Science & Technology · GS - III

“Advances in understanding the molecular machinery of pathogens can open new avenues for combating antimicrobial resistance.” Discuss with reference to recent CSIR-CCMB research on tuberculosis.

EXAM YEAR	PAPER	SUBJECT
Mains Daily Practice 10/11/2026	GS - III	Science & Technology

MARKS	WORD LIMIT
10	~150 words

Answer Hint

Protein secretion, SecA1 and Tat pathways, bacterial survival, drug-resistant TB, molecular research, targeted drug development, translational challenges, antimicrobial resistance, public health infrastructure and India's TB elimination strategy.

Model Answer

Tuberculosis (TB), caused by Mycobacterium tuberculosis, remains a major public health challenge, particularly due to increasing antimicrobial resistance.

A CSIR-Centre for Cellular and Molecular Biology (CCMB) research team has mapped the protein transport machinery of the bacterium, identifying potential therapeutic targets. Researchers examined SecA1 and Twin-Arginine Translocation (Tat) pathways, which facilitate protein movement essential for bacterial survival.

Using computational modelling, laboratory experiments and CRISPR-based gene silencing, scientists demonstrated that disrupting these pathways significantly reduces bacterial growth and damages cellular membrane integrity. The findings reveal vulnerabilities that could support development of novel anti-TB drugs, including treatments against resistant strains. However, identifying potential targets does not immediately translate into medicines; further validation, drug development, clinical trials and regulatory approval remain necessary.

The discovery highlights the importance of fundamental research, interdisciplinary collaboration and biotechnology in addressing infectious diseases. India must strengthen research institutions, affordable diagnostics, surveillance and treatment adherence under the National Tuberculosis Elimination Programme.

Thus, molecular research, innovation and effective public health implementation together can accelerate tuberculosis elimination and strengthen India's healthcare security.

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