

## *Enterococcus faecalis* biofilm: a clinical and environmental hazard

Bindu Sadanandan and Kavyasree Marabanahalli Yogendraiah

Department of Biotechnology, M S Ramaiah Institute of Technology, Bengaluru 560054, Karnataka, India

### Introduction

- Enterococcus faecalis* is a Gram-positive facultative anaerobe and a part of normal gut flora.
- Its ability to form resilient biofilms makes it a major pathogen in nosocomial infections and a threat to environmental safety.

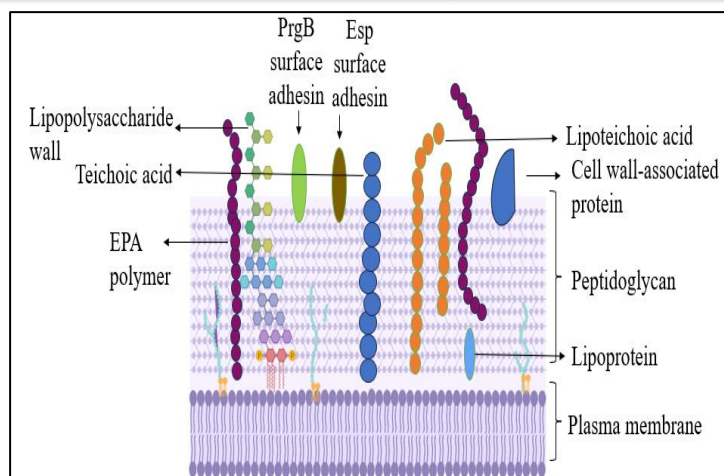


Fig 1: Structure of *E. faecalis* cell wall

### Stages of Biofilm Formation

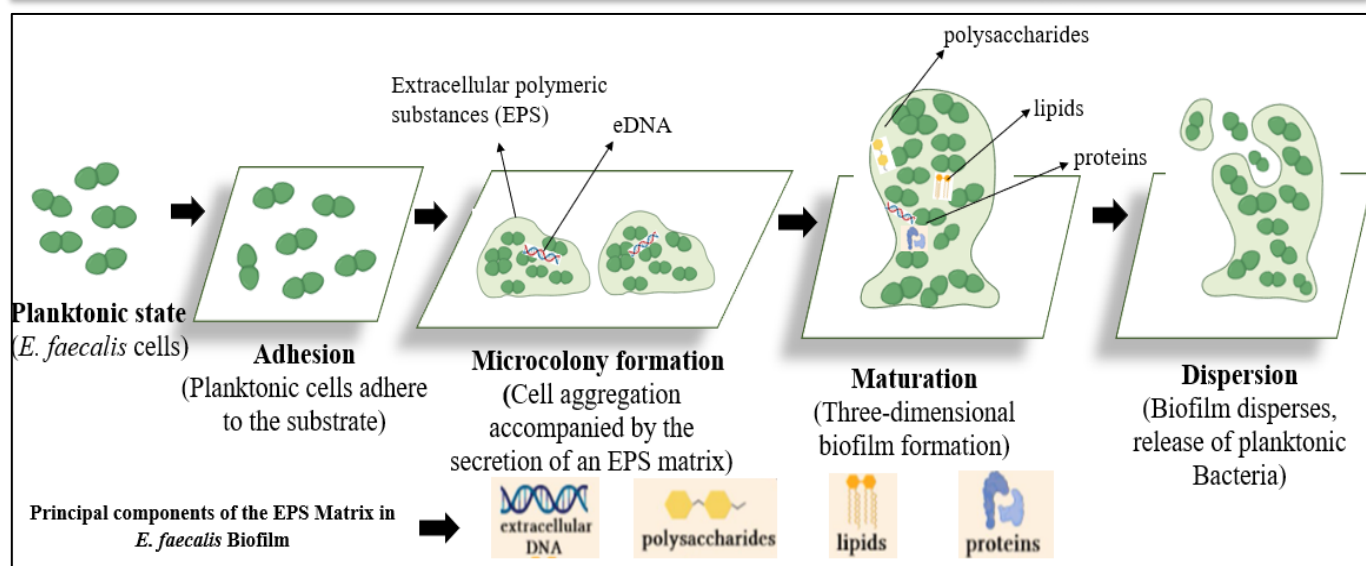


Fig 2 : Stages of Biofilm formation in *E. faecalis*

- E. faecalis* cells will adhere to the substrate → EPS matrix development (Microcolony formation) → Maturation → Dispersion
- Key proteins involved are : Agg, GelE, Esp, Ebp.

