

# **AMR A Major Health Challenge: Preparedness in India**

**Prof. YK Gupta**

Principal Advisor, Global Antibiotic Research & Development Partnership (GARDP), Geneva

Co-chair: DBT One Health Consortium

President, AIIMS Kalyani

Former President, AIIMS Bhopal and AIIMS Jammu

Former Dean and HoD, Pharmacology, AIIMS, New Delhi

# The Discovery of Penicillin – A Medical Breakthrough (1928)



## Warning of resistance

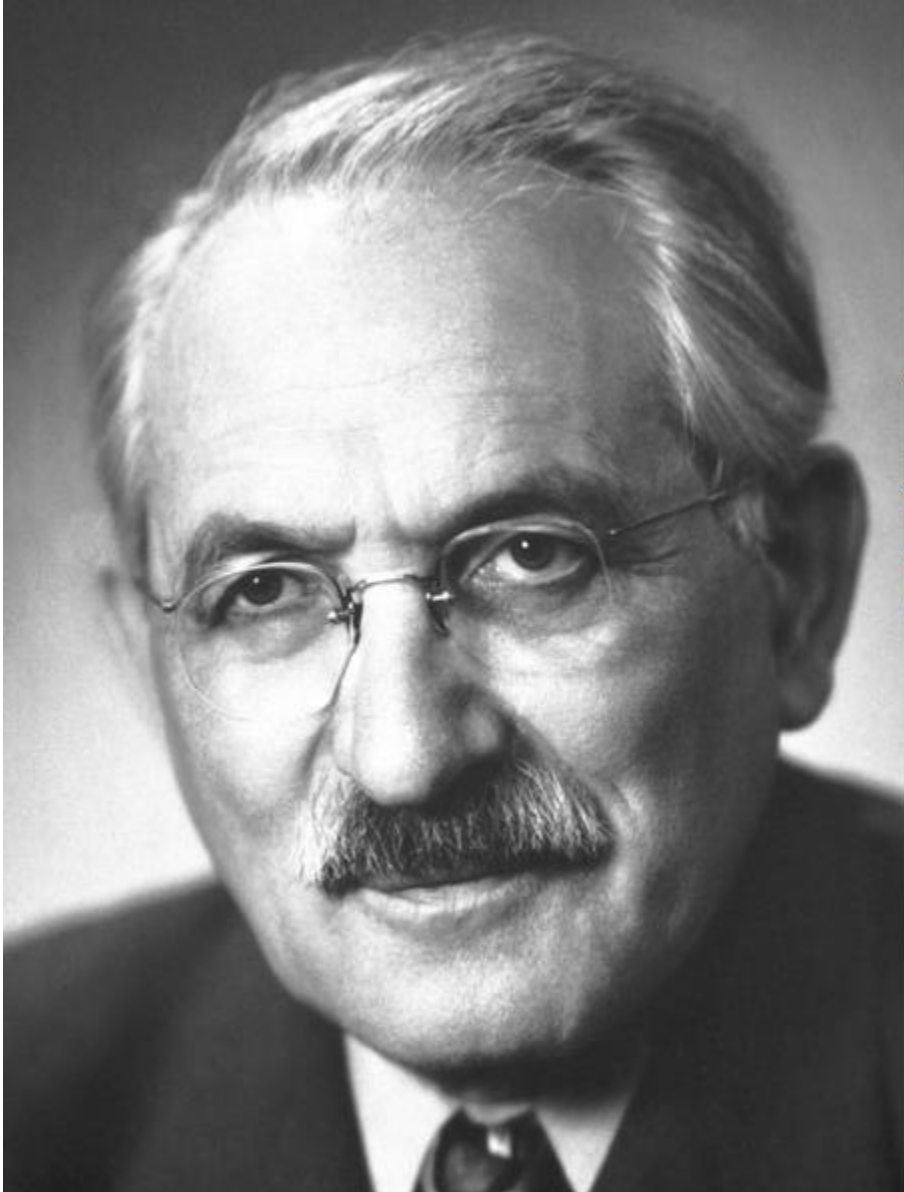
“I would like to sound one note of warning ... It is not difficult to make microbes resistant to penicillin in the laboratory by exposing them to concentrations not sufficient to kill them, and the same thing has occasionally happened in the body.”

Alexander Fleming

1945 Nobel Prize  
acceptance speech



## **Another Nobel Prize**



**Selman Abraham Waksman**

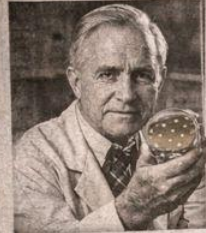
**Discovery of streptomycin: 1943**

**Effective against tuberculosis**

# Antimicrobial Resistance: From Past Warnings to Present Crisis

Sir Alexander Fleming discovered penicillin, the first true antibiotic. Despite this revolutionary breakthrough, Fleming warned as early as 1945 that misuse of antibiotics could lead to resistant bacteria.

## A WARNING IGNORED



Sir Alexander Fleming discovered penicillin, the first true antibiotic. Despite this revolutionary breakthrough, Fleming warned as early as 1945 that misuse of antibiotics could lead to resistant bacteria.

## THE SILENT PANDEMIC

700,000 global deaths annually.

By 2050, drug-resistant infections could cause 10 million deaths per year, surpassing cancer.

“Antimicrobial resistance poses a fundamental threat to modern medicine,” warns WHO.

“The thoughtless person playing with penicillin is morally responsible for the death of the man who succumbs to infection with the penicillin-resistant organism.”

