REPORT & RECOMMENDATIONS

"Addressing Antimicrobial Resistance in India: A One Health Action Plan

INGSA_ASIA PROJECT

Grassroots Science Advice Promotion Awards 2023

Preface

The project ‘Addressing Antimicrobial Resistance in India: A One Health Action Plan’, funded by the International Network for Governmental Science Advice – Asia Regional Chapter (INGSA-Asia) under the Grassroots Science Advice Promotion Awards 2023, aims to combat the pressing issue of antimicrobial resistance (AMR) through a multisectoral One Health approach. This initiative focuses on creating awareness among stakeholders about AMR's impact on human, animal, and environmental health, assessing the current AMR containment policies and programs in India, and fostering collaboration among various sectors to address challenges and identify opportunities to tackle AMR.

To achieve its objectives, the project has successfully conducted three workshops: two offline and one online. A World Café workshop held on September 27, 2024, at the Academic Staff College, Mannuthy, engaged 25 senior veterinary surgeons to examine critical issues of AMR in veterinary sector and assess the status of AMR action plans. An online focus group discussion on October 10, 2024, brought together 15 veterinarians working in diagnostic laboratories and public health specialists to evaluate the challenges in AMR surveillance. The valuable insights gathered from these two sessions served as a foundation for shaping the themes and discussions at the conclave, ensuring a well-rounded, evidence-based approach to addressing AMR in a One Health framework. The culminating event, AMR Conclave 2024: Strengthening One Health Action Plan, was held on November 20, 2024, at Hotel Ashoka Inn, Thrissur, in collaboration with INGSA-Asia and ReAct Asia Pacific. This event, commemorating ‘World Antimicrobial Resistance Awareness Week’, gathered distinguished experts and stakeholders from diverse sectors to formulate actionable strategies for AMR containment, emphasizing the One Health framework

Dr. Deepthi Vijay

Principal Investigator of the project: 'Addressing Antimicrobial resistance in India: A One Health Action Plan'
Assistant Professor with 10 years of expertise as academician with research arena on antimicrobial resistance and farm biosecurity. Co-author of the *Textbook on Zoonoses*, published by Wiley Blackwell and have more than 20 research publications. Elected council member of the 'World Animal Biosecurity Association' representing Asia.

Dr. B. Sunil

Mentor of the Project: 'Addressing Antimicrobial resistance in India: A One Health Action Plan'
Professor and Head of the Department of Veterinary Public Health with over 29 years of expertise in zoonoses and food safety. Pioneer in establishment of first One Health Centre in India, 'Centre for One Health Education, Advocacy, Research and Training (COHEART)' at Kerala Veterinary and Animal Sciences University. Expert in 'Strategic focus group on One Health of 'World Veterinary Association'. Has led significant research projects, including the 'Outreach Programme on Zoonotic Diseases'. Awarded with patent and has guided more than 20 postgraduate theses in Veterinary Public Health.

Overview of Workshops conducted as prelude to the AMR Conclave 2024

Workshop 1: Group Discussion on AMR Situation Analysis and Recommendations

A World Café method group discussion conducted on 27.9.2024 at Academic Staff College, Mannuthy, Thrissur involving 25 Senior Veterinary Surgeons addressed critical issues on antimicrobial resistance (AMR) in veterinary practice, focusing on a situational analysis and the current status of AMR action plans. The veterinarians observed that while a national AMR action plan exists, its implementation within the animal husbandry sector remains in its infancy, with limited awareness and engagement among practitioners. Recognizing AMR as a pressing One Health issue, they recommended a multifaceted approach to address AMR that includes cross-sectoral collaboration between human, animal health and environmental sectors, a ban on over-the-counter antibiotic sales, and enhanced laboratory access for better diagnostic support. The participants underscored the need for policy reforms to regulate antibiotic use more effectively, increased AMR training for veterinarians, and strengthened surveillance to monitor antimicrobial usage across both human and animal health domain.

The discussion highlighted significant gaps in awareness, with the majority of veterinarians unfamiliar with the national AMR action plan and its objectives. Many participants expressed concern over the limited implementation of AMR strategies in animal husbandry, noting that efforts are still in early stages, especially in rural settings. The primary challenges identified included the lack of local laboratory facilities for AMR diagnostics, which limits effective monitoring and response. Another key issue was the widespread use of antibiotic combinations and the proliferation of unqualified practitioners (quacks) prescribing antimicrobials without adequate oversight, exacerbating AMR risks.

Key recommendations emphasized increasing awareness and training on AMR for veterinary practitioners, especially regarding the action plan's goals and antimicrobial stewardship practices. Participants highlighted the urgent need for accessible laboratory infrastructure and reinforced regulatory mechanisms. Specifically, they recommended a ban on over-the-counter (OTC) antibiotic sales to prevent misuse and self-prescription, advocating for stricter control on antibiotic distribution and quackery by unauthorized practitioners. Strengthened monitoring, reporting systems, and enforcement of regulations across veterinary and animal husbandry sectors were identified as critical steps to mitigate AMR effectively in veterinary practice.

Workshop 2: Group Discussion on Situation Analysis of AMR surveillance

An online focus group discussion was conducted on October 10, 2024, bringing together 15 veterinarians and public health specialists to evaluate the current state of antimicrobial resistance (AMR) surveillance and address its associated challenges. Participants identified significant gaps in surveillance infrastructure, particularly a lack of standardized protocols for data collection and reporting across laboratories. The limited integration between veterinary and public health sectors emerged as a key barrier, hindering comprehensive surveillance efforts and a holistic view of AMR trends. Veterinarians working in laboratories highlighted challenges in resource allocation for laboratory facilities, noting that many labs lacked the necessary equipment to perform consistent AMR diagnostics. Public health specialists echoed these concerns, emphasizing the need for better coordination between human and animal health labs to support a One Health approach to AMR surveillance. Insufficient training on AMR testing methods and variable diagnostic standards across regions were also flagged as obstacles to achieving consistent, reliable data. The recommendations focused on establishing a unified framework for AMR data sharing and reporting across veterinary and public health sectors. Participants advocated for enhanced training programs in AMR diagnostics, increased funding for laboratory infrastructure, and the adoption of digital tools to streamline data management. Implementing standardized testing protocols and building a robust surveillance network with cross-sectoral collaboration were viewed as essential steps for improving AMR monitoring and mitigating risks.


