Centre for Health Research and Innovation

PATH

GSK

# Consultative meeting report Safe disposal of unused and expired antibiotics for antimicrobial resistance (AMR) containment in Maharashtra

# Contents

# Preface

This report summarizes the key deliberations and outcomes of the "Consultative meeting on the safe disposal of unused and expired antibiotics for AMR containment in Maharashtra," held on January 12, 2026, in New Delhi. The meeting brought together government officials, policymakers, regulators, clinicians, researchers, financing experts, innovators, and global partners. The discussions highlighted that antimicrobial resistance (AMR) is not only a clinical challenge but also a significant environmental and governance concern. Safe disposal of antibiotics emerged as a critical, yet often overlooked, component of India's AMR strategy.

*Antimicrobial resistance (AMR) is not only a clinical and research challenge, but also an environmental concern. Safe disposal of antibiotics is a part of controlling AMR. Let us take responsibility for not only using antibiotics but also disposing off their unused/expired doses.*

**Dr. Vinod Paul**
*Member, NITI Aayog*

# About the project

The project, Promoting safe disposal of unused or expired antibiotics to mitigate antimicrobial resistance in Maharashtra, addresses a critical and often overlooked driver of antimicrobial resistance (AMR): the improper disposal of antibiotics. In India, unused and expired medicines from households and health care facilities are frequently discarded through unsafe practices, such as flushing, mixing with household waste, or storing them indefinitely. These practices contribute to environmental contamination, increase the risk of accidental misuse, and accelerate the development of AMR.

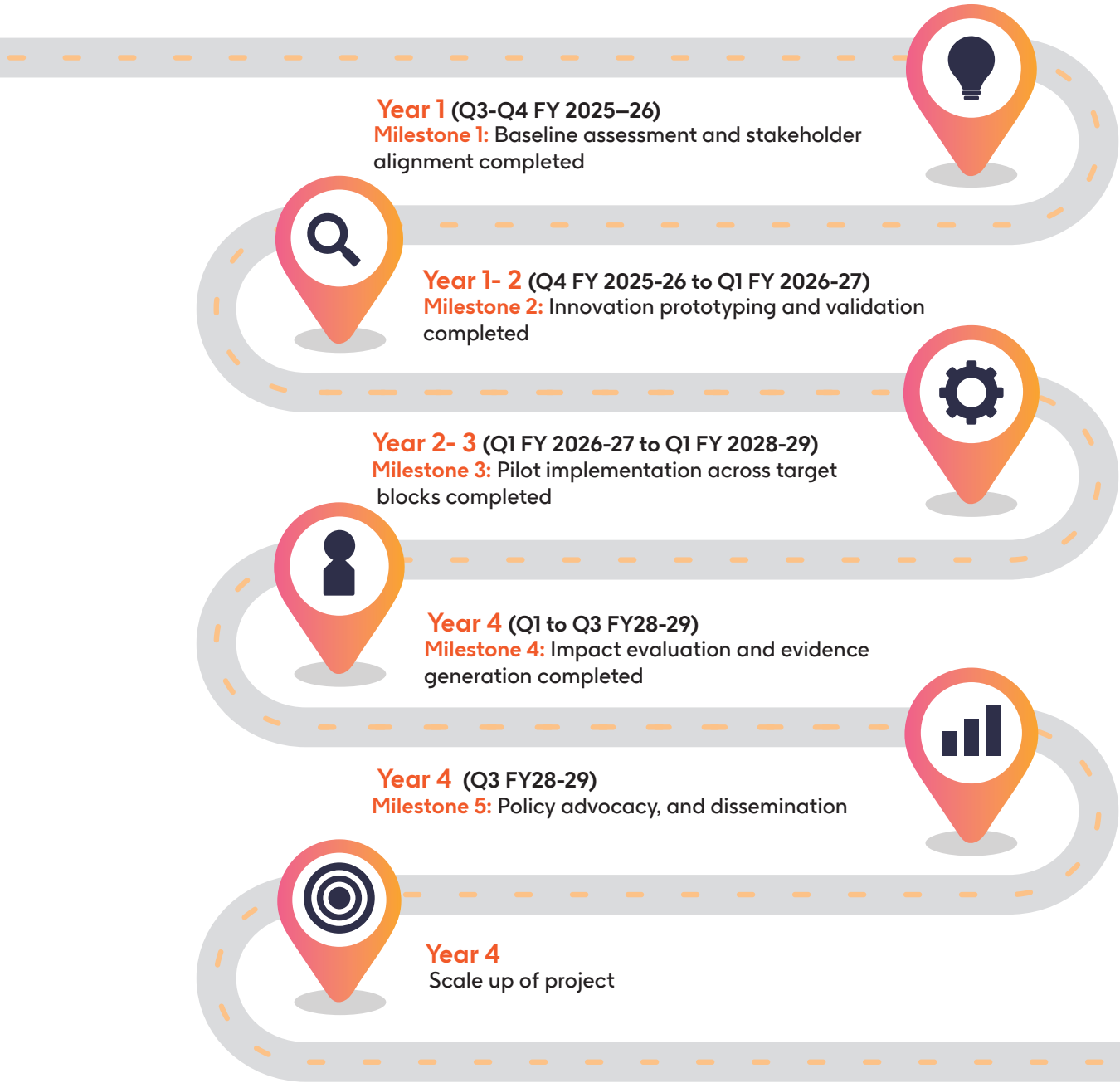
This initiative aims to design and pilot evidence-based, community-driven solutions to promote safe antibiotic disposal in selected districts of Maharashtra. The program is supported by GSK cares - a CSR initiative and implemented in collaboration with the Department of Public Health, Government of Maharashtra, with technical support from partner organizations.

The program uses a phased approach. In the first phase, CHRI will generate evidence to inform intervention design. Activities include a knowledge, attitudes, and practices (KAP) assessment and a technical landscape analysis to understand community behaviors, identify system gaps, and review existing guidance on medicine disposal. Findings from this phase will inform the development of context-appropriate solutions.

In the second phase, CHRI and partners will implement evidence-informed interventions. Key activities include stakeholder consultations, community awareness efforts, health technology innovation, capacity building of health care providers and community stakeholders, and pilot pharmacy-based medicine take-back models. These efforts aim to promote responsible disposal practices and strengthen integration within existing health systems.

The project will be implemented over multiple years and will include pilot testing, community engagement, and impact evaluation. Evidence generated through this work will contribute to strengthening Maharashtra's approach to AMR containment and inform policy efforts to institutionalize safe disposal systems at scale.