## Era of Antibiotic Abuse Begins 1940s-1960s

The mass production and overprescription of antibiotics led to what Fleming called an ‘era of abuses.’ The golden age of antibiotics brought miraculous cures, but also saw growing resistance. In this period, the first strains of drug-resistant bacteria, such as penicillin-resistant *Staphylococcus*, began to appear.



AMR makes common procedures riskier, turning routine infections deadly.

## THE FIGHT TO PREVENT A CATASTROPHE 1970s- Present

Warnings and Tackling AMR as silent pandemic. Countries, health organizations, and researchers launch global initiatives to promote responsible antibiotic use and monitor drug resistance. WHO governments advocate new antibiotics and alternatives (vaccines, prophylactic rationing, and empiric, and meliticultural prevention, investigation prevention and plant biology is crucial.

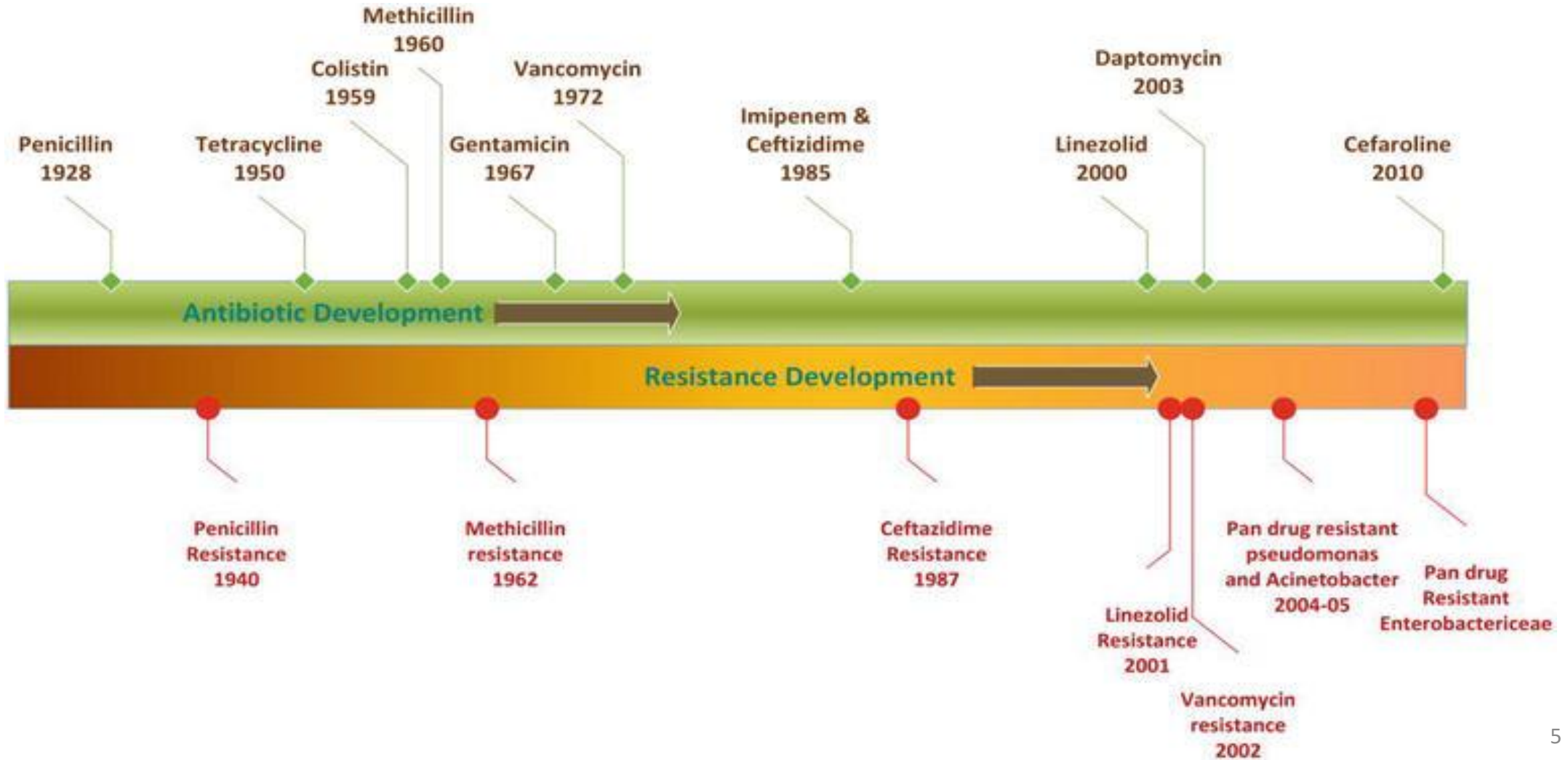
## ANTIMICROBIAL RESISTANCE TODAY

### 2020s

- Antimicrobial resistance (AMR) now recognized as one of the greatest threats to public health and modern medicine.
- Routine operations at risk
- Limited treatment options
- Global efforts urgently needed