Kerala Veterinary and Animal Sciences University
Pookode, Wayanad
Addressing Antimicrobial Resistance in India:
A One Health Action Plan
Situation Analysis and Recommendations


Addressing Antimicrobial Resistance in India:
A One Health Action Plan


Addressing Antimicrobial Resistance in India : A One Health Action Plan
SITUATION ANALYSIS & RECOMMENDATIONS


STATUS OF ACTION PLANS

The outcomes of the above workshops were summarized as a handbook, *One Health Approach to Antimicrobial Resistance: A Veterinary Perspective, with* ISBN Number: 978-81-977384-4-9. Designed as a resource for veterinarians as well as general public, this publication outlines practical strategies for promoting responsible antibiotic use, implementing infection control measures, and educating farmers on sustainable practices. The handbook aligns with the broader goal of empowering professionals to tackle AMR through evidence-based interventions.

One Health Approach to
Antimicrobial Resistance
A Veterinary Perspective

Department of Veterinary Public Health
College of Veterinary and Animal Sciences,Mannuthy
Kerala Veterinary and Animal Sciences University

"It's not about using less antibiotics. It's about using the right antibiotic for the right diagnosis and for the right duration of time."
-Susan Bleasdale, Medical Director of Infection Prevention and Control at University of Iowa Health

If we use antibiotics when not needed, we may not have them when they are most needed."
-Tom Frieden, MD, Former Director U.S. CDC

Acknowledgement

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AMR Conclave 2024

Strengthening One Health Action Plan

20 November 2024,
9AM to 5PM

Hotel Ashoka Inn, Thriss

Inauguration

Dr. S. S. Lal
Director
ReActAsia Pacific

OUR DISTINGUISHED SPEAKERS

Dr. Jyoti Misri
AMR and Zoonoses Specialist, FAO, New Delhi

Dr. Devika Pillai
Assistant Director General (Inland Fisheries), ICAR

Dr. Sandhya Sukumaran
Global Health Security Technical Advisor, USAID

Dr. Previn Punnoose
Deputy Director, Avian Disease Diagnostic Laboratory (ADDL),Thiruvalla

World Café: "Addressing Antimicrobial Resistance: A One Health Action Plan"

Organized by Department of Veterinary Public Health, KVAS, Mannuthy, School of Zoonoses, Public Health and Pathobiology, ReActAsia Pacific and INGSA-Asia

Executive Summary

A comprehensive understanding of various policy measures, strategies, and objectives within India's diverse local contexts is essential for enhancing efforts to contain antimicrobial resistance. Such an understanding can provide valuable insights and evidence to address the complexities of public health systems and social challenges linked to AMR at the local level. It can also aid in identifying context-specific, effective measures to guide future policies and interventions. This study, therefore, aims to examine and evaluate India's existing policies and strategies to combat AMR and reduce antimicrobial usage in livestock production, thereby strengthening One Health initiatives.

To initiate a comprehensive review of existing AMR policies, a focus group discussion involving 25 Senior Veterinary Surgeons was conducted at the Academic Staff College, Kerala Veterinary and Animal Sciences University, Thrissur, on 27th September 2024. The primary objectives were to perform a situational analysis of antimicrobial resistance (AMR) in veterinary practice, critically evaluate the effectiveness of current AMR containment strategies, identify systemic barriers to policy implementation and intersectoral collaboration, and propose actionable recommendations to enhance AMR mitigation efforts in India. A second round of discussions, conducted as an online focus group on 10th October 2024, engaged 15 public health specialists and veterinarians from diagnostic laboratories. This session aimed to assess the current status of AMR surveillance, identify associated challenges, and explore opportunities for improvement. The outcomes of these deliberations formed the thematic framework for a subsequent 'World Café' discussion, focused on reviewing AMR containment policies in India and generating evidence-based recommendations.

The AMR Conclave 2024, held on November 20 in Thrissur, Kerala, was a pivotal scientific event addressing the multifaceted challenge of antimicrobial resistance (AMR) through the One Health approach. The event was organized by the Department of Veterinary Public Health, College of Veterinary and Animal Sciences (CVAS), Mannuthy, in collaboration with ReAct Asia Pacific and INGSA-Asia. The conclave aimed to critically evaluate AMR strategies, identify barriers to policy implementation, and propose practical, actionable solutions. The event was part of the ongoing INGSA project, with Dr. Deepthi Vijay serving as the Organizing Secretary.

The inaugural session was graced by Dr. S. S. Lal, Director of ReAct Asia Pacific, who highlighted the urgency of operationalizing the State Action Plan on AMR. Dr. Lal emphasized the importance of the One Health framework in addressing the interconnected challenges of AMR in human, animal, and environmental health. During this session, a handbook titled "*One Health Approach to Antimicrobial Resistance: A Veterinary Perspective"* was released, providing a comprehensive reference for stakeholders.

The event featured compelling speeches by distinguished experts:

- **Dr. Sandhya Sukumaran (Global Health Security Technical Advisor, USAID):** Dr. Sandhya underscored the significance of infection prevention, equitable access to medicines, and robust biosecurity measures in animal farming. She stressed the role of community engagement in strengthening stewardship programs.
- **Dr. Devika Pillai (Assistant Director General (Inland Fisheries), ICAR):** Highlighting aquatic health, Dr. Devika elaborated on the importance of wastewater surveillance to monitor AMR pathogens. She illustrated the One Health linkages between aquatic systems and human and animal health**.**
- **Dr. Jyoti Misri (AMR and Zoonoses Specialist, FAO, New Delhi) FAO):** Dr. Jyoti detailed FAO's collaborative efforts with governments to promote integrated policies and strategies for AMR control. Dr. Jyoti emphasized the need for capacity building, intersectoral coordination and community involvement to mitigate AMR.

- **Dr. Previn Punnoose (Nodal officer (Animal Husbandry), Kerala Antimicrobial Resistance Strategic Action Plan):** Dr. Previn presented detailed data on AMR patterns in *E. coli* isolated from poultry, drawing attention to the significant contribution of intensified farming practices to the emergence and dissemination of resistance.

A total of 24 multidisciplinary experts participated in structured discussions guided by the World Café methodology. These discussions were organized around four thematic areas:

1. *Evaluating AMR Containment Strategies and Surveillance*: Assessing current efforts and identifying gaps in surveillance and stewardship.
2. *Identifying Barriers to Policy Implementation and Reviewing Action Plans*: Exploring systemic obstacles and proposing solutions for policy coherence.
3. *Fostering Cross-Sectoral Collaboration through One Health*: Strengthening intersectoral synergies and data-sharing mechanisms.
4. *Developing Practical and Actionable Recommendations*: Translating policies into practice with targeted interventions.

