

# Innovative Solutions to Combat Biofilms and Antimicrobial Resistance: Advancing with Marine Bioactives and Microbiome Research

Tom Coenye – [Tom.Coenye@UGent.be](mailto:Tom.Coenye@UGent.be)





**Fund Alphonse and Jean Forton**  
managed by the King Baudouin Foundation

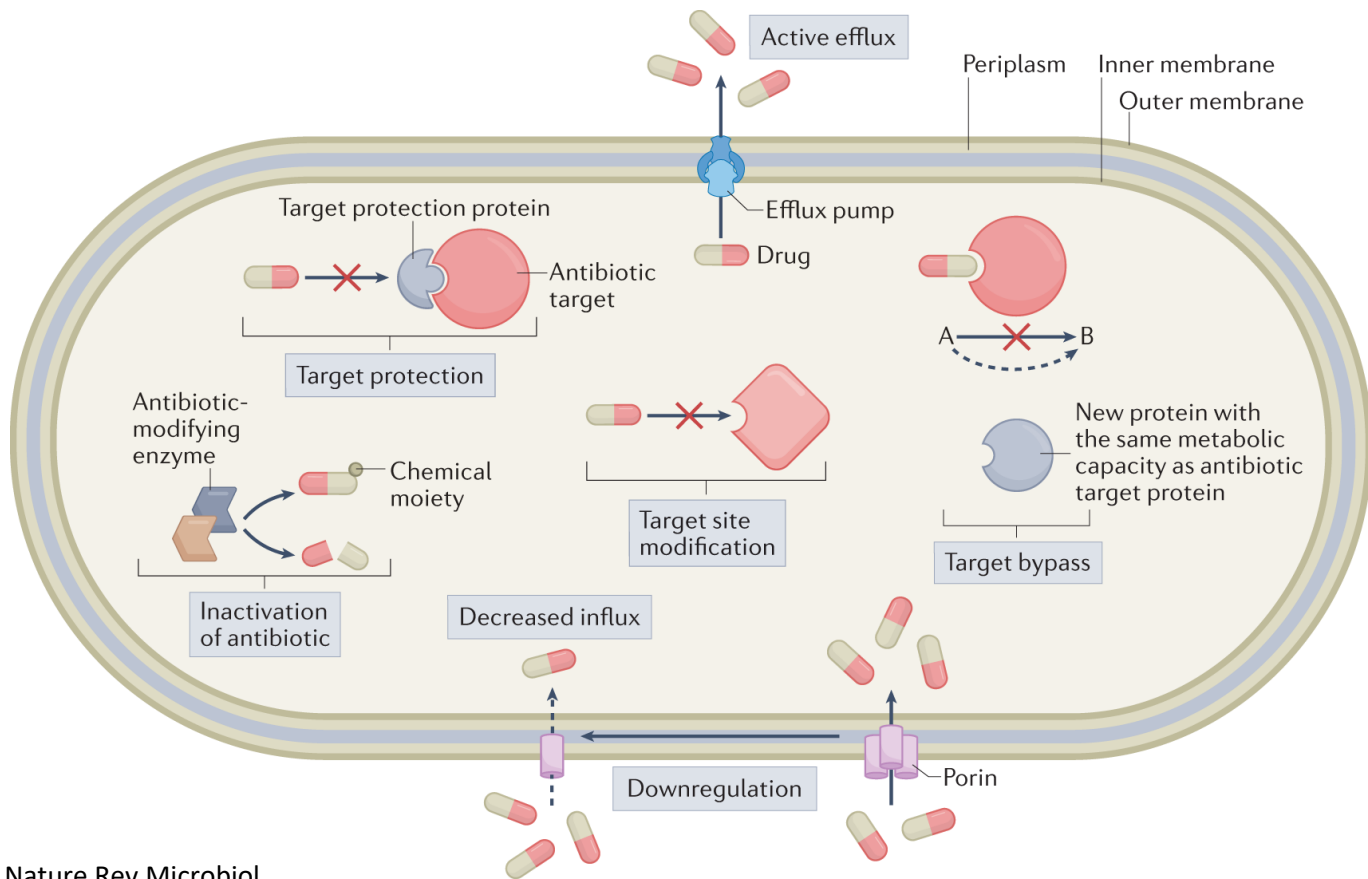


# **Innovative Solutions to Combat Biofilms and Antimicrobial Resistance: Advancing with Marine Bioactives and Microbiome Research**