### Biofilm Architecture of *E. faecalis*

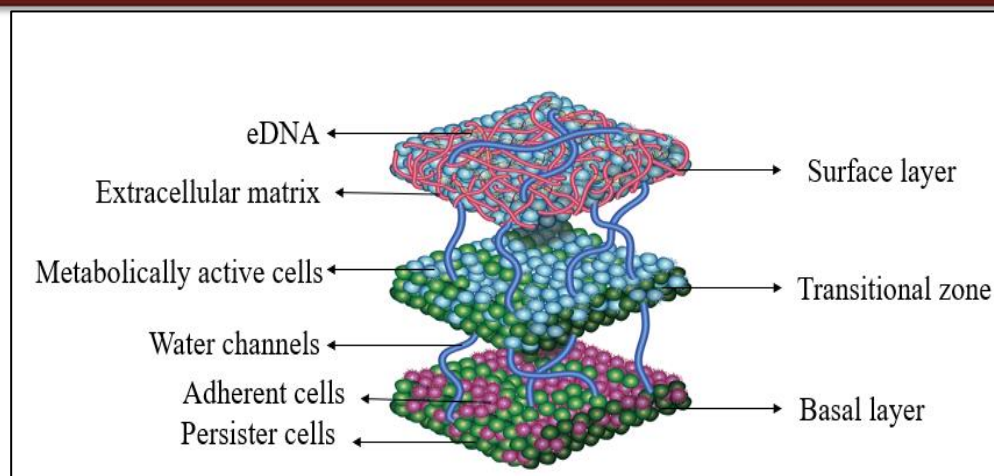


Fig 3: 3D stacks of *E. faecalis* biofilm

- E. faecalis* forms a dense, three-dimensional biofilm with three different layers (Surface layer, Transistional zone & Basal layer)
- Basal layer consists of adherent cells & more of persister cells, Transistional zone consists of persister cells & metabolically active cells and Surface layer has metabolically active cells embedded in extracellular matrix rich in polysaccharides, proteins, and eDNA.
- The biofilm contains internal water channels that facilitate nutrient transport and waste removal.

### Conclusion

- E. faecalis* biofilm present a serious dual threat in both clinical and environmental settings.
- Addressing this issue is crucial for improving patient outcomes and reducing the spread of resistant organisms in the environment..

### Clinical Hazards

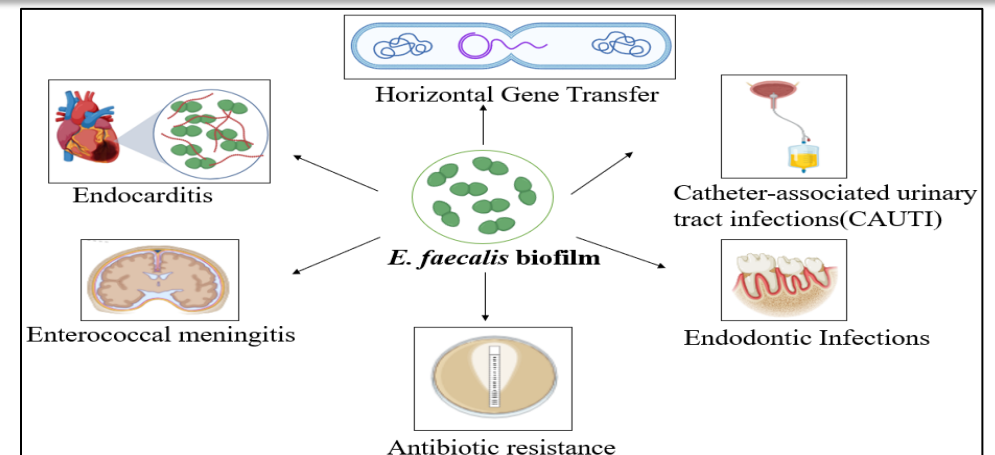


Fig 4: Clinical hazards caused by *E. faecalis* biofilm

- E. faecalis* cells are associated with persistent UTIs, endocarditis, root canal failure, and device-related infections.
- E. faecalis* biofilm reduces antibiotic efficacy and evades host immunity.