The conclave concluded with a unanimous call to action, emphasizing the critical need for:

- Integrated AMR surveillance systems linking human, animal, and environmental health sectors.
- Regulatory frameworks promoting rational antimicrobial use.
- Community-driven interventions to foster awareness and compliance.
- Capacity-building initiatives across healthcare, veterinary, and environmental sectors.

The AMR Conclave 2024 served as a platform for forging intersectoral partnerships, advancing evidence-based strategies, and reaffirming the One Health approach for combating AMR sustainably.

Introduction

Antimicrobial resistance (AMR) represents a critical global health crisis with profound implications for public health, food security, and environmental sustainability. Unchecked, AMR could result in 10 million deaths annually by 2050 and economic losses of up to USD 100 trillion globally. Low- and middle-income countries (LMICs) like India face disproportionate challenges, with factors such as over-the-counter antibiotic availability, inadequate regulation, and high population density accelerating resistance. According to the World Bank, failure to address AMR could reduce global GDP by 1.1% to 3.8% by mid-century, underscoring the urgent need for coordinated action. The inappropriate use of antimicrobials in human medicine, veterinary practices, aquaculture, and agriculture has been a significant driver of resistance. The use of critically important antimicrobials (CIAs) in livestock and food animals has further compounded the problem, creating reservoirs of resistant bacteria that can transfer to humans through direct contact, contaminated food, and environmental pathways.

The AMR Conclave 2024 was organized to address these challenges under the One Health framework, which recognizes the interconnected nature of human, animal, and environmental health. The conclave aimed to foster multidisciplinary collaboration, evaluate existing AMR containment strategies, and propose actionable solutions tailored to India's unique context. The event brought together 24 experts from diverse fields, including human healthcare, veterinary sciences, environmental science, aquaculture, and traditional medicine.

India's high antibiotic consumption, particularly in the veterinary and aquaculture sectors, underscores the urgency of implementing the One Health approach. With projections indicating that antimicrobial usage (AMU) in animal husbandry will double by 2030, efforts to mitigate AMR must prioritize responsible usage, enhanced surveillance, and robust regulatory frameworks. Surveillance studies in livestock have already revealed troubling resistance levels to critical drugs like colistin and third-generation cephalosporins, posing significant public health risks. Environmental AMR adds another dimension to the crisis. Effluent from hospitals, pharmaceutical industries, and livestock operations contaminates water and soil, creating reservoirs for AMR genes that can spread to humans and animals. Poor waste management practices in LMICs exacerbate this issue, with untreated animal waste releasing resistant bacteria into the environment. The need for advanced effluent treatment systems and environmental surveillance was a key focus of the conclave.

The AMR Conclave 2024 highlighted the necessity of integrating traditional medicine systems into AMR containment strategies. Ayurveda and other systems of traditional medicine offer preventive care approaches that can reduce dependency on antibiotics. As part of the event, experts emphasized the importance of biosecurity in mitigating AMR in animal husbandry. Enhanced biosecurity measures—such as improving housing conditions, isolating infected animals, and implementing rigorous hygiene protocols—can significantly reduce antimicrobial usage. Research has demonstrated that farms with better biosecurity have lower rates of AMR, validating this approach. The AMR Conclave 2024 served as a platform to foster cross-sectoral collaboration and advance evidence-based strategies for AMR mitigation. By focusing on integrated surveillance, rational antimicrobial usage, and grassroots-level awareness, the conclave reaffirmed the One Health approach as essential for addressing the AMR crisis. Through a combination of policy reforms, stakeholder engagement, and scientific innovation, India can lead the way in combating AMR while ensuring sustainable public health and food systems.

Methodology: World Café Approach

The World Café methodology, known for fostering interactive and collaborative discussions, was instrumental in structuring the deliberations during the AMR Conclave 2024. This approach provided a dynamic and inclusive platform for participants to share insights, analyze challenges, and co-create solutions. Its adaptability to multidisciplinary discussions made it particularly suitable for addressing the complex, intersectoral nature of antimicrobial resistance (AMR).

Structure and process: The methodology was designed around thematic tables, with each table dedicated to one of the four core areas of focus:

1. **Evaluating the effectiveness of existing AMR containment strategies**: Participants assessed the current state of AMR surveillance, stewardship programs, and policy frameworks across sectors. They identified gaps and areas requiring improvement.
2. **Identifying systemic barriers to policy implementation:** Discussions explored challenges such as regulatory weaknesses, resource constraints, and infrastructural gaps that hinder effective AMR policy enforcement.
3. **Exploring synergies under the one health framework**: The One Health approach was central to the discussions, emphasizing the interconnectedness of human, animal, and environmental health. Participants sought ways to enhance collaboration and data sharing across sectors.
4. **Developing practical and actionable recommendations for AMR containment:** The conclave aimed to translate discussions into concrete actions, proposing solutions that could be implemented at the local, regional, and national levels.

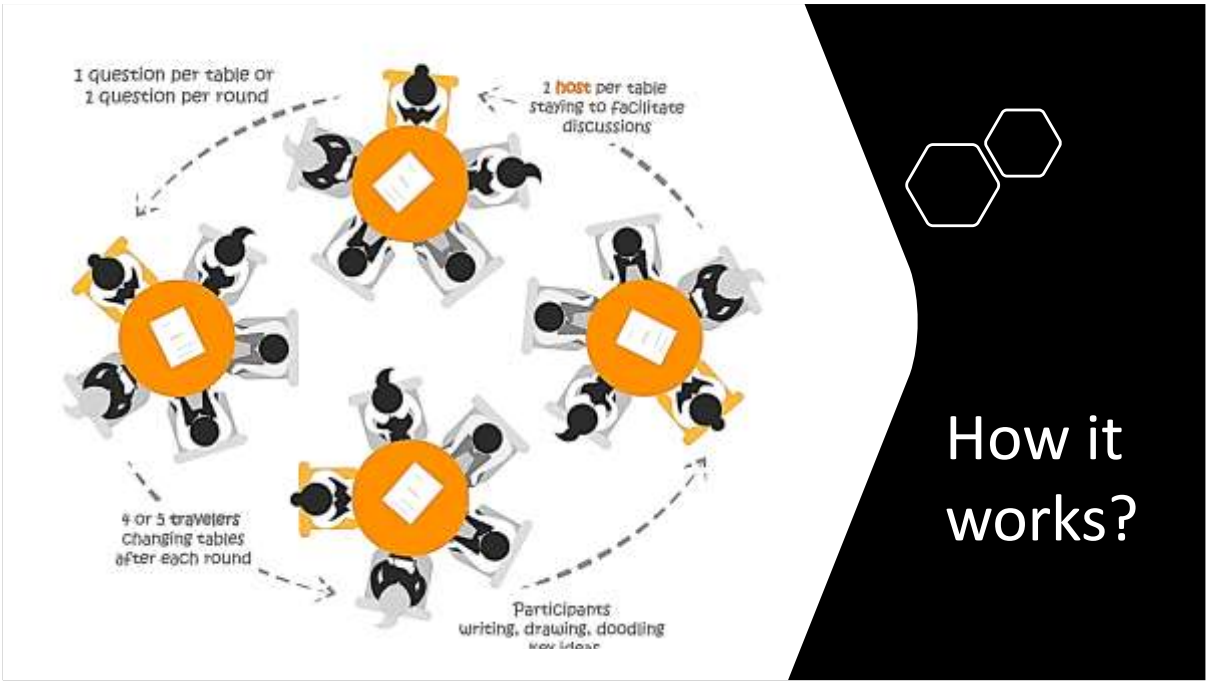
Participants, including experts from human health, veterinary sciences, aquaculture, environmental sciences, and traditional medicine, were divided into small groups to encourage in-depth discussions. Each group engaged with a specific theme, guided by a table facilitator responsible for moderating the discussion, documenting key insights, and maintaining focus on the objectives. After a fixed time, participants rotated to a new table, enabling cross-pollination of ideas and perspectives while allowing for continuity in discussions.