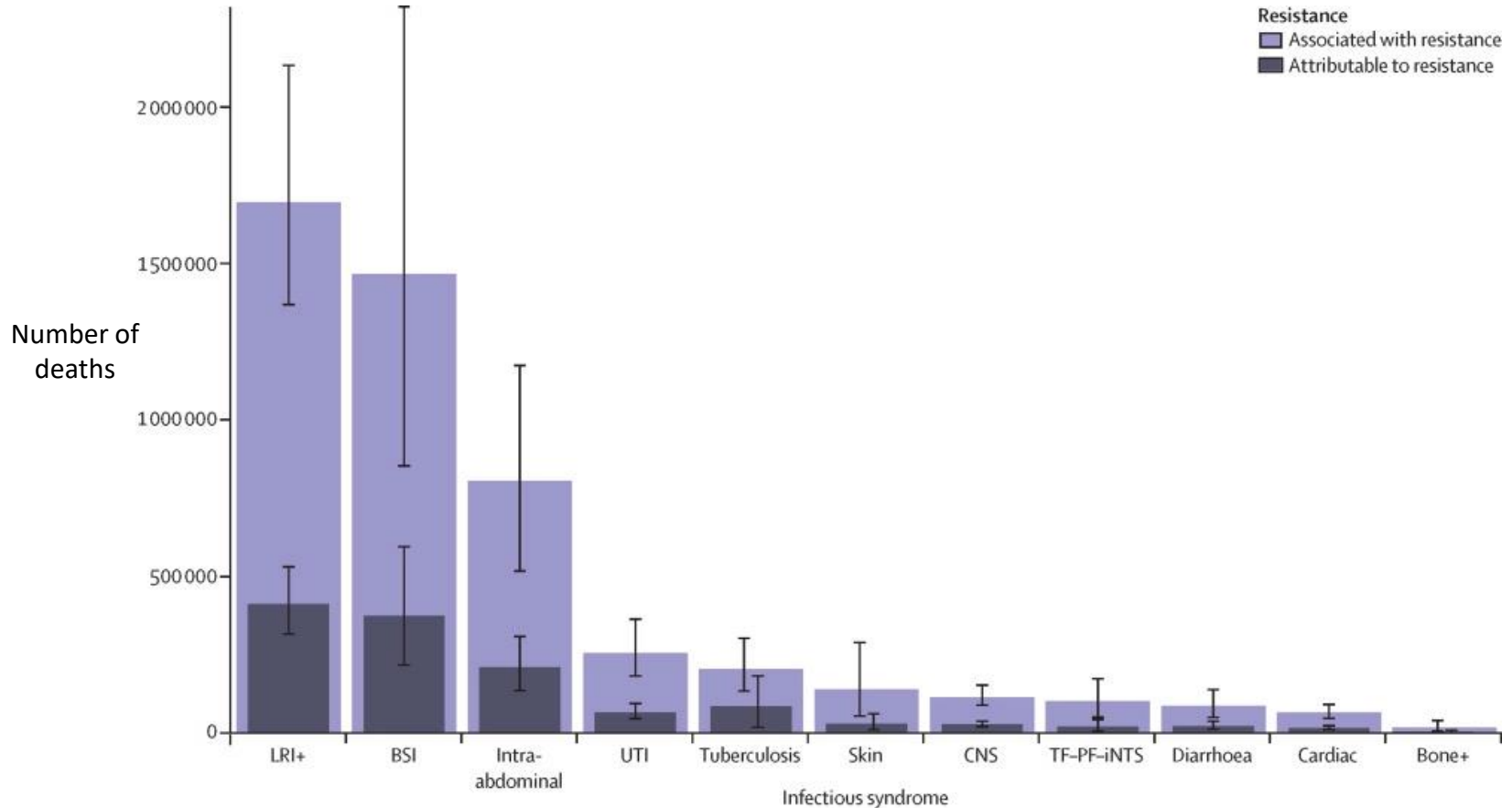
What I will talk about:

- Brief introduction to antimicrobial resistance and clinical biofilms
- Why are biofilm-related infections so difficult to treat?
- Alternative approaches to treatment using marine natural products

