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Surface modification strategies for mitigating biofilm adhesion on glaucoma drainage devices in the intraocular environment: a systematic review

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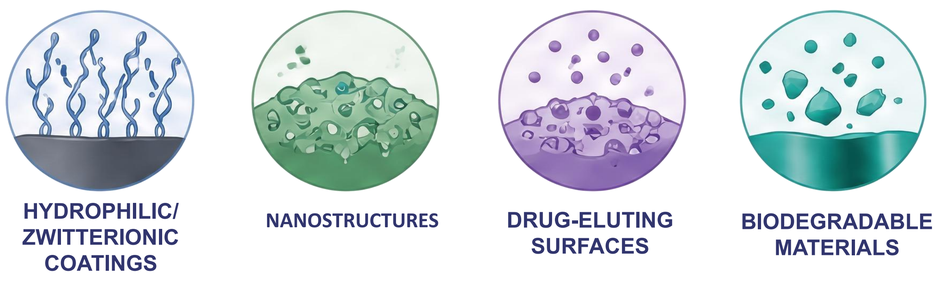
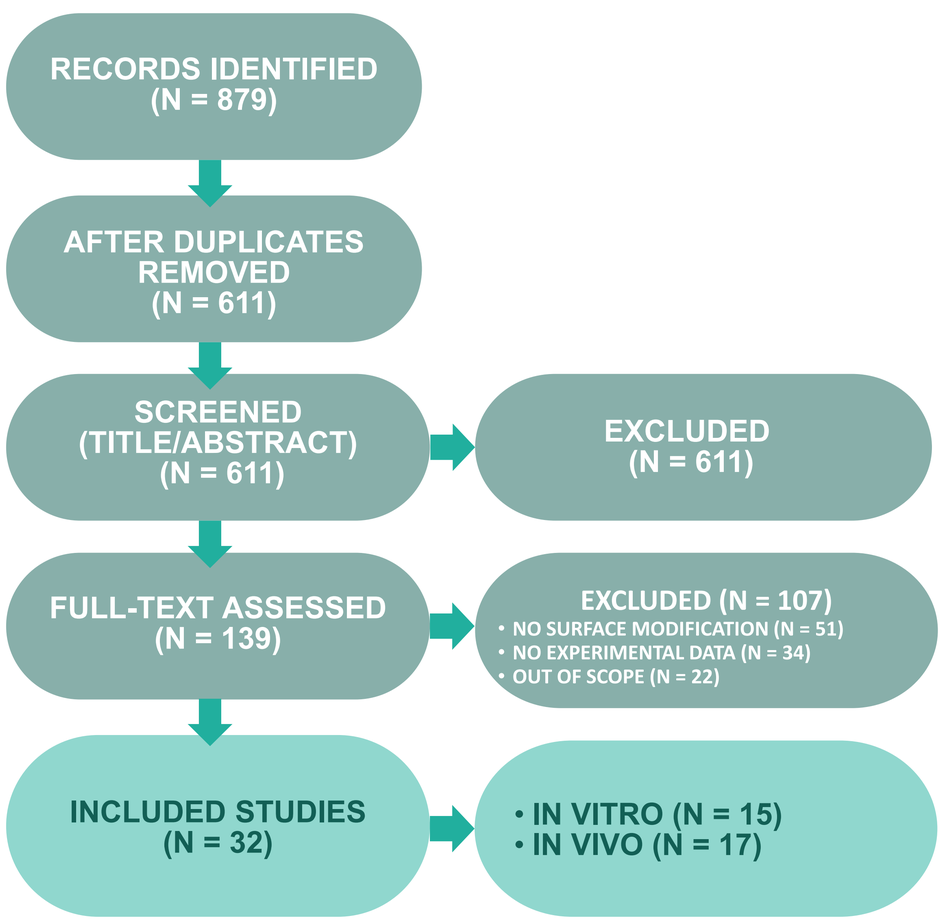
INTRODUCTION & AIM

The presence of a foreign body in the ocular environment can promote the adhesion of proteins, cells, and microorganisms. Biofilm poses a particular threat because bacteria embedded in the biofilm matrix are less susceptible to immune responses and antibiotics. Biofilm is recognized as a significant problem in infections associated with ophthalmic implants, including intraocular lenses, contact lenses, and other ophthalmic devices.

Aim: To review surface-engineering strategies that may reduce bacterial adhesion and biofilm formation on glaucoma drainage devices, with emphasis on intraocular biocompatibility and translational potential.