Key Features of the Activity

1. **Inclusivity:** The methodology allowed stakeholders from varied disciplines to contribute their expertise and experiences, ensuring a comprehensive understanding of AMR challenges.
2. **Collaborative environment:** The informal and open nature of the World Café discussions encouraged free-flowing dialogue, fostering innovation and creativity in problem-solving.
3. **Integration of perspectives:** By rotating participants between tables, the process ensured that ideas and insights from one group informed and enriched the discussions at other tables, promoting an integrated approach.
4. **Focus on actionable outcomes:** Each table aimed to generate specific, practical recommendations aligned with the theme, ensuring that discussions were outcome-oriented.

Role of Facilitators and Reporters: Each table had a dedicated facilitator and a reporter who played a crucial role in ensuring productive discussions. Facilitators guided participants through the thematic focus, encouraged active participation, and synthesized the group's insights into key points. Their contributions were essential for maintaining the flow of discussions and ensuring that the objectives were met. Reporters recorded insights, challenges, and recommendations from each round of discussions

Outcome Documentation: To ensure that the rich discussions translated into actionable outcomes, a systematic process for documentation was employed. The concluding session had the final presentation on all the four themes by each team captain summarizing the insights from each group on the four different themes. These notes were synthesized into a comprehensive report, which served as the basis for drafting the outcomes of the conclave.



Practical instructions

- **4 different tables:** one THEME per table
- **6 participants** on each table
- Each group has **01 facilitator & 01 reporter**
- Discussion time is **20 min** per table
- **Facilitator will stimulate** participants to create novel ideas
- **Reporter will compile** all the ideas
- **Last part:** compilation (**stick notes)** to be done by each group

Facilitators

Dr. K. Vrinda Menon **Theme 1*: Evaluating current AMR containment strategies and surveillance*** Associate Professor with 17+ years of experience specializing in *Listeria* and *Leptospira* species and leading the 'All India Network Project on Antimicrobial Resistance' at Kerala Veterinary and Animal Sciences University. Have guided more than 10 post graduate thesis	
Dr. Deepa Jolly **Theme 2*: Identifying barriers to policy implementation and reviewing action plans*** Assistant Professor with 17 years of experience focusing on *Campylobacter* species and leading the 'All India Network Project on One Health' at Kerala Veterinary and Animal Sciences University. Have guided 5 post graduate research projects.	
Dr. C. Sethulekshmi **Theme 3*: One Health approach and cross-sectoral collaboration*** Associate Professor with 17 years of expertise in food safety and water quality, heading the revolving fund project on 'Evaluation of Food and Water Quality', with 8 post graduate thesis	
Dr. Binsy Mathew **Theme 4*: Developing practical and actionable recommendations*** Assistant Professor having more than 12 years of experience in various realms of food safety and antimicrobial resistance. Have guided 6 MVSc thesis and recipient of Association of Indian Universities (AIU) Best PhD Thesis award.	

Reporters

Dr. Haritha V. Soman **Theme 1*: Evaluating current AMR containment strategies and surveillance*** Post Graduate scholar in the Department of Veterinary Public Health, College of Veterinary and Animal Sciences, Mannuthy with research work focussing on the seroprevalence of Leptospira spp. in occupational risk groups and cattle from hotspots in Pathanamthitta district, Kerala.	
Dr. Arunima K. M **Theme 2*: Identifying barriers to policy implementation and reviewing action plans*** A final-year MVSc scholar in the Department of Veterinary Public Health, with research on the antimicrobial resistance profiles of Enterococcus spp. isolated from pigs and pork sampled from organized slaughterhouses and retail outlets emphasizing its implications for public health and the One Health framework. Have intern experience at Charles Sturt University, Wagga Wagga, Australia	
Dr. Neeraja Krishna **Theme 3*: One Health approach and cross-sectoral collaboration*** Post Graduate student in the Department of Veterinary Public Health, College of Veterinary and Animal Sciences, Mannuthy, with research focusing on the occurrence of Campylobacter spp. in birds and their associated environments, along with their antibiotic resistance profiles.	
Dr. Sareen N. V **Theme 4*: Developing practical and actionable recommendations*** MVSc scholar in the Department of Veterinary Public Health of College of Veterinary and Animal Sciences, Mannuthy, with research focusing on investigating the occurrence of antibiotic-resistant *Escherichia coli* in ready-to-eat shawarma and sandwiches sourced from Thrissur and Ernakulam districts.	

Workshop themes

1. Evaluating Current AMR Containment Strategies and Surveillance

2. Identifying Barriers

3. One Health Approach & Cross-Sectoral Collaboration

4. Policy level recommendations to combat AMR

Thematic analysis

Theme 1: Evaluating Current AMR Containment Strategies and Surveillance

The evaluation of antimicrobial resistance (AMR) containment strategies across sectors reveals significant disparities in implementation, data integration, and resource allocation. Despite ongoing efforts, gaps in surveillance, infrastructure, and regulatory enforcement continue to hinder effective AMR containment. Addressing these challenges requires a systematic and collaborative approach that leverages existing frameworks while introducing targeted interventions to fill critical gaps.