# Microorganisms have many ways of dealing with antibiotics leading to antimicrobial resistance and therapy failure

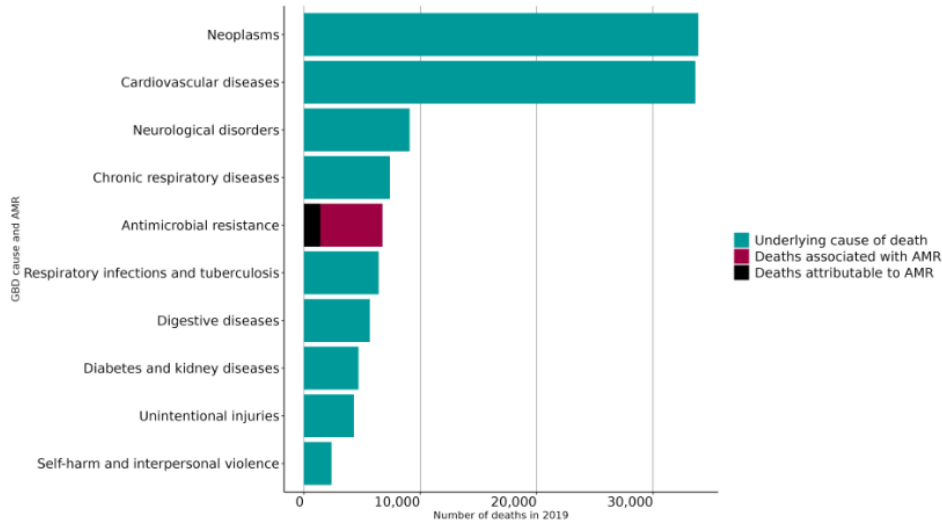


# The global burden of antimicrobial resistance - 2019

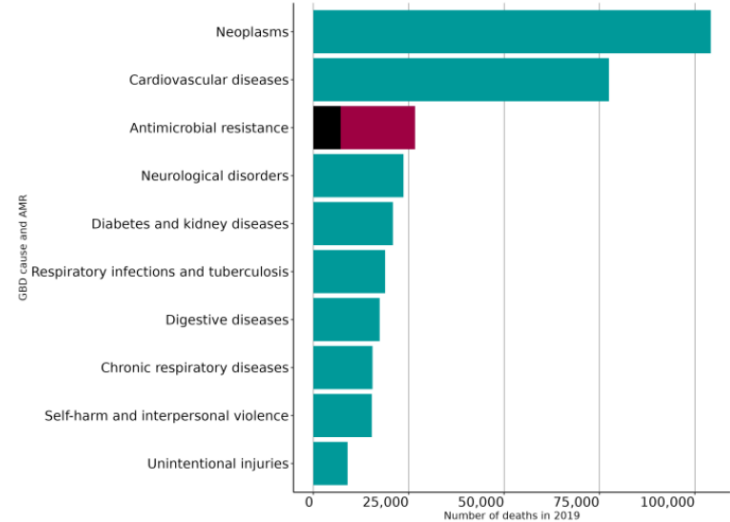