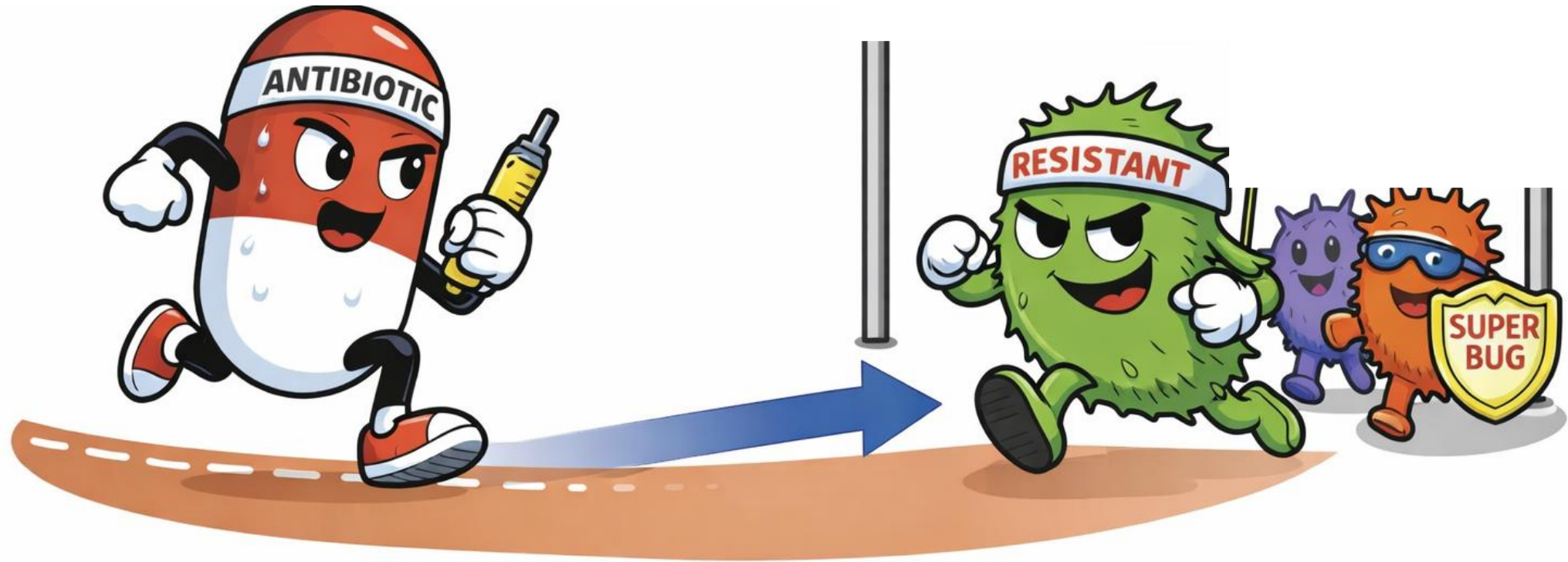


# Pace of antibiotic development and resistance development



## Development of Antibiotic

## Development of Resistance



**Who Wins??**

# Global unnecessary use of antibiotics



**In India ??**

# India is one of the countries hit hardest by AMR

---



- Over 17% of the world population lives in India
- Nearly *30% of global deaths associated with antibiotic resistance in 2019 occurred in South Asia*
  - India, Bangladesh, Bhutan, Nepal and Pakistan

**In India, limited studies of antibiotic prescription analysis**

**Very alarming data**

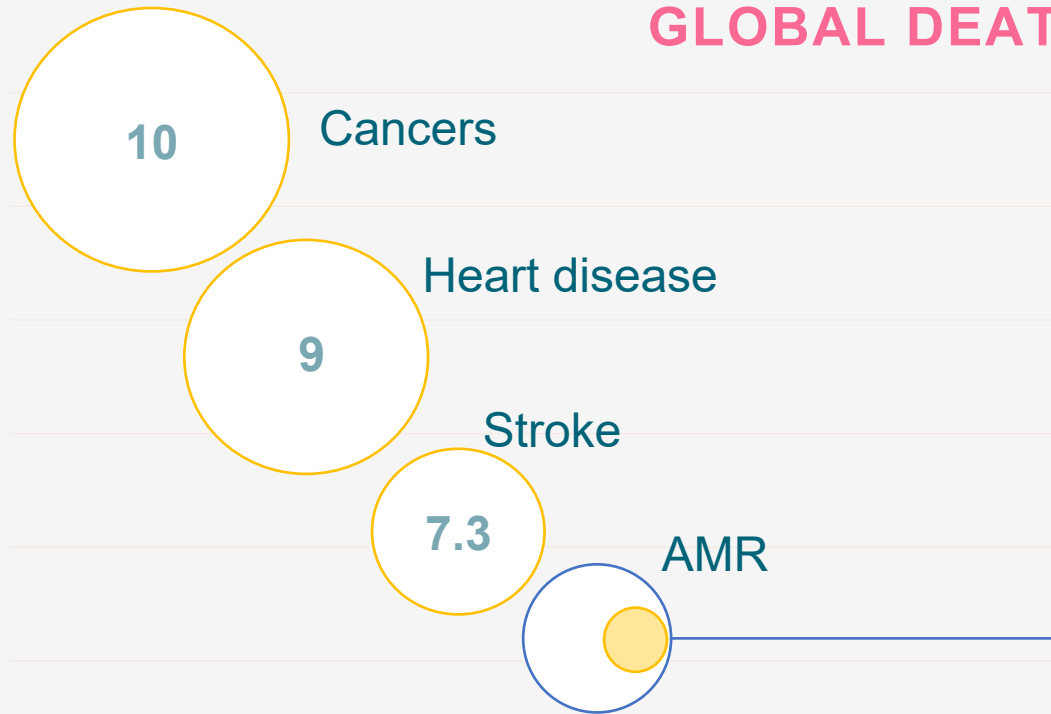
**A need for prescription audit in all hospitals  
across all disciplines, in rural and urban**