**Geography for implementation:**
8 blocks from two districts, of Maharashtra state



# Key insights from leaders and experts

This section captures the insights and perspectives shared by panelists during the consultative meeting. These reflect the collective views of policymakers, regulators, clinicians, researchers, industry representatives, and development partners on the importance of the safe disposal of unused and expired antibiotics for antimicrobial resistance (AMR) containment.

The quotes below are presented thematically to reflect the breadth of the discussion while retaining each speaker's original articulation. They provide the contextual foundation for the synthesis presented in the executive summary.

## Safe disposal as a public health, environmental, and governance responsibility

*"Safe disposal of unused and expired antibiotics is a shared civic responsibility. It is a crucial part of India's efforts to combat antimicrobial resistance."*

**- Dr. Nitin Ambadekar, Director Health Services, Mumbai, Maharashtra**

*"Unused and expired antibiotics should never become silent drivers of antimicrobial resistance. Safe disposal must be embedded in national stewardship efforts, supported by coherent regulation and effective systems for collection and accountability."*

**- Dr. Catharina Boehme, Officer in Charge, WHO South East Asia**

*"A systems-level intervention to implement safe antibiotic disposal practices in the community has crucial implications for public health, environmental safety, health security, and One Health. Wastewater monitoring is an important tool."*

**- Dr. NK Arora, Executive Director, INCLEN Trust**

*"Safe disposal of unused or expired antibiotics reflects our commitment to preventing AMR and promoting healthier communities."*

**- Dr. Mahesh Khalipe, District Health Officer, Satara**

## Prescribing, awareness, and behavior change

*"Make disposal part of prescribing dialog."*

**- Dr. Kamini Walia, Senior Scientist, ICMR**

*"The 4 A's:*
*1. Awareness for rational use*
*2. Awareness of prescribing*
*3. Awareness of distribution by chemist*
*4. Awareness of disposal by end user*
*a. Take back by chemist*
*b. Take back by public health systems"*

**- Dr. Shirshendu Mukherjee, Managing Director, Wadhwani Foundation**

*"Creating awareness in public, pharmacist and medical referrals."*

**- Dr. Narendra Saini, Clinical Microbiologist, Chairman Standing Committee, Indian Medical Association**

*"Antibiotics saved lives. But this only happens when we use and dispose of them carefully. Proper disposal protects our health and our future."*

**- Dr. Yuvraj Karpe, Civil Surgeon, Satara**

## Implementation gaps, regulation, and urgency for action

*"By the time without prescription over the counter sale of antibiotics is stopped, it'll be too late. We can't just wait and watch AMR rise. Tackling antibiotic waste appropriately can be started immediately."*

**- Dr. Ankur Mutreja, Director of External Affairs and Health Security, PATH**

*"Implementation of law regarding safe disposal."*

**- Dr. Narendra Saini, Clinical Microbiologist, IMA**

## Technology, data, and innovation

*"AI powered digital systems can revolutionize prescription audits and guide safe disposal, promoting the rational use of antibiotics."*

**- Dr. YK Gupta, President, AIIMS Kalyani**

*"Data as the center piece to generate evidence and guide implementation."*

**- Dr. Tavpritesh Sethi, Professor, IIIT Delhi**

## Community engagement and accessibility

*"Community can play a critical role in reducing the threat of antimicrobial resistance by safe disposal of antibiotics."*

**- Dr. Ajay Kumar Khera, Country Representative, Engender Health**

*"In cities where medicines are easily accessible, responsible disposal must also be easy to access for the containment of antimicrobial resistance."*

**- Dr. Vaishali Jadhav, Pune Municipal Corporation**

*"Save antibiotics, save environment."*

**- Dr. Ruby Raphel, Manager, Hetero Drugs Ltd.**

# Executive summary

Antimicrobial resistance (AMR) is an escalating public health challenge with wide-ranging implications for human health, environmental sustainability, and health system resilience in India. While significant efforts have focused on promoting rational antibiotic use and regulating over-the-counter sales, the safe disposal of unused and expired antibiotics remains an insufficiently addressed component of national- and state-level AMR containment strategies. Improper disposal practices enable antibiotic residues to enter soil and water systems, creating conditions that facilitate the development and spread of resistant microorganisms across human, animal, and environmental interfaces.

To examine this critical gap, the "consultative meeting on the safe disposal of unused and expired antibiotics for AMR containment in Maharashtra" was convened on January 12, 2026, in New Delhi by the Centre for Health Research and Innovation (CHRI), PATH, and GSK Cares. The meeting brought together senior government officials, policymakers, regulators, clinicians, researchers, industry representatives, and global development partners to assess current practices, understand system readiness, identify policy and implementation challenges, and explore pathways for strengthening safe disposal mechanisms, with a focus on Maharashtra.

## Key observations

Discussions during the consultation highlighted that unsafe disposal of antibiotics is prevalent at household, community, and facility levels, with medicines commonly discarded through municipal waste streams or flushed into drains. Although regulatory provisions exist under the Drugs and Cosmetics Rules, Biomedical Waste Management Rules, and recent guidance issued by the Central Drugs Standard Control Organisation (CDSCO), implementation remains inconsistent. Key challenges identified include limited awareness among health care providers, pharmacists, and the public; inadequate segregation and tracking mechanisms; weak enforcement and monitoring; and insufficient integration between health care systems, waste management infrastructure, and environmental oversight.

At the same time, the consultation underscored that important elements required for implementation are already present within the system. These include existing waste management frameworks, ongoing pilot initiatives, emerging pharmacy-based collection models, and the growing availability of digital health tools. Participants noted that these elements provide a foundation upon which more systematic, accountable, and scalable disposal mechanisms can be built, provided there is stronger leadership ownership and coordination.

A strong and consistent message across discussions was the need to situate the safe disposal of antibiotics within a One Health framework. Participants emphasized that significant antibiotic use occurs beyond human health, particularly in animal husbandry, agriculture, and aquaculture, often with limited regulation or surveillance. Fragmented governance across sectors was identified as a major barrier to effective AMR containment, reinforcing the need for integrated policies, shared accountability, and inter-sectoral coordination.

## Strategic considerations for Maharashtra

The consultation highlighted that Maharashtra possesses enabling conditions to advance structured approaches to safe antibiotic disposal, including an active AMR agenda, institutional capacity, and opportunities for public–private and CSR enabled collaboration. Strategic considerations emerging from the discussions include embedding disposal protocols within state AMR action plans, piloting health facility  and pharmacy based collection mechanisms, strengthening linkages with biomedical and municipal waste management systems, generating reliable data to inform policy and scale up, leveraging digital platforms for monitoring and compliance, and institutionalizing coordination across health, animal, and environmental sectors.