# The burden of antimicrobial resistance in BE and ROK - 2019

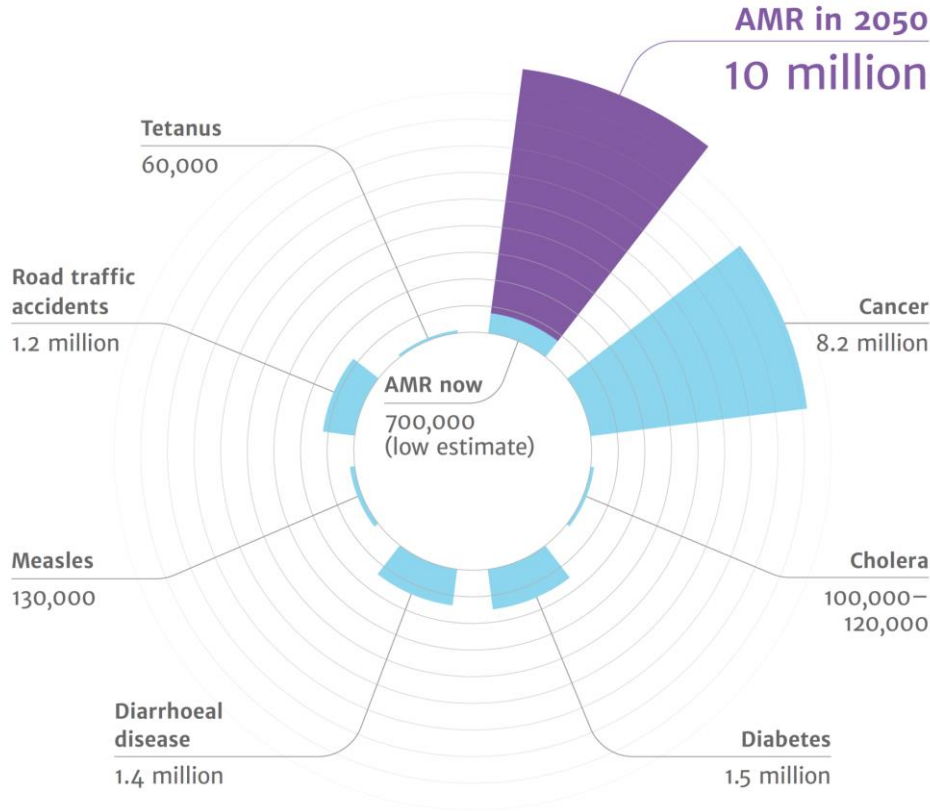
## Belgium



## Republic of Korea



Main organisms: *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Streptococcus pneumoniae*, *Enterococcus faecium*, *Pseudomonas aeruginosa*