**Initiative of IIT-BIRAC start-up, VaidyaRx**

**“Digital platform for prescription analytics”**

# Antibiotic resistance is a global killer

## GLOBAL DEATHS IN 2021 (MILLIONS)

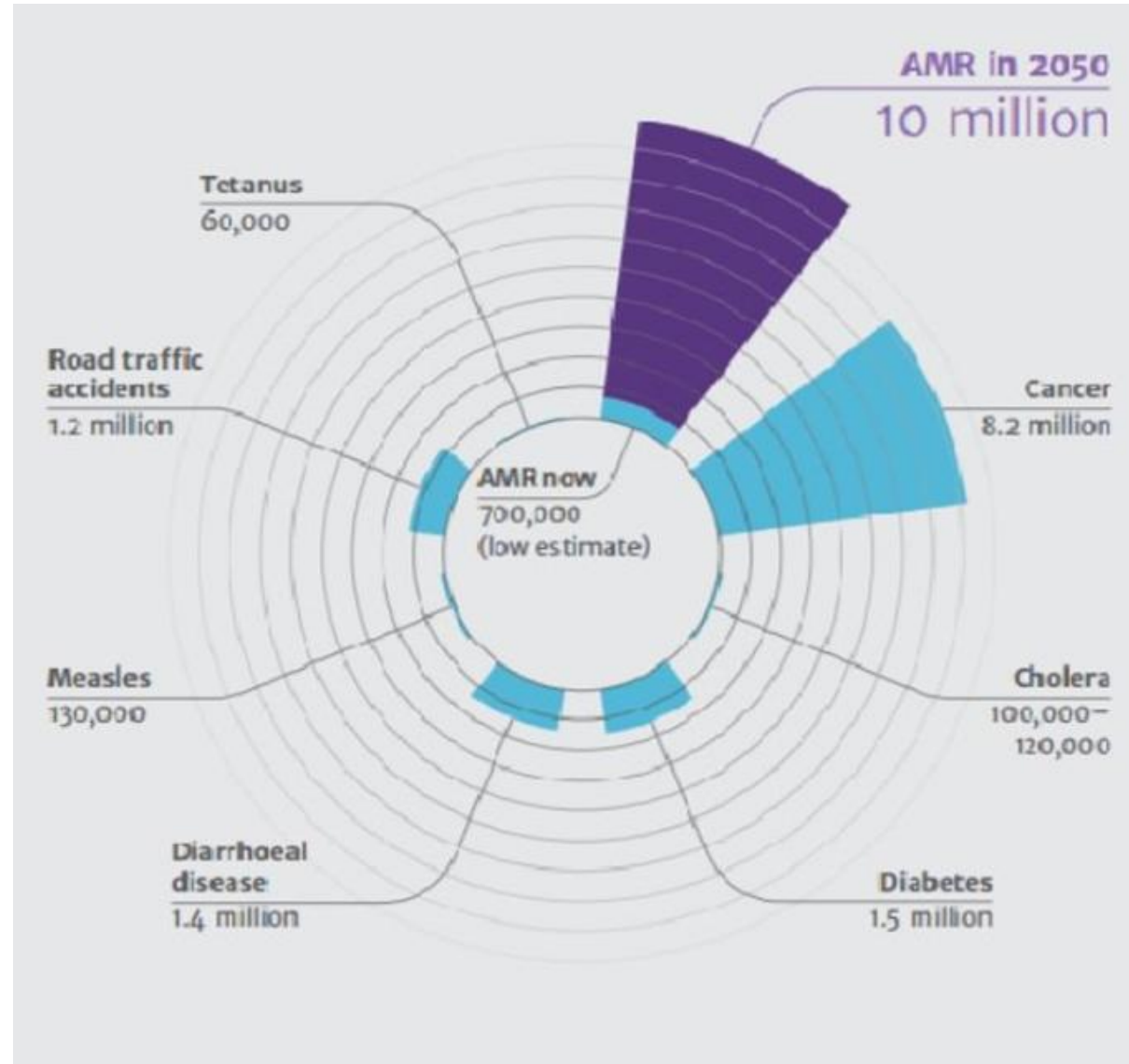


**4.71 M deaths**  
associated with resistant bacterial  
infections

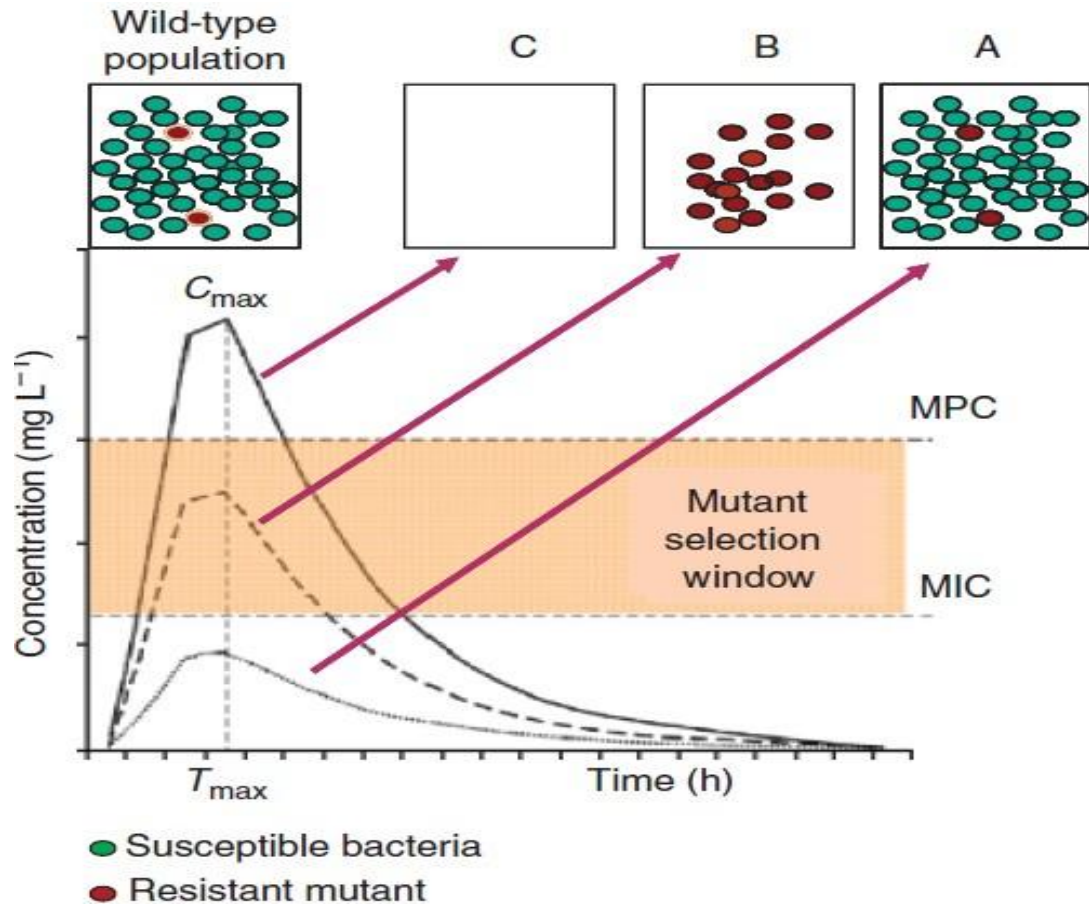
**1.14 M deaths**  
attributed to resistant bacterial infections

## India: A Major Player

# Deaths Attributable to AMR Every Year Compared to Other Major Causes



# Antibiotic Concentration and Resistance



	Antibiotic	MIC50 (mg /L)	MPC50 (mg /L)
Pseudomonas aeruginosa	Levofloxacin	0.25	8
	Ceftazidime	2	32
Escherichia coli	Imipenem	0.25	0.5
	Meropenem	0.03	0.06

**Do we need to recalibrate AB doses?  
Maximum Tolerated Dose (MTD) ?**

# WHO Priority Pathogen List for R & D

## Priority 1: CRITICAL<sup>#</sup>

*Acinetobacter baumannii*, carbapenem-resistant

*Pseudomonas aeruginosa*, carbapenem-resistant

*Enterobacteriaceae*<sup>\*</sup>, carbapenem-resistant, 3<sup>rd</sup> generation cephalosporin-resistant

## Priority 2: HIGH

*Enterococcus faecium*, vancomycin-resistant

*Staphylococcus aureus*, methicillin-resistant, vancomycin intermediate and resistant

*Helicobacter pylori*, clarithromycin-resistant

*Campylobacter*, fluoroquinolone-resistant

*Salmonella spp.*, fluoroquinolone-resistant

*Neisseria gonorrhoeae*, 3<sup>rd</sup> generation cephalosporin-resistant, fluoroquinolone-resistant

## Priority 3: MEDIUM

*Streptococcus pneumoniae*, penicillin-non-susceptible