The consultative meeting reaffirmed that strengthening systems for the safe disposal of unused and expired antibiotics is an important and actionable component of comprehensive AMR containment efforts. While policies and pilots exist, their effectiveness depends on sustained leadership commitment, clearer accountability, improved system integration, and continued engagement with communities and stakeholders across sectors. The deliberations documented in this report provide a foundation for informed decision-making and prioritization of next steps for Maharashtra, with potential relevance for broader state- and national-level policy discussions.

# Background

AMR is a complex and multifaceted challenge that requires coordinated action across human health, animal health, environmental systems, and governance structures. While initiatives have been undertaken to curb the over-the-counter sale of antibiotics without prescription, such interventions require sustained enforcement and typically yield results over the long term.

An important but often overlooked contributor to AMR is the unsafe disposal of unused or expired antibiotics. At the household level, antibiotics are frequently discarded through municipal waste streams or flushed into drains. These practices allow antibiotic residues to enter landfills and water bodies, potentially creating conditions that enable pathogens to develop and spread AMR.

Convened by CHRI, PATH, and GSK cares - a CSR initiative, the national consultative meeting on the safe disposal of antibiotics for AMR containment in Maharashtra brought together a diverse group of stakeholders to deliberate on system readiness, policy gaps, and implementation strategies for strengthening safe disposal practices. Discussions focused on identifying pragmatic and scalable approaches, including the potential for technology-led social and behavior change communication interventions in select districts of Maharashtra .

# ANTIMICROBIAL RESISTANCE
## Global Impact & Healthcare Burden

GLOBAL DEATHS - 2019

**1.27M**

Deaths directly attributable to AMR worldwide in 2019

**~5M**

Deaths associated with AMR complications globally

MOST VULNERABLE

**20%**

Of deaths occurred in children under 5 years of age

ECONOMIC RISK - BY 2050

**3.8%** Potential loss of world's annual GDP due to AMR (UNEP)

INDIA - 2019

**267,000**

Estimated deaths due to AMR in India (IHME data)

### HEALTHCARE BURDEN

Longer stays . Higher costs . More deaths
AMR leads to extended hospital stays, elevated treatment costs, and avoidable mortality - all preventable through better disposal practices.

### ROOT CAUSE

Unsafe disposal practices in homes and clinics contribute directly to community-wide AMR risks, accelerating resistance and endangering vulnerable populations.

Sources: IHME Global Burden of Disease 2019 | UNEP AMR Assessment | Global Research on AMR (GRAM)

## Objectives of the meeting

- Understand leadership perspectives on the safe disposal of unused and expired antibiotics
- Examine current practices and gaps in antibiotic disposal across the country
- Deliberate on safe disposal approaches within a One Health framework
- Assess system readiness and implementation challenges
- Identify actionable and scalable recommendations to strengthen safe disposal mechanisms

# Sessions and deliberations

## Session I: Inaugural and context-setting

The consultative meeting commenced with an inaugural and context-setting session that outlined the rationale, scope, and expectations of the consultation.

## Welcome address:


**Dr. Ankur Mutreja,** Director of External Affairs and Health Security, PATH, welcomed participants and set the context for the meeting. He outlined the growing concern around AMR and highlighted the potential role of unsafe disposal of unused and expired antibiotics in exacerbating the problem. Dr Mutreja presented the rationale for focusing on safe disposal and provided an overview of the project "Promoting safe disposal of unused and expired antibiotics to contain AMR in Maharashtra." He also articulated the objectives of the consultation and emphasized the need for actionable inputs to inform the roadmap for implementation.

## Special address:


**Dr. Nitin Ambadekar,** Director of Health Services, Department of Public Health, Government of Maharashtra, delivered the special address. He emphasized the importance of safe disposal of antibiotics as a key strategy for AMR containment and reaffirmed the Maharashtra government's support for the initiative led by CHRI, PATH, and GSK Cares. He also expressed the state's commitment to integrating evidence-based solutions into the public health system.

## Presentation on current practices


**Dr. Sachin Gupte,** Senior Advisor, PATH, presented an overview of the existing regulatory framework and current practices related to the disposal of unused and expired drugs across manufacturing units, pharmacies, healthcare facilities, and communities.
His presentation highlighted key gaps and challenges across the disposal pathway, setting the stage for subsequent panel discussions.

# Panel discussion I
# Leaders' perspective: safe disposal of antibiotics for AMR containment

## Overview

The panel examined the role of safe disposal of unused and expired antibiotics in addressing AMR by focusing on gaps in evidence, awareness, regulation, and implementation across health care and community settings.


Photo 1: Moderator-Dr. NK Arora, Executive Director, The INCLEN Internation Trust
Left-right panelists: Ms. Swati Srivastava, Deputy Drug Controller (India), CDSCO, DGHS, MoHFW; Dr. Kamini Walia, Senior Scientist, ICMR; Dr. Rajiv Kumar Pathni, Advisor, NHSRC; Dr. Y. K. Gupta President, AIIMS Kalyani; Dr. Deepika Nayar Chaudhery, Senior Health, Nutrition and Population Specialist, South Asia Region, World Bank; Mr. Neeraj Jain, Country Director – India & Director, Growth Operations – Asia, Middle East & Europe (AMEE), PATH, Dr. Ankur Mutreja, Director – External Affairs & Health Security, PATH

# Key discussion highlights

- Data and evidence gaps: Panelists highlighted the lack of reliable data on antibiotic consumption and the volume of unused and expired antibiotics generated at household and health care facility levels, limiting evidence based decision making.

- Unsafe disposal practices: Unused and expired antibiotics are commonly disposed of through municipal waste or drains, contributing to environmental contamination and antibiotic residues in soil and water. Aligning disposal practices with biomedical and municipal waste management systems was emphasized.

- Awareness and leadership gaps: Limited awareness exists among health care professionals, hospital leadership, pharmacists, and communities regarding disposal risks and protocols. Panelists stressed the need for leaders of health care institutions to actively champion safe disposal practices and for community level awareness initiatives.

- System readiness and accountability: Antibiotics are not routinely segregated for disposal in health care facilities, and monitoring mechanisms are weak. Strengthening linkages with common biomedical waste treatment facilities (CBWTFs) and introducing reverse supply chain mechanisms were discussed as potential solutions.

- Policy and regulatory frameworks: While guidelines and provisions exist under CDSCO advisories, Drugs and Cosmetics Rules, and the Biomedical Waste Management Rules, enforcement remains inconsistent. The National Action Plan on AMR (NAP AMR 2.0) provides an enabling framework for awareness and implementation at national and state levels.