Human Health

In the human health sector, surveillance systems such as WHONET are functional but suffer from limited data coverage and integration:

1. **Data gaps:**
   - WHONET captures data primarily from public health facilities, excluding private healthcare providers and smaller clinics that account for a substantial proportion of antibiotic prescriptions.
   - As a result, surveillance data often underrepresent community-level antimicrobial usage and resistance trends.
2. **Inconsistent prescription audits:**
   - Audits for antimicrobial prescriptions are inconsistently conducted and lack real-time tracking mechanisms. This limitation restricts the ability to monitor and regulate irrational prescription practices effectively.
3. **Variable IPC implementation:**
   - Infection prevention and control (IPC) programs differ significantly in their implementation across healthcare settings, particularly in resource-limited regions.
   - Poor IPC adherence exacerbates the spread of resistant pathogens in hospitals and clinics.

Proposed actions:

- Expand WHONET's reach to incorporate data from private healthcare facilities and primary healthcare centers in underserved regions.
- Digitize prescription audits and integrate them with electronic health records (EHR) for real-time monitoring and intervention.
- Establish national IPC guidelines with regular training programs to standardize implementation across healthcare settings**.**

Veterinary Sector

The veterinary sector faces unique challenges in AMR containment, primarily due to the absence of systematic surveillance and regulatory oversight

1. **Research-driven surveillance:**
   - AMR monitoring in the veterinary sector is often limited to research initiatives, lacking integration into routine veterinary practices.
   - This gap results in fragmented data that cannot inform policy or intervention effectively.
2. **Reliance on Empirical Treatment:**
   - The limited availability of affordable diagnostic tools forces veterinarians to rely on empirical treatment, increasing the risk of inappropriate antimicrobial use.
3. **Unregulated Antibiotic Sales:**
   - Over-the-counter antibiotic sales are widespread, with no tracking systems in place to monitor usage patterns or ensure rational prescribing.
4. **Disposal of used and expired antibiotics:**
   - Disposal of used antibiotics in the veterinary sector remains a critical concern. Unregulated disposal practices contribute to environmental contamination, promoting the spread of antimicrobial resistance.
   - The absence of clear guidelines for managing veterinary pharmaceutical waste exacerbates this issue, leaving veterinarians and animal farmers without proper disposal mechanisms.

Proposed actions:

- Develop veterinary-specific AMR surveillance frameworks integrated with national and global databases such as the OIE-WAHIS.
- Subsidize diagnostic tools and incentivize their adoption to promote evidence-based veterinary practices.
- Strengthen regulatory frameworks to restrict over-the-counter antibiotic sales and introduce prescription audits for veterinary medicines as well as clear guidelines for managing veterinary pharmaceutical waste

Fisheries Sector

Surveillance in the fisheries sector is minimal and primarily focused on export certification, overlooking broader public health implications

1. **Minimal surveillance:** Existing monitoring frameworks prioritize compliance with international trade standards rather than addressing domestic health risks.
2. **Misuse of antibiotics:** Antibiotics are commonly misused for growth promotion and disease prevention in aquaculture, often without professional oversight**.**
3. **Emerging fungicide resistance:** Resistance to fungicides, driven by their indiscriminate use, is an emerging concern that complicates AMR management in aquaculture.

Proposed actions:

- Strengthen the national AMR surveillance program for fisheries that includes clinical cases and healthy stock sampling to provide comprehensive data.
- Conduct targeted training programs for aquaculture operators on judicious antibiotic use and alternative practices such as probiotics and immunostimulants.
- Collaborate with fisheries research institutes to identify and mitigate resistance trends specific to aquatic environments.

Environmental Health

Environmental factors play a significant role in the propagation of AMR, with inadequate effluent treatment and limited surveillance exacerbating the problem

1. **Inadequate effluent treatment:** Effluent treatment plants (ETPs) in hospitals, pharmaceutical industries, and livestock farms are often insufficient to eliminate resistant bacteria and antibiotic residues.
2. **Limited geographical scope:** Sampling efforts for environmental AMR hotspots are restricted to select regions, limiting the identification and understanding of resistance trends.
3. **Lack of regulatory specificity:** Environmental policies rarely address AMR directly, leaving significant gaps in mitigation strategies for contaminated water and soil.

Proposed actions:

- Mandate advanced effluent treatment protocols for healthcare and pharmaceutical facilities, supported by government incentives to ensure compliance.
- Expand environmental sampling to cover diverse geographical regions, prioritizing areas with high antibiotic usage.
- Develop AMR-specific environmental policies, including waste management guidelines and effluent monitoring standards.

Theme 2: Identifying Barriers to Policy Implementation and Reviewing Action Plans

Effective policy implementation is a cornerstone of AMR containment. However, efforts in this direction face significant obstacles, including weak enforcement mechanisms, infrastructure deficits, limited awareness among stakeholders, and fragmented data systems. These barriers undermine the translation of well-intended policies into impactful actions, leaving critical gaps in AMR mitigation.

Key barriers

Regulatory challenges: The absence of robust regulatory frameworks and weak enforcement of existing laws contribute to inconsistent AMR containment efforts:

a) **Weak law enforcement:**
- In rural areas, enforcement mechanisms are often lacking, leading to widespread over-the-counter sales of antibiotics and their misuse.
- The absence of monitoring systems allows non-compliance with antimicrobial prescription guidelines.

b) Lack of sector-specific guidelines:
- Veterinary and fisheries sectors lack tailored guidelines for antimicrobial usage, creating ambiguities that hinder responsible practices.
- Regulatory frameworks often fail to incorporate sector-specific risks, such as the prophylactic use of antibiotics in aquaculture or the lack of diagnostic tools in veterinary medicine.

Infrastructure and resource deficits: Inadequate infrastructure and limited resources further impede the implementation of AMR policies:

a) Urban-centric diagnostics:
- Diagnostic facilities are predominantly located in urban areas, leaving rural regions underserved.
- The disparity in diagnostic access exacerbates reliance on empirical treatments, increasing the risk of inappropriate antimicrobial use.

b) Chronic underfunding:
- Veterinary and aquaculture sectors, critical components of the One Health framework, suffer from insufficient funding for AMR-specific initiatives.
- Budget constraints limit the establishment of surveillance systems and capacity-building programs.

Knowledge gaps among key stakeholders weaken AMR containment efforts:

a) Limited professional training:
- Healthcare workers, veterinarians, and aquaculture operators often lack training on AMR best practices and stewardship principles.
- Inadequate knowledge of resistance mechanisms and rational antimicrobial use leads to suboptimal practices.

b) Ineffective public awareness campaigns:
- Current campaigns fail to address behavioral and cultural factors, such as self-medication and the overuse of antibiotics in livestock.
- Communication strategies are not tailored to the specific needs of rural populations or marginalized communities.