*Haemophilus influenzae*, ampicillin-resistant

*Shigella spp.*, fluoroquinolone-resistant

# Indian Priority Pathogen List (DBT)

CRITICAL PRIORITY	
Enterobacteriaceae ( <i>Klebsiella pneumoniae</i> and <i>Escherichia coli</i> )	Carbapenem – R Tigecycline – R Colistin – R
Non-fermenting bacteria ( <i>Acinetobacter baumannii</i> and <i>Pseudomonas aeruginosa</i> )	Carbapenem – R Colistin – R
HIGH PRIORITY	
<i>Staphylococcus aureus</i>	MRSA, hVISA Daptomycin – NS Linezolid – R
<i>Enterococcus species</i>	Vancomycin – R Linezolid – R Daptomycin – NS
<i>Salmonella species</i> (Typhoidal and Non-typhoidal)	Azithromycin – NS Third generation cephalosporins – NS Carbapenem – NS

MEDIUM PRIORITY	
<i>Streptococcus pneumoniae</i>	Cephalosporin – R Fluoroquinolones – R Linezolid – R
<i>Staphylococcus, coagulase-negative</i>	Vancomycin – R Linezolid – R
<i>Shigella species</i>	Third generation cephalosporins – R Azithromycin – R
<i>Haemophilus influenzae</i>	Third generation cephalosporin – NS Carbapenem – NS
<i>Neisseria meningitidis</i>	Fluoroquinolones – NS Third generation cephalosporins – NS

R: resistant; NS: non-susceptible; MRSA: methicillin resistant *Staph. aureus*; hVISA: heterogenous vancomycin-intermediate *Staph. aureus*  
Mycobacteria (including *Mycobacterium tuberculosis*) were not included in this prioritization exercise as it is a well-established global and national priority for which innovative new treatments are urgently needed and being developed.

