

Johns Hopkins Engineering

Immunoengineering

Immunoengineering—Pathogens

Biomaterial Anti-bacterial Design



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Biomaterials can be engineered to improve existing therapies

Pathogenic Immunoengineering applications we will look at:

- Vaccines
- **Antibiotics**

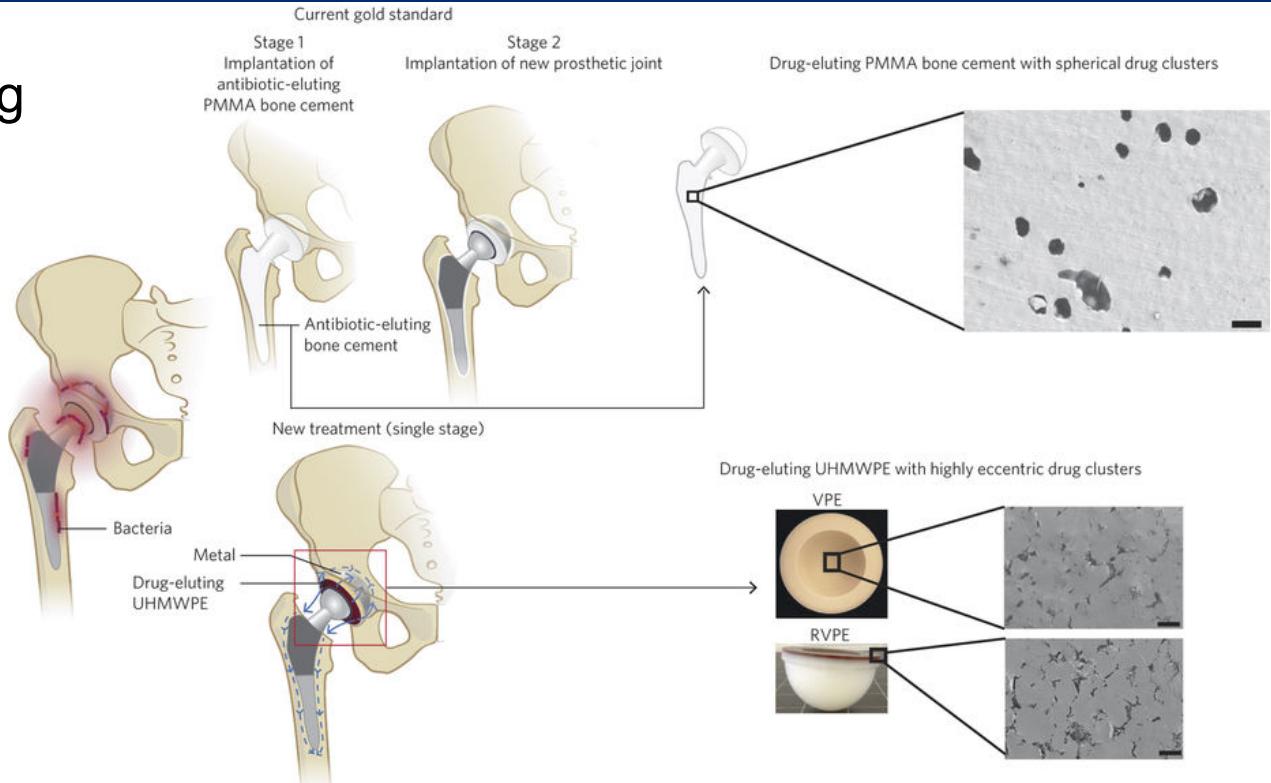
Challenges Facing Antibiotics

Challenges Facing Antibiotics

- Limiting systemic effects to microbiota
- Delivery to site of infection
- Poor penetration into bacteria
- Antibiotic resistance
- Lack of novel antibiotics

