Breakthrough AI Research Offers New Hope in the Fight Against Antimicrobial Resistance

New Delhi: 19th May, 2025: A team of researchers from Inria Saclay (France) and the Indraprastha Institute of Information Technology Delhi (IIIT-Delhi, India) has developed an innovative artificial intelligence (AI)-based method that could help doctors treat drug-resistant infections by recommending alternative antibiotics using existing medications.

Antimicrobial resistance (AMR) is one of the gravest global health threats of our time. It occurs when bacteria evolve and no longer respond to antibiotics that were previously effective. This rising resistance means that routine infections—like pneumonia, urinary tract infections, or even minor wounds—can become life-threatening. The crisis is especially severe in low- and middle-income countries, where over 70% of hospital-acquired infections show resistance to at least one common antibiotic.

The traditional drug development pipeline has been slow and costly, often taking over a decade and hundreds of millions of dollars to produce a single new antibiotic. As such, healthcare professionals are increasingly relying on **drug repositioning**—finding new uses for existing drugs—as a faster and more cost-effective strategy.

To aid this effort, a collaborative team led by **Dr. Emilie Chouzenoux** (Inria Saclay) and **Dr. Angshul Majumdar** (IIIT-Delhi) has developed a novel machine learning algorithm that can intelligently recommend alternate treatment options for drug-resistant bacterial infections. The interdisciplinary team also includes **research engineer Stuti Jain** and **graduate students Kriti Kumar and Sayantika Chatterjee**.

What sets this work apart is the **hybrid nature of the AI approach**. Instead of relying on rigid rule-based systems or limited susceptibility databases, the algorithm learns from patterns in real-world clinical data. The researchers compiled and curated detailed antibiotic usage guidelines from leading Indian hospitals—capturing how clinicians actually treat infections in practice. The model then integrates this with molecular-level data, such as **bacterial genome information** and **chemical structures of antibiotics**, to uncover underutilized treatment options.

The AI system was rigorously tested using case studies of **multi-drug resistant strains**, including:

- *Klebsiella pneumoniae* – a leading cause of ventilator-associated pneumonia and bloodstream infections in hospitals;

- *Neisseria gonorrhoeae* – the bacteria behind gonorrhea, which has become increasingly resistant to first-line therapies;

- *Mycobacterium tuberculosis* – responsible for tuberculosis, still a major health burden in countries like India.

In all cases, the algorithm was able to identify antibiotics that were either already known to be effective or showed strong potential for repurposing based on cross-referenced evidence. These suggestions were validated against known resistance profiles and expert feedback, pointing toward real-world clinical utility.

Beyond its immediate applications, this research is significant because it provides a **scalable, data-driven decision-support tool** for doctors, microbiologists, and policy-makers. It can be embedded in hospital systems or public health frameworks to reduce treatment delays, improve antibiotic stewardship, and potentially save lives.

"*This is an excellent example of how **AI and international collaboration** can come together to solve real-world medical challenges*," said Dr. Majumdar. "*Our method makes it possible to use existing knowledge more effectively and opens the door to smarter, faster responses to AMR*."

The research team believes that such tools could become part of standard practice in infection management, particularly in settings with limited access to advanced diagnostic infrastructure.