# AMR Complexities

- Under recognized diagnostics
- Lack of Access
- Inappropriate prescriptions
- Challenging healthcare system
- Antibiotic use apart from humans

# **Consequence of delay in appropriate treatment for septic shock**



**Correct treatment within 1 hour of initial hypotension – 80% survival**

**For each hour delay in treatment – survival rate declines by 7.6%**

**“A correct diagnosis is three  
fourths of the remedy”**

# Fit-for-purpose diagnostics improve outcomes

- Importance of a correct diagnosis
  - Fit-for-purpose diagnostics
  - Making accurate diagnosis
  - Ideal characteristics of a point-of-care test
- Turn Around Time (TAT)
- Time to Appropriate Antimicrobial Treatment (TAAT)

# **Barriers to diagnosis**

**Availability**

**Accessibility**

**Acceptance**

**Guidance and training**

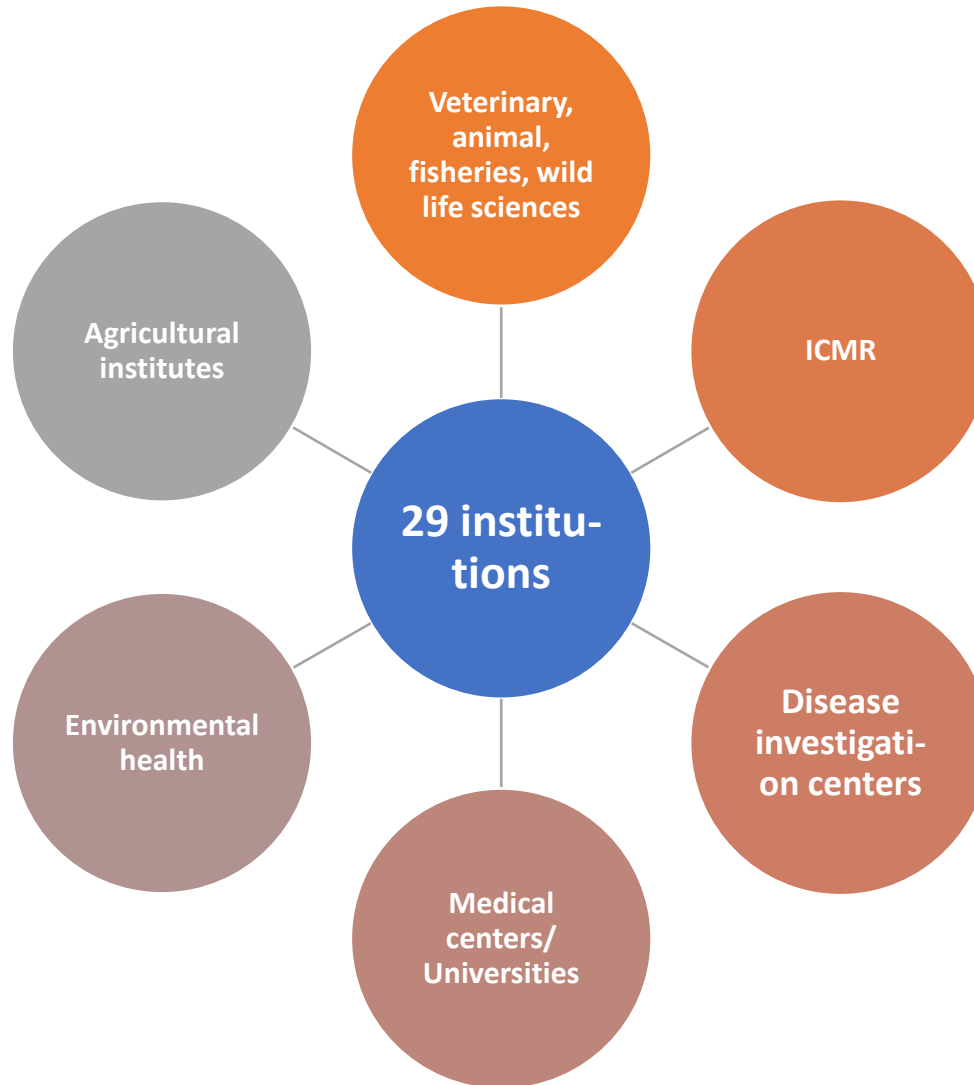


What are we doing to  
respond this crisis?



# DBT - One Health Consortium

- One of the mandate is AMR
  - ~INR 31 Crore for 3 years





# MANN **KI** BAAT



THIS IS WHY DISEASES AND INFECTIONS ARE  
OVERPOWERING THESE ANTIBIOTIC MEDICINES



**28<sup>TH</sup> DEC**

**Hon'ble PM Narendra Modi public message  
on AMR**

**Shifted AMR from laboratories and policy  
documents into public consciousness**

# From Political Commitment to Implementation Impact

- India currently emphasizes on convergence of:
  - Robust evidence
  - Strong policy architecture and
  - High-level political leadership

# Innovative Approaches

- **For New Antibiotic Discovery & Development**
  - Mapping the Indian Laboratories and Scientists working on AMR
  - Identifying Potential Molecules and Initiate Multidisciplinary Approaches
  - Linking Laboratories and Pharmaceutical Industries
  - Mobilizing and Motivating Funding

# Antibiotic innovation milestones in India



## India's First New Discovery Antibiotics from Wockhardt Granted Indian Regulatory Approval

### Wockhardt: 1<sup>st</sup> Indian Company to Achieve Approval for New Discovered Antibiotics

Indian drug regulator, DCGI has approved Wockhardt's 2 new antibiotics **EMROK (IV) and EMROK O (Oral)** for acute bacterial skin and skin structure infections including diabetic foot infections and bacteraemia based on the Phase 3 study involving 500 patients in 40 centres across India. The new drug will target superbug like Methicillin resistant Staphylococcus aureus (MRSA), which is a leading cause of rising antimicrobial resistance (AMR).