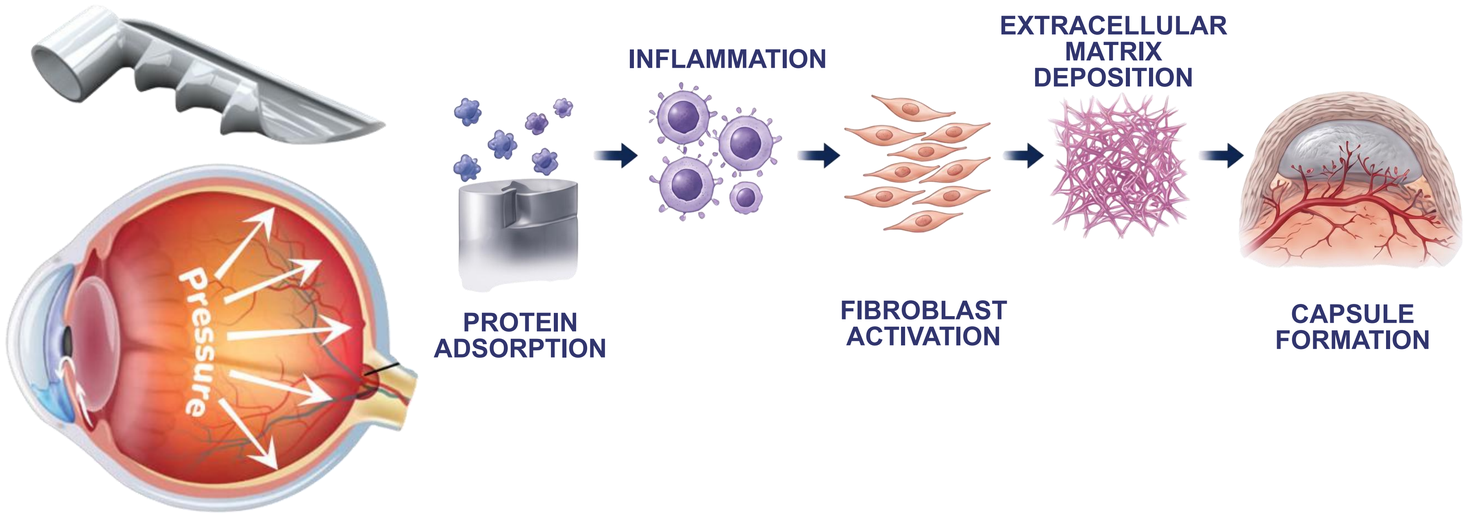
METHOD



CONCLUSIONS

Surface modifications significantly reduce fibrosis and improve biocompatibility in preclinical models. Among the available options, zwitterionic coatings offer the best balance of antifibrotic, antimicrobial, and endothelial-friendly properties. While drug-eluting systems are the most effective against fibrosis, they still require optimization to reduce cytotoxicity. Furthermore, antimicrobial functionality remains underdeveloped across current ophthalmic implants.

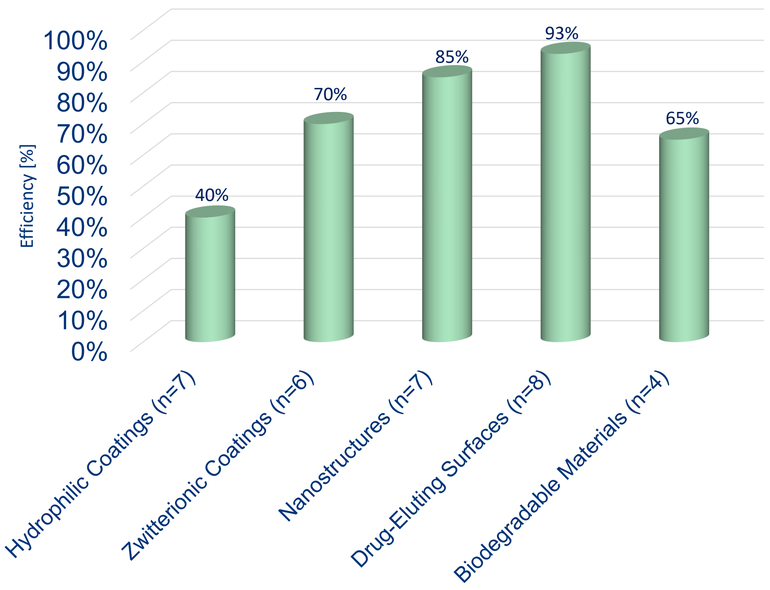
FUTURE SUCCESS = MULTIFUNCTIONAL SURFACES



