environmental Scientist (FAC), Andhra Pradesh State Pollution Control Board

Kannepalli Annapurna, Former Head, Division of Microbiology, ICAR-Indian Agricultural Research Institute, New Delhi

Lahari Saikia, Head of Department, Microbiology, Gauhati Medical College & Hospital, Assam

Lata Kapoor, Joint Director, National Centre for Disease Control, New Delhi

M P R Prasad, Deputy Director, Drugs Control Administration, Andhra Pradesh

Manjeet Saluja, National Professional Officer, Environment and Public Health, WHO India

Manjit Singh, Director, Corporate Sustainability, Centrient Pharmaceuticals

Mehendra Kendre, Assistant Director, District Health Society, Mumbai

Mohit Sanghani, Superintendent, Department of Fisheries, Gujarat

Munmun Das, Professor, Department of Microbiology, Nodal person of state committee for AMR, School of Tropical Medicine, West Bengal

Neeraj Arora, Microbiologist, Civil Hospital, Haryana

Nitin Prabhu, Veterinary Officer, Department of Animal Husbandry, Karnataka

P Anand Kumar, Professor & Head, Department of Veterinary Microbiology, NTR College of Veterinary Science, Andhra Pradesh

P Ramesh, Deputy Drugs Controller (HQ), Drugs Control Department, Karnataka

P Sampath, Joint Director of Public Health and Preventive Medicine (Communicable Diseases), Director of Public Health and Preventive Medicine, Tamil Nadu

Pankaj Saxena, Joint Director, Communicable diseases, Health Directorate, Uttar Pradesh

Payden, Deputy Head, WHO India

Peeyush Sharma, Secretary, UP Council of Agricultural Research, Department of Agriculture, Uttar Pradesh

Polin Chan, Team Lead, Communicable Diseases, WHO India

Pradip Dave, Scientific Officer, Gujarat State Pollution Control Board

Pramod Goel, Deputy Director, QA, National Health Mission, Madhya Pradesh

Prashant Gangwar, Assistant Director, Department of Fisheries, Uttar Pradesh

Pratap Ekka, Joint Director of Fisheries (Planning & Training), Department of Fisheries, Odisha

Preeti Thaware, Program Officer for AMR, District Health Society, Punjab

Previn Punnoose, Assistant Director, Avian Disease Diagnostic Laboratory, Kerala

Prithvi Singh, Designated Officer, Food and Drug Administration, Haryana

Rajeev Bhargava, Assistant Drugs Controller, Drugs Control Department, New Delhi

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Rajeshwari Sinha, Program Manager, Sustainable Food Systems, Centre for Science and Environment, New Delhi

Rashmi Varghese, Deputy Director, Department of Agriculture, Madhya Pradesh

Ravindra Aggarwal, Chief Coordinator AMR, Government of National Capital Territory of Delhi and Additional MS (SP), Lok Nayak Hospital, New Delhi

Roderico Ofrin, WHO Representative to India

Rupesh Yadav, Veterinary Surgeon, Haryana Livestock Development Board, Haryana

Sajeesh Joy, Environment Engineer, Kerala State Pollution Control Board

Sameer Patel, Assistant Manager, Sabar Dairy, Gujarat

Samir Ardesana, Assistant Director, Department of Fisheries, Gujarat

Sangeeta Dalal, Sub-Divisional Officer, Hatchery farm, Haryana

Sangeeta Sharma, President, Delhi Society for Promotion of Rational Use of Drugs, New Delhi

Sehr Brar, Technical Officer (AMR & IPC), WHO India

Shipra Dutt, Veterinary Officer, Department of Animal Husbandry, Uttar Pradesh

Shraddha Sachaan, Veterinary Officer, Department of Animal Husbandry, Uttar Pradesh

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Endnotes and references

1. National Action Plan on Antimicrobial Resistance (NAP-AMR) 2017 – 2021, Government of India. https://ncdc.mohfw.gov.in/WriteReadData/l892s/File645.pdf, accessed on Nov 1, 2023

2. The Integrated Child Development Scheme (ICDS) is a scheme launched by the Ministry of Women and Child Development (MoWCD), Government of India in 1975 with the objective to improve the nutritional and health status of preschool children 0-6 years of age group.