Fragmented data systems: Data collection and reporting systems are siloed across sectors, limiting their utility for evidence-based policy design:

1. **Disjointed reporting mechanisms:**

- Human health, veterinary, and environmental data are often collected independently, hindering a holistic understanding of AMR trends.
- Lack of standardized protocols prevents data harmonization, reducing the effectiveness of surveillance systems.

2. **Limited accessibility:**
   - Data collected through research initiatives or isolated monitoring programs are rarely shared with policymakers, further limiting their impact.

Key insights from sectoral discussions

1. **Human health sector:**
   - The human health sector emphasized the importance of infection prevention and rational antimicrobial use in combating AMR. While the focus has often been on treating infections with antibiotics, there is a growing recognition that preventing infections through vaccination, improved sanitation, and hygiene is critical to reducing the need for antibiotics.
   - Antibiotic stewardship programs that promote the judicious use of antibiotics are essential, but they need to be more widely implemented across healthcare settings, including hospitals, clinics, and pharmacies.
   - In addition, surveillance systems in human health need to be enhanced to capture data more comprehensively and in real time, particularly from private healthcare settings, which often remain underrepresented in national AMR databases.

2. **Veterinary sector:**
   - The veterinary sector highlighted many critical areas for improvement: diagnostic stewardship, antibiotic tracking, farm biosecurity, hygiene and sanitation in animal farms
   - **Diagnostic stewardship** refers to the practice of ensuring that antibiotics are used only when absolutely necessary, guided by accurate diagnosis rather than empirical treatment. In many veterinary practices, especially in rural areas, diagnostic tools are either unavailable or underused, leading to the overprescription of antibiotics.
   - **Antibiotic tracking** is another key area for improvement. In the absence of systems to monitor antimicrobial use, it becomes difficult to understand patterns of resistance and to ensure that veterinary practices are in line with national and global standards. The introduction of antimicrobial use (AMU) tracking systems would help veterinarians make informed decisions and avoid contributing to AMR.
   - **Farm Biosecurity:** Enhanced biosecurity measures are pivotal in preventing disease outbreaks and reducing the need for antibiotics in animal husbandry. Effective biosecurity involves several layers of prevention. By minimizing the introduction and spread of infections, farms rely less on antibiotics for treatment or prevention, decreasing selective pressure that fosters the emergence of resistant bacteria. Further, robust biosecurity ensures healthier livestock, reducing the risk of infections that might otherwise require prolonged or broad-spectrum antimicrobial treatment. Practices like quarantining infected animals and managing pests prevent the spread of resistant pathogens between animals, farms, and the environment.
   - **Hygiene and Sanitation**: Rigorous hygiene and sanitation practices on farms can significantly lower the risk of infections, thereby reducing the reliance on antibiotics. Key components include:
     - **Cleaning and Disinfection**: Regular cleaning of animal housing, feeding equipment, and other farm facilities to eliminate potential reservoirs of pathogens.
     - **Waste Management**: Proper disposal and treatment of animal waste to prevent contamination of surrounding areas and water bodies with resistant bacteria. Proper waste management prevents antibiotics or resistant bacteria in animal excreta from contaminating soil and water sources, reducing the environmental spread of resistance genes.

- **Worker Hygiene**: Ensuring farm workers are trained in hygiene protocols, including handwashing, use of personal protective equipment (PPE), and limiting contact with sick animals. Training workers in proper hygiene ensures responsible handling of animals and equipment, reducing cross-contamination and unnecessary antimicrobial exposure.

- **Water Quality in Animal Farms**: Maintaining high water quality is essential to curbing the spread of antimicrobial-resistant bacteria in farm environments. Actions include:
  - **Routine Water Testing**: Regular testing for microbial contamination, heavy metals, and antibiotic residues in drinking water and irrigation systems used on farms.
  - **Water Treatment Systems**: Installing filtration or treatment systems, such as chlorination or UV treatment, to ensure the availability of safe water for livestock.
  - **Preventing Runoff**: Constructing proper drainage systems to prevent farm waste and antibiotics from contaminating nearby water bodies.
  - **Sustainable Water Use**: Promoting sustainable water practices, such as recycling and natural filtration through wetlands, limits environmental exposure to antibiotics and resistant bacteria.

3. **Environmental sector:**
   - The environmental sector raised concerns about the routine monitoring of antibiotic residues and resistant organisms in the environment, particularly in water and soil. Antibiotic residues from agricultural runoff, sewage, and hospital effluents contaminate water bodies, creating reservoirs of resistant bacteria that can spread to both humans and animals. The improper disposal of unused antibiotics into the environment further exacerbates this issue, contaminating soil and water systems, fostering the development of antimicrobial resistance, and negatively impacting ecosystems and biodiversity.
   - Environmental surveillance is currently insufficient, with only limited monitoring of effluent treatment plants and agricultural runoff. More comprehensive monitoring, coupled with the implementation of stricter environmental regulations, is necessary to curb the spread of AMR in the environment.
   - Additionally, the role of wastewater treatment was highlighted, as inadequate treatment processes can fail to remove antibiotic-resistant pathogens from hospital and industrial effluents, allowing them to persist in the environment and further fuel resistance.

Theme 3: One Health Approach and Cross-Sectoral Collaboration

The One Health approach is critical for addressing the global challenge of antimicrobial resistance (AMR), given the complex interdependencies between human health, animal health, and the environment. AMR does not recognize boundaries between these sectors, making cross-sectoral collaboration essential. However, integrating these domains into a unified strategy presents significant challenges, including regulatory fragmentation, sectoral silos, and gaps in data-sharing mechanisms.

Challenges to integration

- **Sectoral silos:**
  - Despite the clear connections between human, animal, and environmental health, these sectors often operate independently, with separate regulatory frameworks and policies. This leads to disjointed efforts in AMR containment and delays in response to emerging resistance patterns.
  - For instance, veterinary practices may prescribe antibiotics based on empirical evidence without access to real-time human health data on resistance trends. Similarly, environmental health policies may not adequately address the role of agricultural runoff in spreading resistant bacteria.

- **Underutilization of traditional medicine systems:**
  - In many countries, including India, traditional medicine systems such as Ayurveda, which emphasize preventive care and natural remedies, are not fully integrated into AMR containment strategies.
  - These systems often offer alternatives to antibiotics for managing infections, particularly in the context of zoonotic diseases, and their potential role in reducing antimicrobial dependence has yet to be fully explored.
  - Integrating traditional medicine into AMR containment strategies can offer a holistic, culturally relevant approach to reducing the reliance on antibiotics, particularly in rural communities.