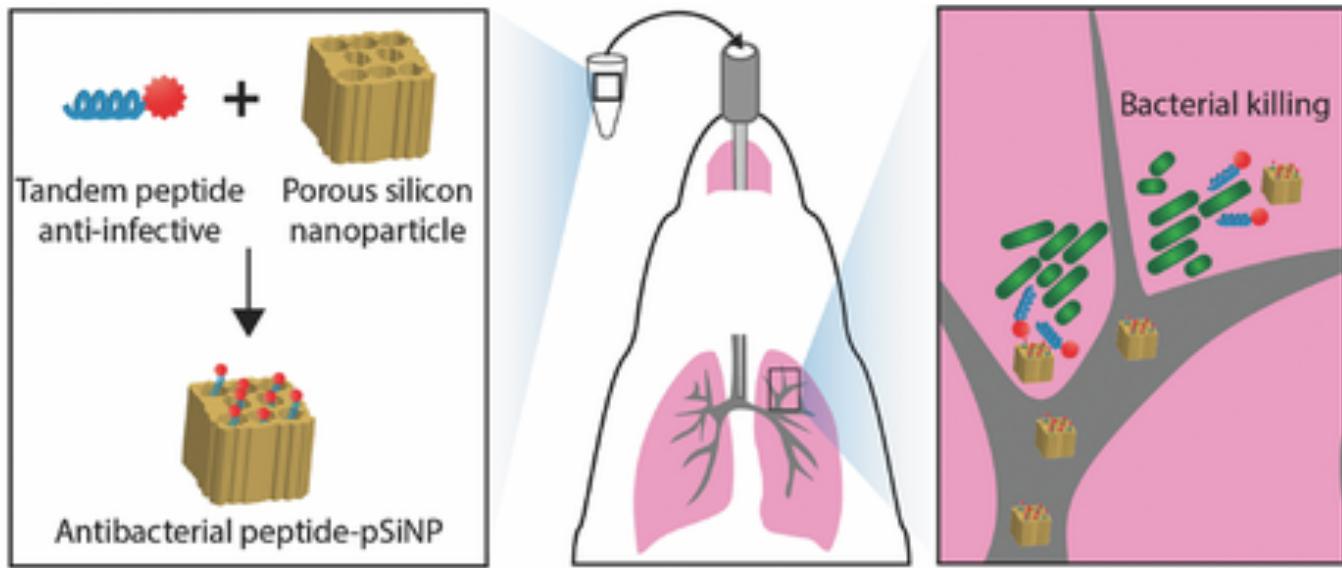
Drug Eluting Joints

- Mechanical vs. drug elution
- Local release



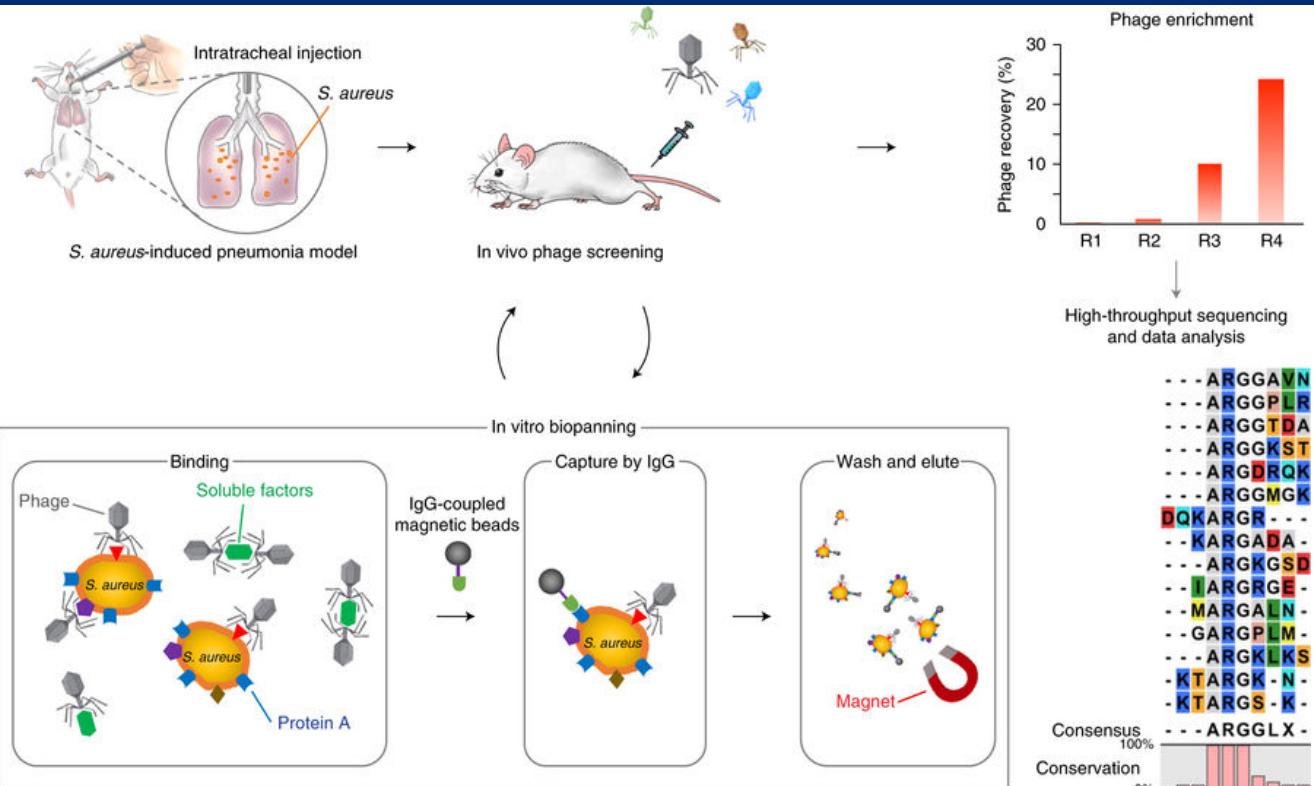
Delivery of Antibiotics to Lung infection