- Leadership models and state innovations: Hospital level ownership by senior administrators was identified as critical. State level innovations, particularly Kerala's "Antibiotic Smart" accreditation and the proud program for collecting unused and expired medicines, were highlighted as promising models.

- **Financing and health security perspective:** The panel noted ongoing technical and financial support from the World Bank under the One Health framework. AMR was consistently framed as a health security concern requiring sustained funding and coordinated global action.

## Conclusion

The panel concluded that although policies and guidelines for safe disposal of antibiotics exist, implementation is weak due to limited leadership ownership, inadequate data, and insufficient monitoring. Strengthening accountability, defining measurable indicators, integrating disposal into accreditation and monitoring systems, and promoting state led models and peer learning were identified as priorities to advance safe disposal practices.

# Panel discussion II
# Safe disposal: system readiness and implementation

## Overview

The panel explored system readiness for safe disposal of antibiotics in India, focusing on environmental risks, existing practices, feasibility of disposal models, industry roles, and the potential of digital solutions to support implementation.


Photo 2: Moderator—Dr. Kamini Walia Senior Scientist, ICMR
Left-right panelists: Dr. Shirshendu Mukherji Managing, Director, Wadhwani Innovation Network, Wadhwani Foundation; Dr. Ankur Mutreja, Director – External Affairs & Health Security, PATH; Dr. Anuj Sharma, Focal Point-AMR WHO Country Office, India; Dr. Ruby Raphel, Manager, Clinical Development & Medical Affairs, Hetero Drugs Ltd.; Dr. Rajeev Sharma, Vice President, Tata 1mg

# Key discussion highlights

- Environmental impact and evidence: Panelists discussed evidence from the World Health Organization (WHO) South East Asia and national studies indicating the presence of antimicrobial residues and resistant bacteria in environmental ecosystems, including wetlands and urban water systems. Household disposal practices were identified as a significant contributor, with antibiotics frequently discarded without segregation, particularly among lower income households. Genomic evidence highlighted similarities between environmental and human-resistant strains, indicating cross transfer of resistance genes.

- Antibiotic classes of environmental concern: The discussion highlighted that fluoroquinolones have high persistence and AMR selection pressure, while macrolides, tetracyclines, sulphonamides, and trimethoprim demonstrate moderate to high persistence. B lactams, though widely used and discarded, degrade more rapidly. Azithromycin was noted for high aquatic persistence, posing risks to aquatic ecosystems.

- Case study- antibiotic disposal box: A case study from a government hospital demonstrated the feasibility of disposal boxes accompanied by awareness efforts, resulting in the collection of a large volume of unused and expired drugs, including antibiotics. While behavioral challenges, limited funding, vandalism, and lack of sustained administrative support affected continuity, the initiative showed strong public engagement and served as proof of concept.

- International and Indian best practices: International models such as pharmacy based take back programs and regulated return systems were discussed—the US, France, the UK, and Sweden—alongside an Indian example of a medicine donation room that encouraged public participation through emotional engagement.

- Industry and private sector perspectives: Panelists highlighted regulatory gaps in post dispensation accountability and identified consumer behavior, including hoarding of leftover antibiotics, as a key challenge. Proposals included pharmacy led take back models, reverse logistics for returning unused

drugs to manufacturers, smaller packaging sizes, and industry participation in awareness and collection pilots.

- Digital and AI based solutions: Participants explored the role of digital platforms in enabling real time tracking, data analytics, and compliance monitoring. Barcode and QR linked systems, WhatsApp integration, and the use of existing infrastructure such as jan aushadhi kendras were discussed as potential enablers. Incentive linked returns, combined with enforcement, were noted as effective in influencing behavior.

## Conclusion

The panel concluded that safe disposal systems are feasible and acceptable, as demonstrated by pilots and international experiences, but sustainability depends on institutional support, funding, system integration, and continued behavior change efforts. Participants emphasized the need to formally enable and scale health facility and pharmacy based take back models through clear operational guidelines and funding mechanisms. Engaging pharmaceutical companies and digital health platforms within regulated public–private partnership models, alongside the use of digital tools for tracking, reporting, and public awareness, was identified as critical to strengthening supervision and compliance in safe antibiotic disposal.

# Panel discussion III
# Safe disposal within a One Health framework

## Overview

The panel deliberated on the role of safe disposal of antibiotics within a One Health framework, examining linkages between human health, animal health, agriculture, and environmental systems in driving AMR.


Photo 3: Moderator: Dr. YK Gupta President, AIIMS Kalyani
Left–right panelists: Dr. Ankur Mutreja, Director - External Affairs & Health Security, PATH; Dr. G. Karthikeyan Executive Director, THSTI; Dr. Tavpritesh Sethi, Professor, Department of Computational Biology, IIIT- Delhi; Dr. O. P. Kansal Public Health Specialist, Health, Nutrition & Population, World Bank; Dr. Narendra Saini Clinical Microbiologist, Chairman Standing Committee, Indian Medical Association (IMA) and Former Secretary General IMA; Dr. Venkatesh Roddawar Project Director, JSI India; Dr Sachin Gupte, Senior Advisor, PATH.

## Key discussion highlights

- **Antibiotic use beyond human health:** Panelists highlighted that a majority of antibiotic consumption occurs outside human health, particularly in animal husbandry and agriculture. Antibiotics are frequently used in poultry and dairy farming, aquaculture and apiculture, and crop production, often without adequate monitoring or veterinary prescription regulation. The absence of systematic data and controls was identified as a major contributor to uncontrolled environmental exposure.

- **Environmental and ecological impact:** Antibiotics enter soil and water bodies through animal waste, agricultural runoff, and improper disposal practices. The discussion cited ecological consequences, including historical examples such as the vulture population decline linked to pharmaceutical residues, illustrating how medication misuse can severely disrupt ecosystems.

- **Policy integration and governance:** The panel noted the absence of a comprehensive policy framework governing antibiotic use and disposal in animal health and agriculture. Speakers emphasized the need for unified national policies and stressed that safe disposal should be integrated into AMR strategies through a One Health lens, rather than treated as a standalone intervention.

- **Technology and innovation for disposal:** Existing disposal practices, particularly low temperature hospital incineration, were identified as insufficient to neutralize antibiotic residues. Alternative technologies such as high temperature incineration, chemical neutralization, and radiation based approaches were discussed, alongside research efforts exploring portable and facility level solutions. The importance of research funding and pilot projects for practical application was emphasized.