Ministry of Chemicals and Fertilizers



### Nafithromycin: Country's First Indigenous Antibiotic

Posted On: 06 DEC 2024 4:18PM by PIB Delhi

*The success of Nafithromycin is a testament to India's growing capability to develop homegrown solutions for pressing healthcare challenges.*

-Union Minister Dr. Jitendra Singh

Antimicrobial resistance has long been a growing global concern, with pharmaceutical companies striving to develop new medicines to combat it worldwide. Despite years of challenges and relentless effort, a breakthrough has finally emerged. After three decades of research and hard work, India has led the way with the creation of **Nafithromycin, the country's first indigenous Macrolide antibiotic**. This remarkable achievement marks a pivotal moment in the fight against antimicrobial resistance, showcasing India's growing capabilities in pharmaceutical innovation.



#### India's Fight Against Antimicrobial Resistance

Antimicrobial Resistance (AMR) occurs when bacteria, viruses, fungi and parasites no longer respond to antimicrobial

Free to Read

Cite Share Jump to Expand

VIEWPOINT | December 19, 2024

## Invention of **Enmetazobactam**: An Indian Triumph in Antimicrobial Drug Discovery

Maneesh Paul-Satyaseela\*

Open PDF

### Abstract

The discovery of antimicrobials was an inflection point in human existence since it contributed enormously to the extension of the human lifespan. Among others, the invention of Enmetazobactam marks a significant milestone in the field of antimicrobial development, especially for India. It is a **novel beta-lactamase inhibitor invented by scientists at Orchid Pharma in Chennai, India**, and has garnered international attention for its potential to address antimicrobial resistance. It became the first new chemical entity invented in India, clinically developed by Allegra Therapeutics GmbH, to be approved by the U.S. Food & Drug Administration, with additional approvals from the European Medical Agency, the U.K.'s Medicine & Healthcare Products Regulatory Agency, and the Drug Controller General of India.

This Article is From Oct 06, 2025

## India Develops Homegrown Antibiotic **Zaynich** To Fight Multi-Drug Resistant Infections

The move marks India's first significant antibiotic innovation in 30 years, offering hope against global antibiotic resistance.

Written by: [Shreya Goswami](#) | [Health](#) | Oct 06, 2025 12:26 pm IST ⓘ

Read Time: 4 mins

Add **NTV** As A

Share



# Advancing antibiotic innovation

- **With Bugworks Research Inc.:** Co-development of compound BWC0977
- **With several partners/sites:** Neonatal sepsis empiric treatment trial
- **With ICMR and several sites:** Antibiotic-resistant infections observational study (“CREP study”)



# Innovative Approaches

- **For Antibiotic Access**

- Pooled Procurement
- Linked with Stewardship
- Policy for Restricted Access of Reserve and New Antibiotics
- Innovative Regulatory Approaches: GARDP – CDSCO Consultative Meetings

# Enabling quality supply and access



- **License agreements focused on LMICs:** GARDP has the rights to commercialize **cefiderocol, zoliflodacin, and cefepime-taniborbactam** (public market only) in India
- **With Orchid Pharma:** Manufacturing sublicense agreement for cefiderocol
- **With Aurigene Pharmaceutical Services Limited:** Discussing the potential to manufacture and supply zoliflodacin
- **Transparent pricing strategy,** based on COGs+ ceiling, in sublicenses

# Improving access to antibiotics through innovation

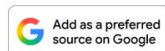


Antimicrobial resistance is a growing health crisis, and tackling it needs a multi-pronged approach

Published - August 27, 2022 07:40 pm IST

Y.K. GUPTA, SUBASREE SRINIVASAN

📖 READ LATER



Review

## Landscape of Push Funding in Antibiotic Research: Current Status and Way Forward

Himika Wasan<sup>1</sup>, Devendra Singh<sup>1</sup>, K.H. Reeta<sup>1,\*</sup> and **Yogendra Kumar Gupta<sup>2</sup>**

<sup>1</sup> Department of Pharmacology, All India Institute of Medical Sciences, New Delhi 110029, India

<sup>2</sup> Principal Advisor India Strategy Development, Global Antibiotics Research and Development Partnership (GARDP), New Delhi 110016, India

\* Correspondence: reetakh@gmail.com

**Simple Summary:** Antibiotic resistance has become one of the biggest threats to global health. The occurrence of resistance is a natural phenomenon of bacterial evolution, but their inappropriate use in humans and the environment is hastening the process at a reckless speed. The speed of developing resistance is at par or, in fact, more than the speed of novel antibiotic development. Most of the big pharmaceutical companies have left antibiotic research due to the high risk of failure and poor return on investment. Antibiotic research is mostly carried out by academic institutes and small- and medium-sized enterprises. However, they lack sufficient funds to take the compounds from early-and-mid-stage to

Editorial

## A Silent Pandemic of Antimicrobial Resistance: Challenges and Strategy for Preparedness in India

Yogendra Kumar Gupta<sup>1,2</sup> Subasree Srinivasan<sup>2</sup>

<sup>1</sup> Former Dean and HOD Pharmacology, All India Institute of Medical Sciences, New Delhi, India

<sup>2</sup> Global Antibiotics Research and Development Partnership, Switzerland

Ann Natl Acad Med Sci (India) 2022;58:55–59.