3. The Rashtriya Bal Swasthya Karyakram (RBSK) is an initiative Ministry of Health & Family Welfare, Government of India, under the National Health Mission which aims at early identification and early intervention for children from birth to 18 years to cover 4 Ds viz. defects at birth, deficiencies, diseases, development delays including disability.

4. Combating AMR: How Delhi's campaign design for school kids helped. Down To Earth. 2020. https://www.downtoearth.org.in/blog/health/combating-amr-how-delhi-s-campaign-design-for-school-kids-helped-74369, accessed on Nov 1, 2023.

5. Network Program on Antimicrobial Resistance, Superbugs & One Health. Gujarat State Biotechnology Mission. https://btm.gujarat.gov.in/npar-soh.htm, accessed on Nov 1, 2023.

6. The PM-Ayushman Bharat Health Infrastructure Mission (PM-ABHIM) is a centrally sponsored scheme whose objective is to fill critical gaps in health infrastructure, surveillance and health research – spanning both the urban and rural areas so that the communities are Atmanirbhar in managing pandemic/health crisis. It is the largest Pan-India scheme for public health infrastructure since 2005. https://main.mohfw.gov.in/sites/default/files/Note%20on%20PM-ABHIM%20for%20MoHFW%20website_1.pdf, accessed on Nov 1, 2023.

7. The Pradhan Mantri Matsya Sampada Yojana is a scheme being implemented by the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India. The scheme aims to bring about ecologically

healthy, economically viable, and socially inclusive development of the fisheries sector of India.

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11. The National Residue Control Plan (NRCP) is a statutory requirement for export to EU countries. Under NRCP, definite sampling schedule and sampling strategies are drawn every year for monitoring the residues of substances like antibacterial/veterinary medicinal products and environmental contaminants. Samples are collected from hatcheries, feed mills, aquaculture farms and located in maritime states and tested for the presence of any of the select set of residue/contaminants.

12. Kerala State Pollution Control Board Antimicrobial Resistance Lab: Pioneering AMR initiative Unveiled in India. 2023. https://kspcb.kerala.gov.in/assets/uploads/widget/anti_microbial_resistance/Untitled_design.jpg, accessed on Nov 1, 2023.

13. The Kayakalp Award Scheme was launched by the Ministry of Health and Family Welfare in 2015 as an extension of 'Swachh Bharat Mission'. The aim of initiative is to improve and promote the cleanliness, hygiene, waste management and infection control practices in public health care facilities and incentivize the exemplary performing facilities. The scheme is intended to encourage and incentivize Public Health Facilities (PHFs) in the country to demonstrate their commitment for cleanliness, hygiene and infection control practices.

14. LaQshya is a national labour room and maternity OT quality improvement initiative.

15. The Jal Jeevan Mission is a program of the Department of Drinking Water and Sanitation under the Ministry of Jal Shakti, Government of India. The mission is envisioned to provide safe and adequate drinking water through individual household tap connections by 2024 to all households in rural India.

16. Swachh Bharat Mission is a national campaign started by the Government of India on October 2, 2014. The aim of the campaign is to keep India clean and litter free. The campaign also aims to reduce or eliminate the problem of open defecation through the construction of individual, cluster and community toilets.

17. The National Animal Disease Control Program (NADCP) is a flagship scheme which was launched in September, 2019 and is being implemented by the Department of Animal Husbandry and Dairying, under the Ministry of Fisheries, Animal Husbandry and Dairying, Government of India. The program aims to control two major prevailing zoonotic diseases, Foot & Mouth Disease and Brucellosis, by vaccinating 100% cattle, buffalo, sheep, goat and pig population for FMD and 100% bovine female calves of 4-8 months of age for brucellosis for five years (2019-20 to 2023-24).

18. The National Animal Disease Reporting System (NADRS) being launched by the Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, Govt. of India with the objective of introducing Computerised system of Animal Disease Reporting, linking each Block, Districts and State level Headquarters to the Central Disease Reporting and Monitoring at New Delhi.

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AMR is a silent pandemic known to have significant impact on human and animal health, food security and development. An effective national response to this crisis depends on multi-sectoral action across human health, livestock, fisheries, crops and environment. Developed in consultation with experts and stakeholders from the Centre and states, this report presents One Health actions that can be considered by states and Union Territories to prevent and contain antimicrobial resistance.

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