- **Data and evidence generation:** Panelists highlighted the lack of integrated data linking antibiotic consumption, environmental contamination, and resistance trends. Proposals included developing interconnected data streams across community usage, health care systems, pharmacies, and environmental monitoring networks. Initiatives such as AMR Sense were cited as examples

of data triangulation to guide forecasting, policy prioritization, and resource allocation.

- Industry, CSR, and behavior change: The role of pharmaceutical companies, retailers, and CSR initiatives was discussed, including proposals for take back programs and collection points at pharmacies and retail outlets. While incentives to encourage public participation were suggested, concerns related to transparency, conflicts of interest, and implementation challenges were also noted. Behavioral change strategies, including visible packaging cues, Kerala's "Blue Envelope" initiative, and integration of antibiotic literacy into school and medical curricula, were highlighted as critical for long term impact.

- One Health coordination: The panel emphasized the need for strengthened collaboration among health, veterinary, agricultural, and environmental institutions, including ICMR, veterinary councils, and environmental monitoring bodies. Participants stressed that AMR containment requires coordinated, synchronized action rather than siloed sectoral efforts.

## Conclusion

The panel concluded that AMR cannot be addressed solely through healthcare interventions, as antibiotic use and disposal in animal health, agriculture, and the environment significantly contribute to resistance. Safe disposal of antibiotics must therefore be embedded within a coordinated One Health approach. Key priorities include integrating disposal protocols into AMR and One Health action plans, strengthening inter sectoral governance, advancing research and pilot projects on disposal technologies, and developing integrated data systems to support evidence based decision making and sustainable implementation.

# Stakeholder reflections and the way forward

The consultative meeting on the safe disposal of unused and expired antibiotics reinforced the understanding that AMR is a multidimensional challenge with implications for public health, environmental safety, and governance. The discussions underscored that AMR cannot be addressed solely through clinical or pharmaceutical interventions, as improper disposal of antibiotics from households, health care facilities, pharmacies, industries, and the veterinary and agricultural sectors continues to contribute to the spread of resistance. Safe disposal of antibiotics emerged as a critical yet systematically under addressed component of India's AMR containment efforts.

## Key recommendations

### 1. Leadership and governance

The discussions highlighted the central role of leadership in translating policy intent into practice. While multiple regulatory provisions and guidelines governing antibiotic use and disposal exist, their impact remains limited due to weak implementation and unclear accountability. Stronger institutional ownership-particularly by hospital administrators, regulators, and state health authoritiesis essential to ensure compliance, oversight, and enforcement across the system.

### 2. Evidence gaps limit policy action

A recurring concern was the lack of reliable and systematic data on antibiotic use, disposal practices, and environmental exposure. The absence of such evidence constrains informed policymaking and scale up. Participants emphasized the urgent need to generate baseline data through household surveys, health care facility audits, environmental monitoring, and digital tracking mechanisms to quantify the magnitude and pathways of antibiotic waste.

### 3. Unsafe disposal practices and environmental risk

The meeting reaffirmed that unsafe disposal of antibiotics through municipal waste streams and drains remains widespread. These practices have led to de-

tectable antibiotic residues in soil and water bodies, with environmental and genomic evidence indicating cross transfer of resistance between environmental and human pathogens. This reinforces the need for urgent and coordinated intervention to prevent further environmental amplification of AMR.

### 4. System readiness exists but lacks integration

Deliberations highlighted that several promising models—such as disposal boxes, pharmacy led collection mechanisms, and drug take back initiatives—have demonstrated feasibility and public acceptability. However, their sustainability depends on stronger system integration, including:

- Alignment with common biomedical waste treatment facilities (CBWTFs) under the Central Pollution Control Board (CPCB) and State Pollution Control Board (SPCB) regulations.
- Development and institutionalization of reverse logistics mechanisms.
- Dedicated funding and clear institutional anchoring.

### 5. One Health imperative

Participants emphasized that AMR containment efforts will remain incomplete without a One Health approach. A significant proportion of antibiotic use occurs in animal husbandry, agriculture, and aquaculture, where monitoring and regulation remain limited. Fragmented sectoral policies need to be replaced by coordinated governance that links human health, animal health, agriculture, and environmental health within a unified framework.

### 6. Technology and innovation as enablers

The consultations highlighted the potential role of digital and technological solutions including barcode and QR based systems, interoperable platforms, AI driven analytics, and messaging tools to support tracking, recall, compliance monitoring, and behavior change. Participants stressed that such tools must be aligned with public health systems, data governance requirements, and regulatory oversight to ensure effectiveness and accountability.

### 7. Socio-behavioral change

Sustained behavioral change was identified as indispensable for effective implementation. Public awareness initiatives, capacity building of health care providers and pharmacists, and integration of antibiotic literacy into school and

medical curricula were highlighted as critical enablers. Experiences from other public health domains demonstrate that long term cultural shifts are achievable through:

- Clear visual cues such as color coding and icons
- Counselling at health facility and pharmacy levels
- School and curriculum based interventions
- Community level engagement and campaigns

## Strategic way forward for Maharashtra

The deliberations culminated in the shared understanding that Maharashtra is well-positioned to advance structured and coordinated approaches to safe antibiotic disposal. Stakeholders identified priority actions including:

- Embedding safe disposal protocols within state AMR action plans
- Piloting take back mechanisms pharmacies and health facilities
- Strengthening linkages with biomedical and municipal waste management systems
- Generating data on segregation and disposal practices to inform policy and scale up
- Leveraging digital health platforms for monitoring and evidence generation
- Institutionalizing One Health coordination mechanisms
- Mobilizing CSR and public–private partnerships with appropriate transparency and safeguards

## Closing statement

The consultative meeting reaffirmed that addressing AMR requires sustained leadership commitment, inter sectoral coordination, evidence informed policymaking, and active community engagement. Strengthening systems for the safe disposal of unused and expired antibiotics is an essential component of broader AMR containment efforts and must be pursued in alignment with health, environmental, and governance priorities to ensure durable and scalable impact.

# Annexure 1

## Questions for panel discussion

## 1. Leaders' perspective: safe disposal of antibiotics for AMR containment

### Opening questions

1. AMR is one of the top public health threats and a national priority, yet safe disposal of antibiotics remains overlooked. Why is it important to bring this issue to the forefront now?
2. What role does safe disposal of antibiotics play in India's broader AMR containment efforts?
3. From your perspective, how does unsafe disposal of antibiotics endanger public health and environmental safety?