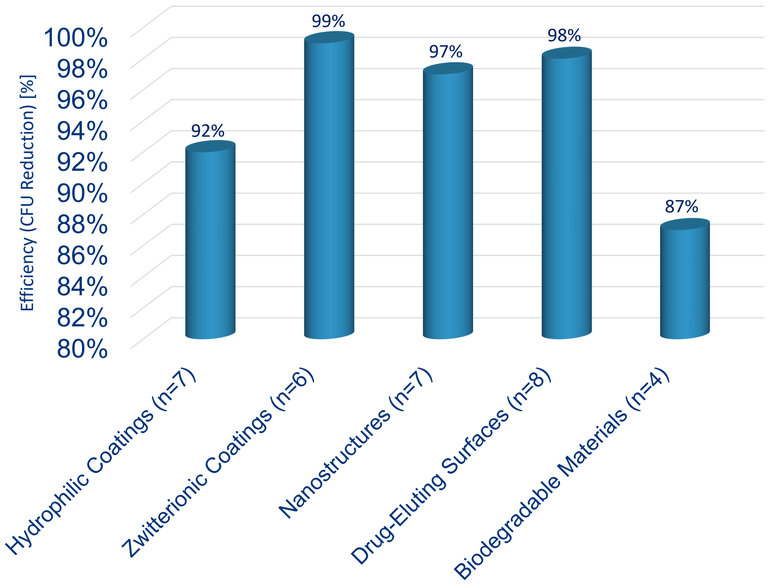
Fibrosis and infection limit long-term success of glaucoma implants.

RESULTS & DISCUSSION

ANTIFIBROTIC EFFICACY



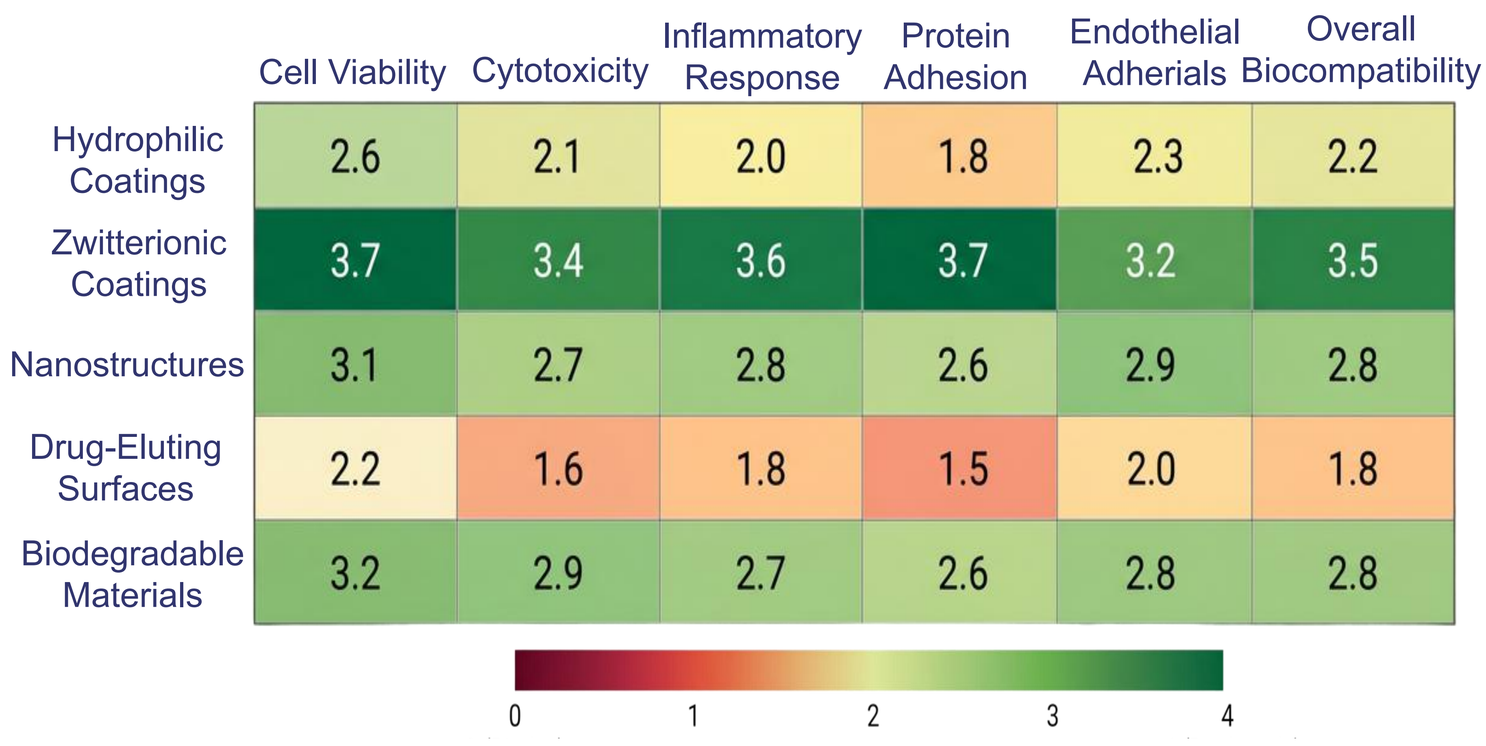
ANTIMICROBIAL EFFICACY



Drug-eluting system show the strongest antifibrotic potential, followed by nanostructured and zwitterionic surfaces

Zwitterionic coatings provide the highest antimicrobial activity by minimizing bacterial adhesion and biofilm formation.

ENDOTHELIAL BIOCOMPATIBILITY



REFERENCES/ACKNOWLEDGMENT

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