## 2023 Antibacterial agents in clinical and preclinical development

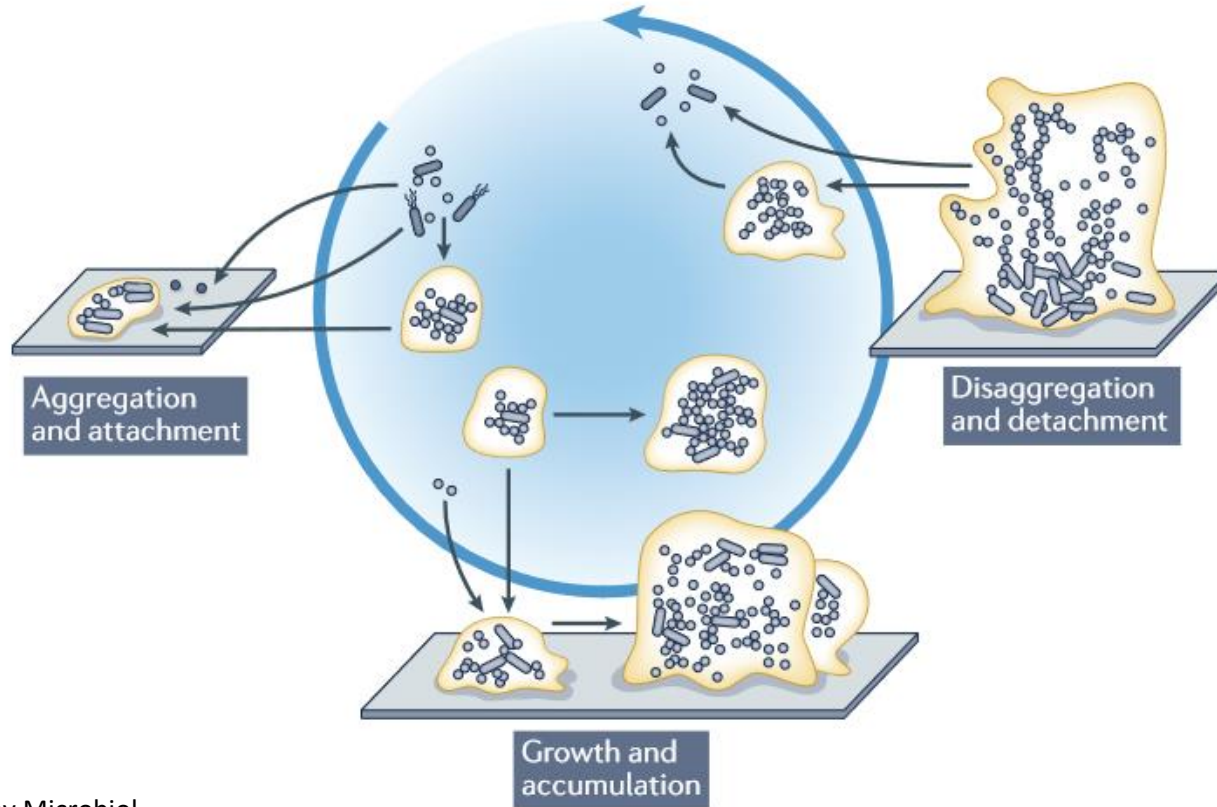
an overview and analysis



Overall, antibacterial agents in the clinical pipeline combined with those approved in the last six years are still insufficient to tackle the ever growing threat of the emergence and spread of drug-resistant infections.

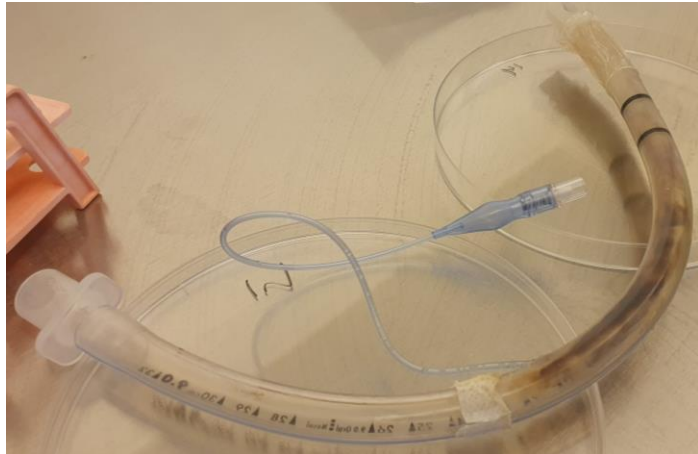
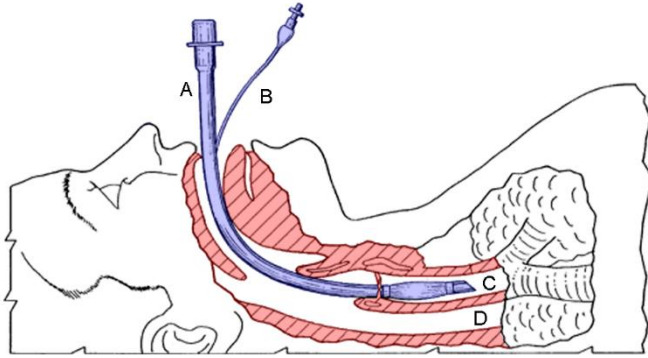
# Problem is made worse by microbial biofilm formation