### Core questions

1. What policy, regulatory, or institutional gaps exist in the country regarding safe disposal of antibiotics and what steps are required to be taken to address each of them and operationalize the safe disposal systems?
2. How can governments, industry (pharma), institutions, and development partners collaborate to create sustainable disposal mechanisms?
3. Where does safe disposal currently feature within the National Action Plan 2.0 on AMR and state action plans?
4. Can safe disposal of antibiotics be mandated in health care facilities/institutions, such as the Biowaste Management (BMW) Rules ?
5. How do we engage communities and citizens into the AMR containment agenda by making safe disposal of unused/expired antibiotics a shared responsibility rather than an only systems-level intervention?
6. How can the generation, collection, and disposal of unused/expired antibiotics be monitored effectively across the supply chain? What are the practical and scalable solutions for the same?
7. From a state perspective (Maharashtra), what implementation challenges do you foresee?
8. What role can states like Maharashtra play in piloting and scaling these models nationally?

### Closing question

1. What is the single most important action required at the leadership level to institutionalize safe disposal of antibiotics?

## 2. Questionnaire: Safe disposal—system readiness and implementation

### Opening questions

1. How credible is the scientific evidence linking improper disposal of antibiotics to AMR and environmental contamination? How does contribute to AMR?
2. Despite having guidelines on AMR, the problem of unsafe disposal of drugs persists. What does this say about system readiness?

### Core questions

1. Are there specific antibiotic classes that pose a higher environmental or AMR risk if not properly disposed?
2. What responsibilities should pharma industries adapt for post-consumer antibiotic waste management?
3. How feasible are models like, drug take-back policies and programs in the Indian context?
4. In your opinion, what behavioral barriers exist among patients, pharmacists, and providers regarding safe disposal of antibiotics?
5. Are the regulations under the CDSCO, CPCB, and BMW Rules sufficient to address antibiotic disposal?
6. What are the currently available and sustainable disposal methods in the country, and how can they be scaled in Maharashtra?
7. How can digital health tools, such as QR codes and applications, support disposal awareness and compliance?
8. Can pharmacies be incentivized or regulated to act as disposal points for unused/expired antibiotics?

### Closing questions

1. What is the biggest challenge in implementing safe disposal of antibiotics at all levels?
2. What one operational or behavioral policy change could help accelerate disposal readiness?

# 3. Questionnaire: Safe disposal and One Health

## Opening questions

1. From a One Health perspective, how does the disposal of antibiotics affect human, animal, and environmental health?
2. Why it is important to view antibiotic disposal not merely as a waste issue, but as a One Health intervention?

## Core questions

1. What institutional mechanisms are required for intersectoral coordination between human, animal, and environmental health?
2. How can academic institutions support the program in terms of implementation, monitoring, and awareness generation on safe disposal?
3. Are there any evidence gaps that need to be addressed to guide policy and implementation?
4. What role can the animal husbandry and agriculture departments play in strengthening safe disposal practices?

## Closing questions

1. What is one key recommendation to make safe disposal of antibiotics a routine practice?
2. How would success look like once safe disposal is effectively integrated into One Health and AMR surveillance systems?

# Annexure 2
# Profile of panelists

### Dr. NK Arora
### Executive Director, The INCLEN Trust International

Dr. Narendra K Arora is the executive director of The INCLEN Trust International, New Delhi, and a globally respected pediatrician and clinical epidemiologist with over four decades of experience in immunization and public health. A former faculty member at AIIMS, New Delhi, and president of All India Institute of Medical Sciences (AIIMS) Deoghar, he has played a pivotal role in shaping India's immunization policies, including the Pulse Polio Programme, vaccine safety, and AEFI surveillance. Through his leadership in major national and international research initiatives, he continues to influence evidence-based vaccine policy and health systems strengthening in India and globally.

### Dr. Rajiv Kumar Pathni
### Advisor, NHSRC

Dr. Pathni is a senior health care leader with over 36 years of experience across military, public, and global health systems. A former officer of the Indian Air Force, he later led the Assam Cancer Care Foundation under Tata Trusts, overseeing the development of a network of 19 cancer hospitals. An alumnus of Armed Forces Medical College with a Master's in Hospital Administration from the All India Institute of Medical Sciences (AIIMS) and a World Health Organization (WHO) Fellow at the Liverpool School of Tropical Medicine, he brings deep expertise in public health, hospital systems, and health sector reform. Dr. Pathni has held key leadership roles at DGAFMS, advised multiple national and international institutions, and is recognized for his work in emergency care, digital health, and health care quality.

### Mr. Neeraj Jain
### Country Director, India and Director, Growth Operations-Asia, Middle East & Europe (AMEE), PATH

Neeraj Jain drives growth strategy, country operations, and government engagement for PATH across Asia, the Middle East, and Europe. Under his leadership, PATH has significantly expanded its global health impact by partnering with innovators and governments to address critical public health challenges. With over 35 years of experience in market expansion, change management, and strategic development, he has driven large-scale initiatives at the intersection of public health, climate and health, digital innovation, sanitation, and child development.

Mr. Jain has held leadership roles at PATH, WaterAid India, the Children's Investment Fund Foundation, Vestergaard Frandsen, and the India Sanitation Coalition, delivering transformative impact across Asia and Europe. Mr. Jain holds an MBA from the University of Delhi and a bachelor's degree in business studies from Hong Kong Polytechnic University.

### Smt. Swati Srivastava
### Deputy Drug Controller (India), MoHFW, Government of India

Smt. Swati Srivastava is currently serving as Deputy Drug Controller under the Directorate General of Health Services (DGHS), Ministry of Health and Family Welfare (MoHFW), Government of India. She has over 24 years of professional experience with the MoHFW. Smt. Srivastava holds a Master's degree in pharmacology from Jamia Hamdard University, New Delhi. She has contributed significantly to the development of several guidelines and regulations under the Central Drugs Standard Control Organisation (CDSCO), including those related to the safe disposal of unused and expired drugs, and has been actively involved in the National Action Plan on Antimicrobial Resistance (NAP-AMR) 2.0.

## Dr. YK Gupta
## President, AIIMS Kalyani

Professor Yogendra Kumar Gupta is a renowned pharmacologist and former Dean of the All India Institute of Medical Sciences (AIIMS), New Delhi, with over four decades of leadership in medicine safety, clinical research, and health policy. He is the founding architect of the Pharmacovigilance Programme of India (PvPI), which has grown into a nationwide network of more than 550 centers under the Ministry of Health and Family Welfare. Prof. Gupta has played a pivotal role in shaping the National List of Essential Medicines, Good Laboratory Practices, National Poison Information Centre, and India's clinical trial regulations, including the New Drugs and Clinical Trial Rules (2019).