- Develop novel protein-based antibiotic
- Protect protein-based antibiotic



Nanoparticle Targeting of Antibiotics

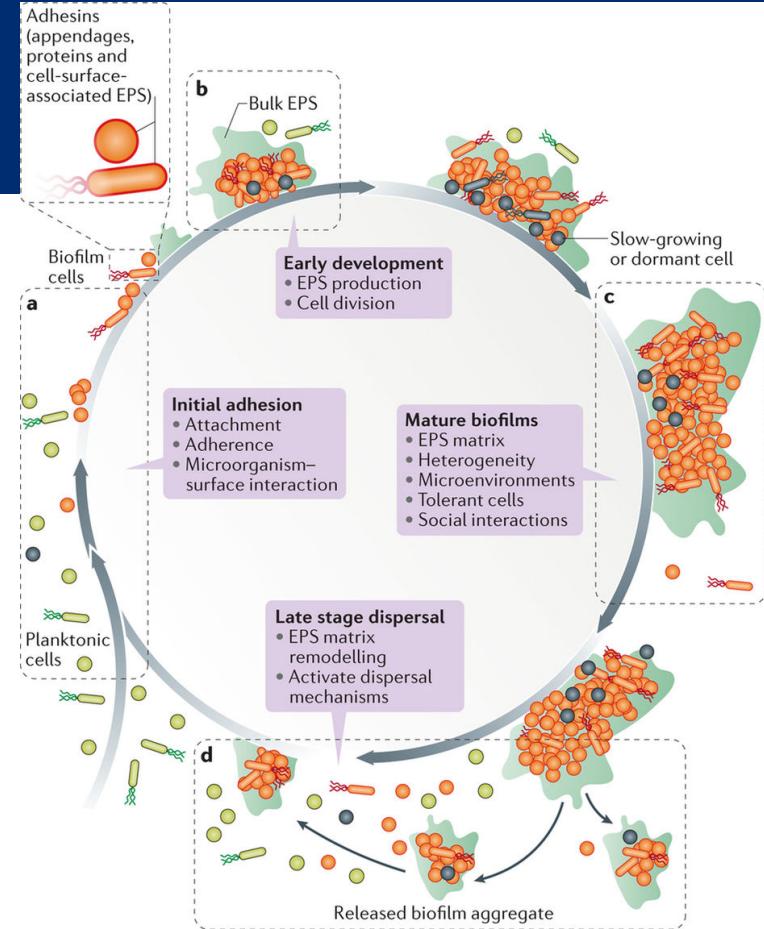
- Improve Biodistribution
- Improve targeting