- **Poorly developed data-sharing mechanisms:**
  - Poorly developed data-sharing mechanisms:
  - One of the most significant barriers to the One Health approach is the lack of robust data-sharing mechanisms between the human, animal, and environmental health sectors.
  - Surveillance data are often collected in silos, making it challenging to track the movement of resistant pathogens across sectors. For instance, data on antibiotic use in agriculture is rarely integrated with public health surveillance, impeding efforts to identify and address emerging resistance patterns.
  - The lack of standardized protocols for data collection and sharing further hinders the development of a comprehensive understanding of AMR trends. Furthermore, the absence of collaborative, cross-sectoral programs with commonly defined objectives and common funding prevents the implementation of cohesive strategies to combat AMR effectively.
- **Lack of a Unified One Health Policy**:
  - Despite the recognized importance of the One Health approach, the absence of a comprehensive policy limits the integration of human, animal, and environmental health initiatives.
  - The lack of such a national level policy will hinder with the efficient fund allocation and sharing. Cross-sectoral AMR mitigation efforts are often underfunded, with limited mechanisms to pool resources across sectors for unified actions.

Recommendations for enhancing the One Health approach

1. **Foster cross-sectoral collaboration:**

- To address AMR effectively, cross-sectoral collaboration is essential. Governments should create platforms for regular dialogue between health ministries, agricultural bodies, veterinary services, and environmental agencies to ensure a coordinated approach to AMR.

- Multi-disciplinary task forces could be established at the national and regional levels, ensuring that AMR mitigation efforts are aligned across human, animal, and environmental health sectors.

2. **Integrate traditional medicine into AMR strategies:**

- Traditional medicine systems such as Ayurveda should be recognized for their potential role in reducing AMR. By incorporating traditional medicine into AMR containment strategies, countries can provide culturally acceptable alternatives to antibiotics, particularly in rural areas.
- Research into the antimicrobial properties of plant-based remedies and other natural treatments could offer valuable alternatives to traditional antibiotic therapies, reducing the reliance on synthetic antibiotics in both human and veterinary medicine.

3. **Develop robust data-sharing systems:**

- Establish a centralized, interoperable AMR database that integrates data from human health, veterinary, aquaculture, and environmental sectors. This platform should be standardized and accessible to all stakeholders, allowing for real-time data collection and trend analysis.
- This data-sharing system should also incorporate global AMR surveillance networks, such as the World Health Organization's Global Antimicrobial Resistance and Use Surveillance System (GLASS), to facilitate international cooperation and knowledge exchange.

4. **Strengthen surveillance and monitoring systems:**

- Improve surveillance systems to capture a comprehensive picture of AMR across all sectors. This includes integrating surveillance efforts across human, animal, and environmental health domains, enabling the early detection of emerging AMR trends and providing the data needed to inform interventions.
- Regular monitoring of antibiotic residues in water bodies, soil, and agricultural runoff should be implemented, alongside enhanced regulations for wastewater treatment and agricultural practices.

5. **Increase investment in AMR education and training:**

- AMR education programs should be expanded to include all sectors. For healthcare workers, veterinarians, and aquaculture operators, training should focus on diagnostic stewardship, rational antimicrobial use, and the importance of cross-sectoral collaboration.
- Public awareness campaigns should also be launched to educate communities on the dangers of over-the-counter antibiotic use, self-medication, and the importance of hygiene in preventing infections

Theme 4: Developing Practical and Actionable Recommendations

The discussions under Theme 4 centered on bridging the gap between policy development and on-ground implementation to achieve measurable outcomes in antimicrobial resistance (AMR) containment. Participants emphasized the importance of actionable, context-specific solutions that address immediate challenges while paving the way for long-term sustainability. Key areas of focus included infection control, diagnostic capacity, surveillance infrastructure, and fostering innovation.

Short-term actions

1. **Expand Infection Control Programs (IPC) in hospitals:** Infection control is a cornerstone of AMR containment. While many hospitals have infection prevention and control (IPC) programs, their implementation often varies.

   Proposed actions:
   - Ensure that all healthcare facilities, including secondary and tertiary care hospitals, adhere to IPC guidelines established by the World Health Organization (WHO).
   - Regularly train healthcare workers on hand hygiene, sterilization techniques, and antibiotic stewardship principles.
   - Monitor IPC compliance through periodic audits and public reporting to increase accountability.
2. **Deploy mobile diagnostic labs:** Many remote and underserved regions lack access to diagnostic facilities, resulting in overuse of broad-spectrum antibiotics.

   Proposed actions:
   - Introduce mobile diagnostic units equipped with advanced tools for rapid microbial identification and antimicrobial susceptibility testing (AST).
   - Focus deployment in rural and high-burden areas to improve access and enable timely treatment decisions.
   - Collaborate with local health departments to integrate these units into community health programs.
3. **Mandate digital prescription audits:** Digital tools can transform how antimicrobial prescriptions are monitored, enabling real-time intervention and reducing irrational use.

   Proposed actions:
   - Implement electronic prescription systems in both urban and rural healthcare settings, mandating that all prescriptions be recorded and audited.
   - Use AI-powered platforms to analyze prescribing patterns, flag non-compliance, and recommend corrective measures.
   - Provide training for healthcare providers to ensure smooth adoption of digital prescription systems.

Long-term goals

1. **Establish a network of integrated AMR surveillance labs:** A robust network of surveillance labs is essential to monitor resistance trends and inform national AMR strategies.

   Proposed actions:
   - Develop integrated lab networks across human, animal, and environmental sectors, ensuring data interoperability and real-time accessibility.
   - Leverage AI and machine learning to identify resistance patterns, predict outbreaks, and optimize resource allocation.
   - Provide adequate funding and capacity-building programs to maintain high operational standards.

2. **Encourage innovation in antibiotic alternatives:** The development of novel therapeutic options is vital to reduce dependency on traditional antibiotics.
   Proposed actions:
   - Promote research into bacteriophage therapy, which targets specific pathogens without harming the host microbiota.
   - Invest in the development of plant-based antimicrobials and immune-boosting therapies, particularly those aligned with traditional medicine systems like Ayurveda.
   - Support clinical trials and accelerate regulatory approvals for innovative treatments.

3. **Develop Public-Private Partnerships (PPPs):** Sustainable AMR mitigation requires the mobilization of both public and private resources.
   Proposed actions:
   - Engage pharmaceutical companies, biotech firms, and academic institutions in collaborative research projects.
   - Establish financial models that incentivize private-sector investment in AMR containment, such as tax breaks and innovation grants.
   - Create platforms for dialogue between policymakers and private-sector stakeholders to align objectives and share progress.