He currently serves as President of AIIMS Kalyani and Chairman of the Review Committee on Genetic Manipulation and is a Principal Strategy Advisor to GARDP on AMR. A Fellow of multiple national and international academies and recipient of over 20 national awards, he has published more than 350 research papers and trained over 80 postgraduate and doctoral scholars, significantly strengthening India's healthcare and pharmaceutical systems.

## Dr. Kamini Walia
## Senior Scientist, ICMR

Dr. Kamini Walia is a microbiologist by training and has subsequently trained in public health from Johns Hopkins. She is working as Senior Scientist in the Division of Epidemiology and Communicable Diseases Division of Indian Council of Medical Research (ICMR). This network is now recognized nationally and internationally and has led to development of collaborative programs with Research Council Norway, NIH, USA and CDC, USA.

### Dr. Deepika Nayar Chaudhery
### Senior Health, Nutrition and Population Specialist, South Asia Region, World Bank

Dr. Deepika Chaudhery is responsible for supporting World Bank's health- and nutrition-related operations, advisory, and analytical work in India, and for providing technical support to the World Bank's Global Financing Facility. She lends support to the Government of Kerala on various dimensions of the One Health Program.

More recently, she has also provided operational and technical support to Afghanistan, Bangladesh, and Yemen's health and nutrition operations. She has over 25 years of experience in maternal and child health and nutrition in South and East Asia, in both technical and managerial capacities.

Her prior experience includes working as a Deputy Regional Director (Asia) at Nutrition International. She also worked as a health and nutrition specialist at the United Nations Children's Fund (UNICEF) and CARE India. She has a doctorate in Public Health Nutrition from the All India Institute of Medical Sciences (AIIMS), New Delhi, India, and has several publications to her credit.

### Dr. Shirshendu Mukherjee
### Managing Director, Wadhwani Innovation Network, Wadhwani Foundation

Dr. Shirshendu Mukherjee is the managing director of the Wadhwani Innovation Network at the Wadhwani Foundation, where he leads strategic partnerships and innovation initiatives across areas such as artificial intelligence, health and medical technologies, life sciences, and emerging technologies. With over 30 years of leadership experience spanning the pharmaceutical sector, government, and global philanthropy, he has been instrumental in advancing innovation-led development programs in India and globally.

He previously served as mission director of Grand Challenges India and led Mission COVID Suraksha, which

supported the development of four indigenous COVID-19 vaccines. A PhD in microbiology and a trained lawyer, Dr. Mukherjee has pursued advanced leadership and strategy programs at Oxford, the London School of Hygiene and Tropical Management (LSHTM), and the Indian Institute of Management (IIM) Calcutta, and continues to build innovative ecosystems that connect science, policy, and entrepreneurship for social impact.

### Dr. Ankur Mutreja
### Director, External Affairs & Health Security, PATH

With nearly 20 years of experience, Dr. Mutreja leads strategy, partnerships, policy, communications, and health security functions at PATH. He previously headed Global South Partnerships portfolio at CEPI, led a research group at the Department of Medicine, University of Cambridge, and held industry roles at MSD-Wellcome Hilleman Labs and Novartis Vaccines.

He holds a PhD in Molecular Biology (Wellcome Sanger Institute), an MSc in Industrial & Commercial Biotechnology (Newcastle University), and a BSc in microbiology (University of Delhi) and sits on several board and advisory committees of governments, public health agencies, and funders globally.

### Dr. Anuj Sharma
### Focal Point-AMR, WCO, India

Dr. Anuj Sharma is a medical doctor and public health expert at the World Health Organization (WHO) India, serving as the Focal Point for antimicrobial resistance (AMR) and infection prevention and control (IPC). With over 33 years of experience in clinical and public health practice, he leads national efforts to strengthen infection control, promote rational use of antimicrobials, and improve patient safety.

An MBBS graduate from Maulana Azad Medical College, Dr. Sharma played a key role in India's COVID-19 response, including training and supporting frontline teams at the Sardar Patel COVID Care Centre, with a strong focus on

IPC systems, while advancing patient-centered, innovative approaches to managing infectious diseases across the health system.

### Dr. Ruby Raphel
### Manager, Clinical Development & Medical Affairs, Hetero Drugs Ltd.

Dr. Ruby Raphel is a trained clinical pharmacologist (MBBS, MD, DM) currently serving as manager, Clinical Development & Medical Affairs, at Hetero Drugs Ltd, Hyderabad. In this role, she leads new product development and works as a medical writer, medical monitor, and medical reviewer across multiple clinical programs. Previously, she served as assistant professor in the Department of Clinical Pharmacology and Therapeutics at NIMS, Hyderabad, and was a coinvestigator in major COVID-19 vaccine trials including BBIL Covaxin, Sanofi's recombinant vaccine, and the ICMR study on the implementation of Antimicrobial Stewardship Programs across tertiary care centers in India. She has played a key role in developing the Essential Medicines List for the Government of Telangana and the Antibiotic Policy for NIMS Hospital. A recipient of the Dr. U.K. Seth Award and multiple Best Research Paper honors, she also initiated the Antibiotic Safe Disposal Campaign and established the Antibiotic Disposal Box at NIMS. Her contributions to COVID-19 vaccine development have been featured in Vogue magazine.

### Dr. Rajeev Sharma
### Vice President, Tata 1mg

Dr. Rajeev Sharma is the Vice President of Medical Affairs at Tata 1mg and a leading voice in India's digital health ecosystem. With over 14 years of experience across clinical medicine and health technology, he leads the platform's medical content, editorial standards, and evidence-based health communication.

Dr. Sharma has played a key role in building and scaling health care startups, including Tata 1mg, and is widely recognized for advancing credible digital solutions on issues such as gut health, weight management, and preventive care. Through Tata 1mg's platforms and national health forums, he actively contributes to shaping how millions of users access trusted, science-based health information.

### Dr. (Prof.) G Karthikeyan
### Executive Director, THSTI

Dr. Ganesan Karthikeyan is a clinical cardiologist and Professor of Cardiology at AIIMS, New Delhi, trained at AIIMS and McMaster University, Canada. He is a Senior International Fellow of the Population Health Research Institute, a Fellow of the Academy of Medical Sciences and NASI, and Editor-in-Chief of BMJ Open Heart.

His research focuses on cardiovascular diseases in low- and middle-income countries, particularly rheumatic heart disease, anticoagulation, and affordable cardiac technologies. Dr. Karthikeyan serves on key national and international policy bodies, including the Government of India's Medical Technology Assessment Board and PMJAY expert panels, and is an honorary consultant to the IAEA on global health research in resource-limited settings.