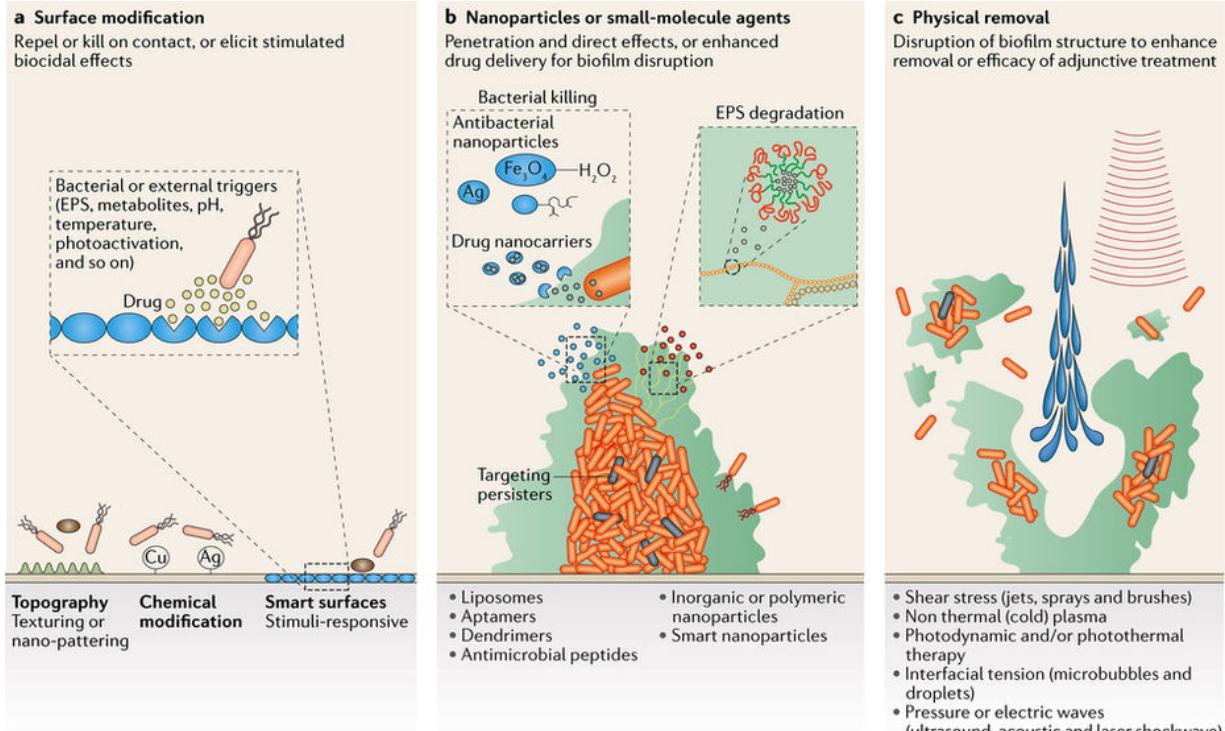
Hussain, Sazid, et al. "Antibiotic-loaded nanoparticles targeted to the site of infection enhance antibacterial efficacy." *Nature Biomedical Engineering* (2018): 1.