### Environmental Hazards

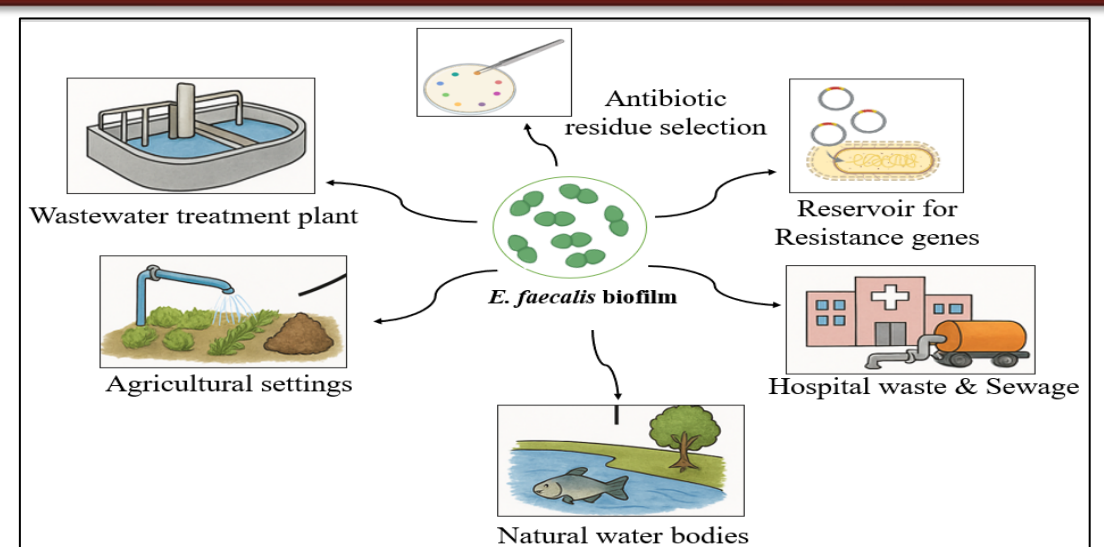


Fig 5: Environmental Hazards caused by *E. faecalis* biofilm

- E. faecalis* cells are found in hospital wastewater and water systems. They can transfer antibiotic resistance genes.
- Highly resilient in harsh environments.

### Emerging Strategies for Prevention & Treatment of *E. faecalis* Biofilms

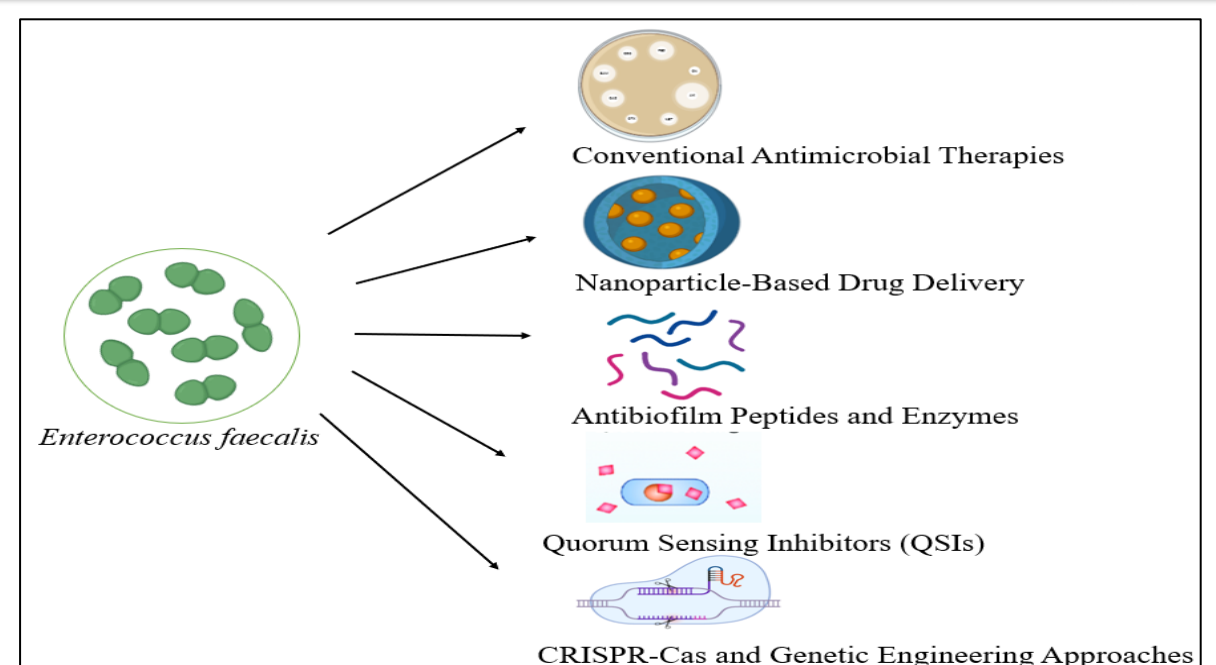


Fig 6: Emerging strategies to prevent *E. faecalis* biofilm

- Emerging strategies for managing *E. faecalis* biofilms include targeted approaches such as conventional antimicrobial therapies, antimicrobial peptides, quorum sensing inhibitors, nanocarrier-based delivery systems, and genetic engineering approaches
- All these approaches enhance *E. faecalis* biofilm disruption and improve clinical outcomes.

### References

- Willett, J. L., & Dunny, G. M. (2025). Insights into ecology, pathogenesis, and biofilm formation of *Enterococcus faecalis* from functional genomics. *Microbiology and Molecular Biology Reviews*, 89(1), e00081-23.
- Yang, S., Meng, X., Zhen, Y., Baima, Q., Wang, Y., Jiang, X., & Xu, Z. (2024). Strategies and mechanisms targeting *Enterococcus faecalis* biofilms associated with endodontic infections: A comprehensive review. *Frontiers in Cellular and Infection Microbiology*, 14, 1433313.