### Dr. Tavpritesh Sethi
### Professor, Department of Computational Biology, IIIT Delhi

Dr. Tavpritesh Sethi is a Professor in the Department of Computational Biology and the founding head of the Center of Excellence in Healthcare at IIIT, Delhi. He received his MBBS from Government Medical College, Amritsar, and a PhD in Computational Biology from CSIR-IGIB, New Delhi. His research interests focus on data-driven, evidence-based stewardship and surveillance of AMR.

He has led the development of AMROrbit, an award-winning AI-based scorecard, and the AMRSense data ecosystem. His team was the joint second-prize winner in The Trinity Challenge. He has been a Visiting Faculty at Stanford University, a fellow of the DBT/Wellcome India Alliance, and a recipient of MIT Technology Review's TR35 India award and Kavli Fellowship. He has published over 60 papers, has delivered two TEDx talks, and is passionate about training the next generation of purpose-driven data scientists for health care.

### Dr. Om Prakash (OP) Kansal
### Public Health Specialist, Health, Nutrition & Population, World Bank

Dr. Om Prakash Kansal, MBBS and MD in community medicine, has over 25 years of experience in public health. He has worked with WHO on Polio Eradication, UNICEF India on immunization, RMNCH+A, and disaster response and Becton Dickinson India (12 years) driving policy, market development, and advocacy. He also contributed to cervical cancer prevention at the American Cancer Society and currently supports Pandemic Preparedness and Response projects at the World Bank.

A certified NQAS assessor and former visiting MBA faculty, Dr. Kansal has collaborated with national and international stakeholders across 19 states and 5 countries. His expertise spans immunization, AMR, patient safety, laboratory and health systems strengthening, capacity development, and much more. Passionate about mentoring, he values outcome-driven projects and field engagement.

## Dr. Narendra Saini
## Clinical Microbiologist, Chairman Standing Committee, IMA and Former Secretary General, IMA

Dr. Narendra Saini is a clinical microbiologist and a senior leader in the Indian Medical Association (IMA), where he currently serves as Chairman of the Standing Committee on AMRAMR. He has also held the national position of secretary general of the IMA from 2012 to 2014, contributing to the association's efforts to improve health care delivery and professional standards across India.

In his role with the IMA AMR Committee, Dr. Saini has been actively involved in initiatives to address the growing threat of AMR and promote infection prevention and control practices nationwide. He has also worked as an assessor for two quality accreditation bodies—National Accreditation Board for Hospitals & Healthcare Providers (NABH) and National Accreditation Board for Testing and Calibration Laboratories (NABL)—reflecting his expertise in clinical microbiology and health care quality.

## Venkatesh Roddawar
## Project Director, JSI India

Venkatesh Roddawar leads health systems strengthening and policy implementation initiatives, with over 18 years of public health experience. As the project director for the Tuberculosis Implementation Framework Agreement (TIFA) at JSI, he provides technical support to the Ministry of Health and Family Welfare on national tuberculosis (TB) and global health security (GHS) program strategies.

Throughout his career with organizations such as PATH, The Union, and the National Health Systems Resource Centre (NHSRC), Mr. Roddawar has done data-driven program monitoring, intersectoral coordination, and private-sector engagement. He specializes in bridging the "know-do" gap through evidence-based policy reforms and collaborative health interventions across India and South Asia. An Erasmus Mundus Fellow, he holds a dual Master of Public Health (MPH) from the University of Sheffield, UK, and the University of Copenhagen, Denmark.

## Dr. Sachin Gupte MD, MPH
## Senior Advisor, PATH

A trained medical doctor with a postgraduate degree in public health from the University of Edinburgh (MPH) and a Masters in community medicine (MD) from the University of Mumbai, Dr. Gupte brings to PATH more than 30 years of experience, working in various positions of responsibility in health and nutrition sectors in India.

Prior to PATH, Dr. Gupte worked with several development sector partners like the Gates Foundation, the WHO, UNICEF, Family Health International, and the Swades Foundation on RMNCH, nutrition, polio eradication, routine immunization, STI/HIV, public health emergencies, and women empowerment through financial and social inclusion.

In PATH, Dr. Gupte had been spearheading technical operations across multiple states in the country, besides providing programmatic guidance and multistakeholder engagements for infectious diseases, family health, respiratory care, nutrition, primary health care, and other public health initiatives for PATH and CHRI. Currently, he is a senior member of the Nutrition and Health Security portfolio and provides oversight to Rice Fortification, One Health, and AMR teams at PATH and CHRI.

# Annexure 3
# Stakeholder representation

1. Public Health Department, Government of Maharashtra
2. Central Drugs Standard Control Organisation (CDSCO), DGHS, MoHFW
3. Indian Council of Medical Research (ICMR)
4. National Health System Resource Centre, MoHFW
5. All India Institute of Medical Sciences (AIIMS), Kalyani
6. Global Antibiotic Research and Development Partnership (GARDP)
7. The INCLEN Trust International
8. The World Bank
9. PATH
10. Wadhwani Innovation Network, Wadhwani Foundation
11. World Health Organization
12. Hetero Drugs Ltd
13. Tata 1mg
14. Translational Health Science and Technology Institute (THSTI)
15. Indraprastha Institute of Information Technology Delhi (IIIT-Delhi)
16. Indian Medical Association (IMA)
17. John Snow India Private Limited (JSI India)
18. Centre for Health Research and Innovation (CHRI)
19. GlaxoSmithKline Pharmaceuticals Limited (GSK)
20. Pune Municipal Corporation

GlaxoSmithKline Pharmaceuticals Limited (GSK) India is a leading pharmaceutical company headquartered in Mumbai, with a manufacturing facility in Nashik, Maharashtra. GSK aims to positively impact the health of 2.5 billion people by the end of the decade through its focus on respiratory, immunology, oncology, HIV, and infectious diseases. GSK India has a mission to unite science, technology, and talent to get ahead of disease together.

Our Corporate Social Responsibility (CSR) initiative - GSK cares is rooted in the belief that true progress lies in the health and empowerment of communities, focusing on addressing critical national priorities and the UN Sustainable Development Goals (SDGs).

For more information, visit www.gsk-india.com.

Centre for Health Research and Innovation

Centre for Health Research and Innovation (CHRI) is a PATH affiliate in India that aims to create lasting public health impact across the country.

We work on some of the most critical areas of public health including tuberculosis, maternal newborn child health and nutrition, neglected tropical diseases, malaria and vaccines.

Our work is spread across India with communities, healthcare professionals, policy makers, innovators, hospitals, laboratories and pharmacists to bring about sustain¬able, scalable and impactful change in public health.

For more information, visit www.chri.org.in


Centre for
Health
Research and
Innovation


PATH


GSK