In the face of growing resistance against existing antibiotics and a dried-up pipeline of newer agents, the world is heading toward a silent pandemic. Globally, an estimated 4.95 million deaths occurred in 2019 due to drug-resistant infections including 1.27 million deaths attributable directly to bacterial antimicrobial resistance (AMR).<sup>1</sup> As per projected esti-

resistant *Staphylococcus aureus* (MRSA) resistant antibiotics emerged in 1962. Vancomycin used sparingly to treat select cases of MRSA its use increased dramatically in the 1980s became much more common. Between 19 pharmaceutical industry was flooded with ne

*J Antimicrob Chemother* 2024; **79**: 1–10

<https://doi.org/10.1093/jac/dkad291> Advance Access publication 27 November 2023

Journal of Antimicrobial Chemotherapy

## Strategies to improve antibiotic access and a way forward for lower middle-income countries

Himika Wasan<sup>1</sup>, K. H. Reeta<sup>1\*†</sup> and **Yogendra Kumar Gupta<sup>2,3†</sup>**

<sup>1</sup>Department of Pharmacology, All India Institute of Medical Sciences, New Delhi, India; <sup>2</sup>All India Institute of Medical Sciences, Jammu, India; <sup>3</sup>India Strategy Development, Global Antibiotics Research & Development Partnership (GARDP), New Delhi, India

\*Corresponding author. E-mail: reetakh@gmail.com, drkhreeta@aiums.edu

†The authors share equal correspondence.

Antibiotics have substantially improved life expectancy in past decades through direct control or prevention of infections. However, emerging antibiotic resistance and lack of access to effective antibiotics have significantly increased the death toll from infectious diseases, making it one of the biggest threats to global health. Addressing the antibiotic crisis to meet future needs require considerable investment in both research and development along with ensuring a viable marketplace to encourage innovation. Fortunately, there has been some improvement in the number of antibiotics approved or in different phases of development through collective global efforts. However

# Innovative Approaches

- **For Leftover/Expired Antibiotic Disposal**

- Survey and Awareness of Appropriate Disposal Methods
- School & College Awareness Programs
- Digital Reminder Apps
- Smart Medicine Return Kiosks – AIIMS (Bhopal), AIIMS (Kalyani) and others
- Developing Biodegradation Technology

- CHRI, PATH, Govt. of Maharashtra, GARDP invited proposals for projects

## AGENDA

*National Consultative Meeting on Safe  
Disposal of Unused/Expired Antibiotics for  
AMR containment in Maharashtra*

**Organised by:** GSK and CHRI-PATH  
**Venue:** India Habitat Centre, New Delhi  
(Magnolia Hall)  
**Date:** 12<sup>th</sup> January 2026  
**Time:** 9:30 AM – 2:00 PM (followed by  
Lunch)

*National Consultative Meeting on Safe Disposal of Unused/Expired Antibiotics  
for AMR Containment in Maharashtra*

**Panel Discussion 1: 'Leaders' perspective on Safe Disposal of Antibiotics to Contain  
Anti-Microbial Resistance**

**Moderator:** Dr N K Arora, INCLIN TRUST

**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?
3. From your perspective, how does unsafe disposal of antibiotics endanger the 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 operationalise the safe disposal systems?
2. How can Government, industry (pharma), institutions and development partners

10:40 AM– 11:30 AM	Panel Discussion: Leaders' Perspective: Safe Disposal of Antibiotics for AMR Containment	<p><b>Moderator:</b> Dr. N. K. Arora, INCLIN Trust</p> <p><b>Panelist:</b> Dr Pragya Sharma, NHSRC Mr. Neeraj Jain, PATH Dr. Bassim Zayed, SEARO, WHO Representative Dr. Y K Gupta, AIIMS Kalyani Dr. Deepika Nayar Chaudhery, World Bank Ms Swati Srivastava, CDSCO Dr. Kamini Walia, ICMR</p>
12:35 AM– 01:25 PM	Panel Discussion: Safe Disposal within a One Health Framework	<p><b>Moderator:</b> Dr. Y. K. Gupta, AIIMS Kalyani</p> <p><b>Panelist:</b> Dr. G. Karthikeyan, THSTI Dr. Tavpritesh Sethi, IIT Delhi Dr. O P Kansal, World Bank Dr. Narendra Saini, IMA Dr. Venkatesh Roddawar, JSI</p>

# Innovative Approaches

- **For AMR Diagnostics**

- AI-Powered Rapid Diagnostics – AIIMS and IIT
- Point-of-Care Testing Devices – BIRAC and ICMR Projects to start-ups
- Smartphone-Linked Diagnostic Kits
- Affordable Molecular Diagnostics
- Sensors for Infection Markers

# Ensuring Affordability



### Sustainable pricing

- Orchid has agreed to a transparent pricing structure known as “Cost of Goods Plus” (COGS+), which will allow the company to make a profit while limiting the costs for patients and health systems



### Limiting costs

- Orchid has agreed to price reduction based on increasing volumes, which means that as Orchid decreases its costs, some of its savings will be passed on to patients

# Fostering appropriate use

---



## Country-support activities, e.g.

- **With PHFI:** Working on Developing strategies for pooled procurement of reserve antibiotics in India.
- **With FIND:** Facility assessments of 30 public and private hospitals in India to understand existing AMR diagnostic laboratory capacity, current antibiotic use and existing stewardship practices
- **Proposed PAN-AIIMS Network for Rational Use of Antibiotics and Stewardship**



## Union Health Minister Shri J P Nadda Launches National Action Plan on Antimicrobial Resistance 2.0

AMR is a major public health concern that can only be addressed through collective action: Union Health Minister

“Overuse and misuse of antibiotics has unfortunately become common practice, underscoring the urgency of corrective measures”

“Key strategies of AMR containment to be implemented under NAP AMR 2.0 which includes strengthening awareness, education and training, enhancing laboratory capacity and infection control in healthcare facilities”

# AMR: Whose Responsibility?

All Stakeholders Including People Listening to this Talk