Biofilms

- Complex structural and biological attributes
- Promotes drug tolerance
- Often complex environment not considered in design of monotherapeutic antibiotics

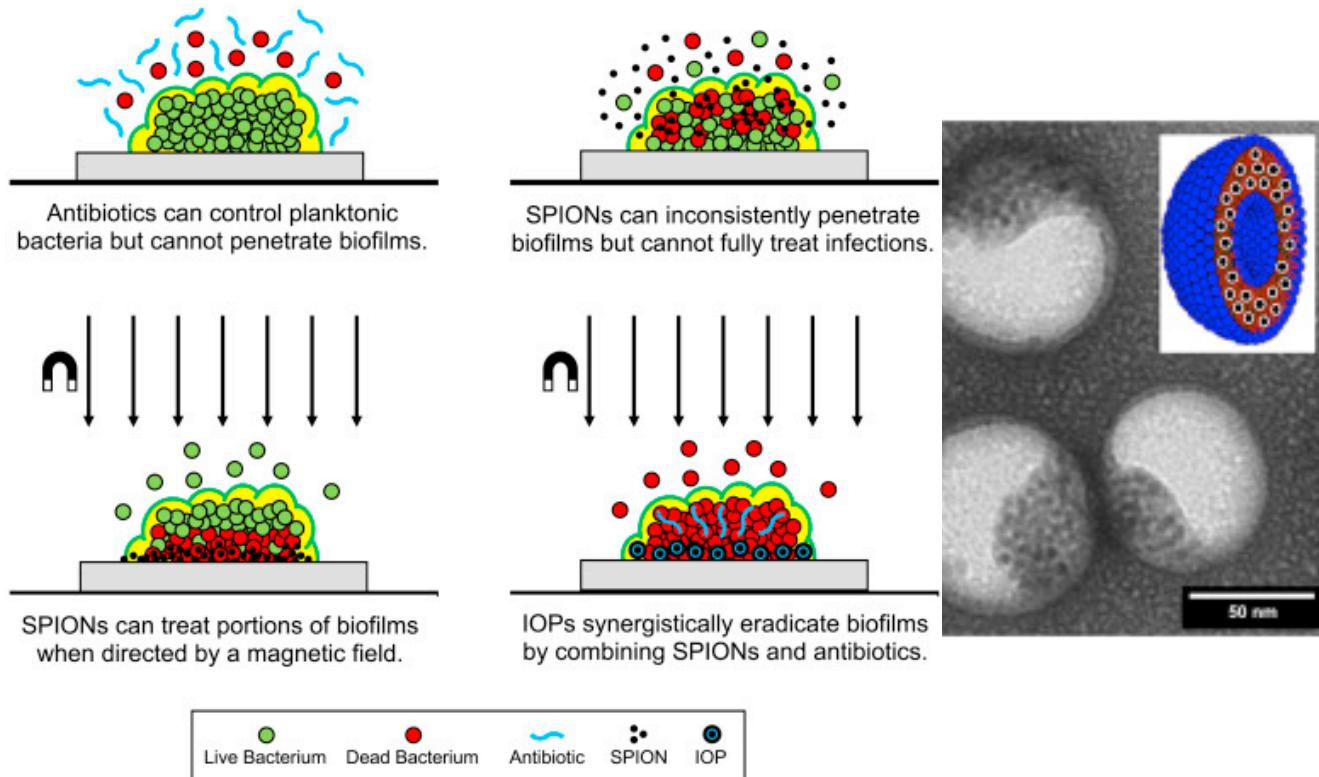


Tackling Biofilms with Biomaterial Engineering

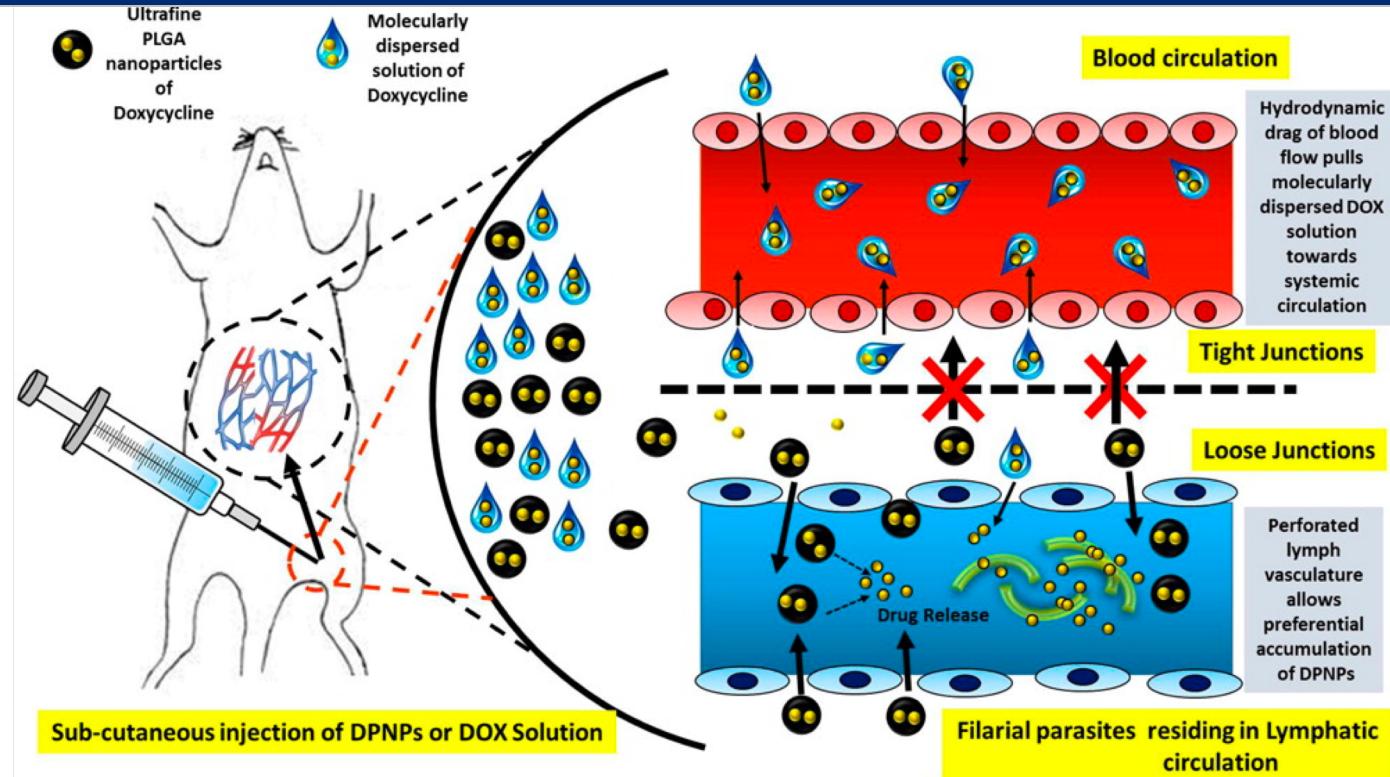


Example: Increasing Penetration into Biofilms

- Magnetic properties include targeting and increasing penetration
- Combination with antibiotic



Extra: Targeting Parasites



Singh, Yuvraj, et al. "Subcutaneously administered ultrafine PLGA nanoparticles containing doxycycline hydrochloride target lymphatic filarial parasites." *Molecular pharmaceutics* 13.6 (2016): 2084-2094.

Challenges and Opportunities for Biomaterials

Advantages

- Tunable engineered properties
 - Controlled Release
 - Targeted Delivery
 - External Control
- Application
- Enhance existing therapies

Disadvantages

- FDA – increased complexity
- In vivo control
- Manufacturing
- Significant improvements



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