Collaborative Initiatives

1. **Organize intersectoral workshops:** Regular workshops can foster collaboration, align objectives, and ensure consistent progress across sectors.
   Proposed actions:
   - Host workshops at national and regional levels, involving stakeholders from healthcare, veterinary, aquaculture, and environmental sectors.
   - Use these forums to share best practices, discuss challenges, and refine strategies based on emerging evidence.
   - Include international experts to provide a global perspective and insights from successful AMR programs.

2. **Provide financial incentives for sustainable practices:** Encouraging industries to adopt environmentally sustainable practices can reduce AMR risks significantly.
   Proposed actions:
   - Offer subsidies or tax incentives to healthcare facilities, pharmaceutical companies, and agricultural enterprises that implement advanced effluent treatment systems or adhere to responsible antimicrobial use guidelines.
   - Recognize and reward exemplary organizations through certifications or public accolades, encouraging wider adoption of sustainable practices.

3. **Partner with Global Organizations:** Global partnerships can provide funding, technical expertise, and knowledge exchange to enhance local AMR efforts.
   Proposed actions:
   - Collaborate with organizations like the WHO, FAO, OIE, and the Global AMR R&D Hub to leverage global expertise and resources.
   - Apply for grants and technical assistance programs to strengthen national AMR initiatives.
   - Participate in global AMR networks and conferences to share progress, learn from international experiences, and advocate for regional needs.

Additional recommendations

1. **Strengthen education and awareness campaigns:**
   - Conduct public awareness drives focusing on the dangers of self-medication, the importance of completing prescribed antibiotic courses, and the role of hygiene in preventing infections.
   - Include AMR-related topics in school curriculums to educate younger generations on the importance of rational antimicrobial use.
2. **Establish AMR stewardship committees:**
   - Form committees at institutional, regional, and national levels to oversee AMR stewardship programs, evaluate outcomes, and recommend improvements.
3. **Encourage community-led monitoring and advocacy:**
   - Empower local communities to monitor AMR trends and advocate for responsible antimicrobial use through citizen-led initiatives.

Outcomes and Conclusions

The AMR Conclave 2024 highlighted the critical need for integrated, sustainable, and actionable strategies to combat antimicrobial resistance (AMR), emphasizing the importance of the One Health approach. This framework recognizes the interconnection of human, animal, and environmental health and aims to unify efforts across these domains. The conclave brought together stakeholders from various sectors to deliberate on the challenges and propose solutions, resulting in a set of key outcomes and recommendations aimed at strengthening AMR containment efforts.

1. **Establishing robust AMR Surveillance systems across sectors**
   A comprehensive surveillance system is essential for understanding and addressing the dynamics of AMR. The conclave underscored the need for robust and integrated surveillance systems that encompass human, animal, and environmental health sectors. Current surveillance efforts are fragmented, often restricted to specific domains, and fail to capture a holistic picture of resistance trends. Participants emphasized the importance of linking existing surveillance frameworks, such as WHONET, with veterinary and environmental monitoring systems to create a unified database.
   This integrated system would enable the early detection of resistance patterns, identification of AMR hotspots, and real-time sharing of actionable data across sectors. Additionally, the use of advanced technologies such as artificial intelligence (AI) and geographic information systems (GIS) can enhance predictive modeling and resource allocation, ensuring that interventions are both timely and effective.
2. **Enhancing diagnostic infrastructure and capacity building**
   Limited diagnostic infrastructure and the lack of skilled personnel were identified as significant barriers to effective AMR containment. The conclave called for expanding diagnostic facilities to underserved areas, particularly rural and peri-urban regions where empirical treatment is more common due to the unavailability of diagnostic tools. Mobile diagnostic labs were proposed as a short-term solution to bridge this gap, while investments in permanent infrastructure were recommended for long-term sustainability.
   Capacity building for healthcare providers, veterinarians, and aquaculture professionals was also a major focus. Training programs on antimicrobial stewardship, diagnostic stewardship, and infection prevention were deemed essential for equipping professionals with the knowledge and skills required to combat AMR. The conclave emphasized that continuous education and upskilling should be institutionalized to keep pace with evolving challenges in resistance management.
3. **Driving policy coherence and regulatory enforcement**
   The conclave highlighted the need for harmonized policies that ensure coherence across human, veterinary, and environmental health sectors. Regulatory inconsistencies, particularly in the veterinary and fisheries sectors, were identified as key obstacles to rational antimicrobial use. Strengthening regulatory frameworks and enforcing compliance were prioritized to address these gaps. Participants advocated for mandatory prescription audits, stricter regulations on over-the-counter antibiotic sales, and the adoption of sector-specific guidelines for antimicrobial use. To ensure effective enforcement, collaboration between regulatory authorities and industry stakeholders was recommended. By aligning policies with global standards set by WHO, OIE, and FAO, countries can enhance their AMR containment strategies while fostering international cooperation.
4. **Promoting grassroots engagement and community-led interventions**
   Public awareness and community involvement are fundamental to the success of AMR containment initiatives. The conclave stressed the importance of grassroots engagement through targeted awareness campaigns that address the behavioral and cultural drivers of antimicrobial misuse. Campaigns should focus on educating communities about the dangers of self-medication, the importance of completing prescribed courses of antibiotics, and the role of hygiene in infection prevention.
   Community-led interventions were proposed as a means to empower local populations to take ownership

of AMR mitigation efforts. By training community health workers, farmers, and aquaculture operators, these interventions can foster a sense of accountability and ensure that AMR strategies are implemented effectively at the grassroots level. Additionally, leveraging digital platforms and social media can expand the reach of awareness campaigns and engage younger populations in AMR advocacy.

The need for unified, cross-sectoral strategies

The conclave reaffirmed the urgency of adopting unified, cross-sectoral strategies to address the growing threat of AMR. The fragmented nature of current efforts often leads to inefficiencies and missed opportunities for collaboration. The One Health approach, which integrates human, animal, and environmental health, was emphasized as the most effective framework for AMR containment. By fostering intersectoral collaboration, data sharing, and joint policymaking, this approach ensures that all sectors work together toward a common goal.

Conclusion

The AMR Conclave 2024 underscored the critical importance of combating AMR through coordinated, evidence-based, and sustainable approaches. The outcomes of the conclave provide a comprehensive roadmap for strengthening surveillance, enhancing diagnostic capacity, driving policy coherence, and promoting community engagement. By prioritizing these actions, countries can not only safeguard public health but also ensure environmental sustainability and food security in the face of the growing AMR threat. The conclave demonstrated that with unified efforts, AMR can be effectively mitigated, protecting the efficacy of antimicrobials for future generations.