## What are microbial biofilms?





# Biofilms occur as attached communities on surfaces and as suspended aggregates



Biofilm 4 (2022) 100079



ELSEVIER

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Biofilm

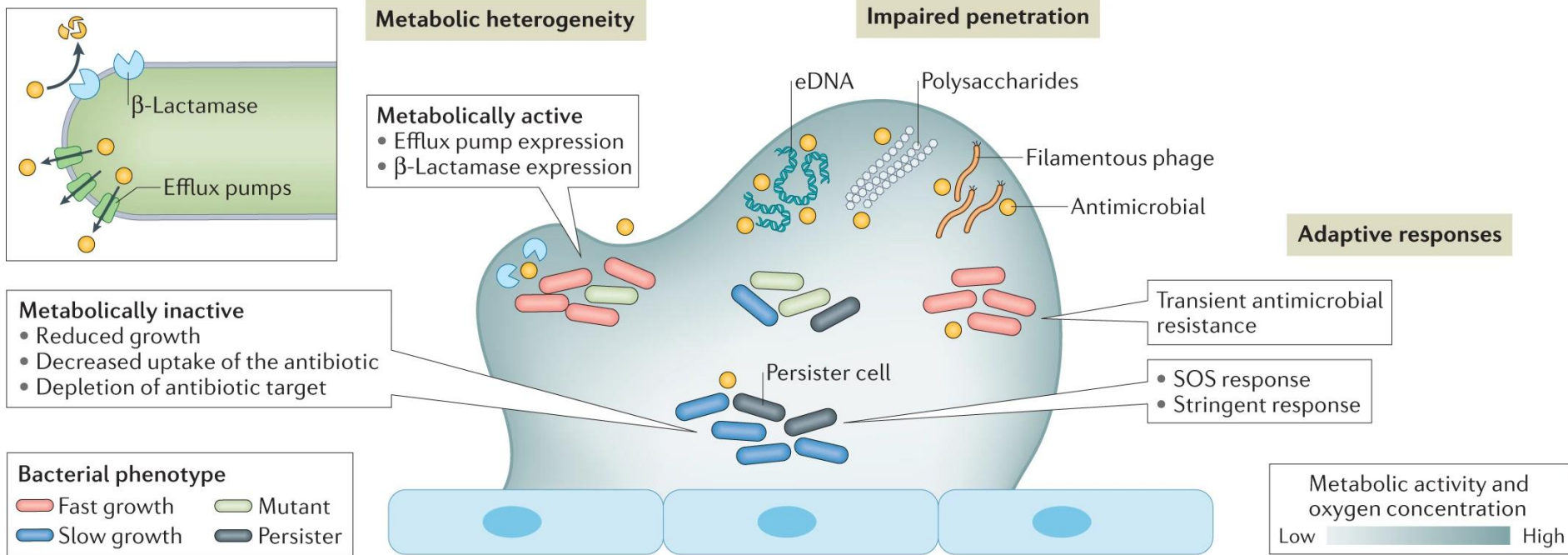
journal homepage: [www.sciencedirect.com/journal/biofilm](https://www.sciencedirect.com/journal/biofilm)



Microbial diversity and antimicrobial susceptibility in endotracheal tube biofilms recovered from mechanically ventilated COVID-19 patients

Frits van Charante<sup>a</sup>, Anneleen Wieme<sup>b,e</sup>, Petra Rigole<sup>a</sup>, Evelien De Canck<sup>b</sup>, Lisa Ostyn<sup>a</sup>, Lucia Grassi<sup>a</sup>, Dieter Deforce<sup>c</sup>, Aurélie Crabbé<sup>a</sup>, Peter Vandamme<sup>b,e</sup>, Marie Joossens<sup>b</sup>, Filip Van Nieuwerburgh<sup>c</sup>, Pieter Depuydt<sup>d</sup>, Tom Goenye<sup>a,\*</sup>

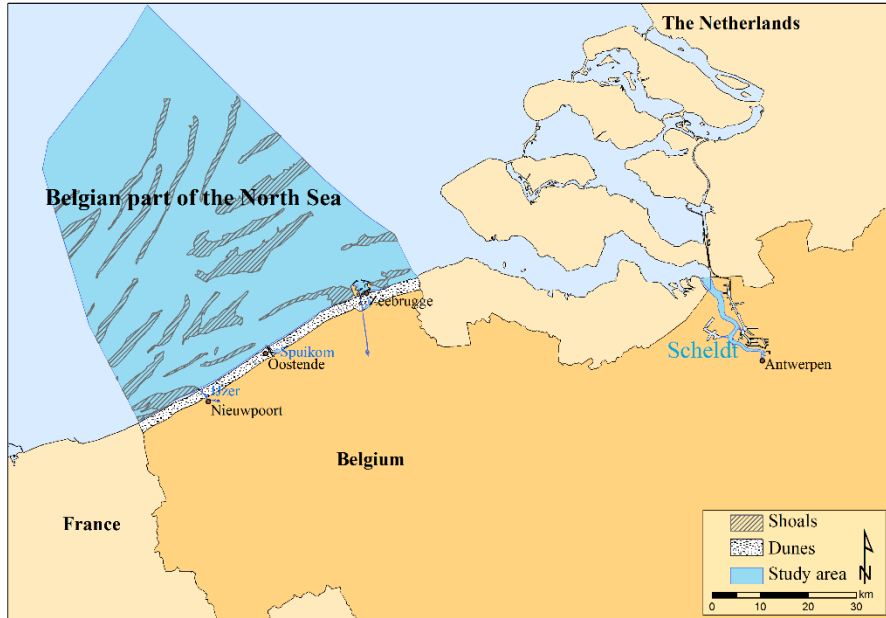
# Biofilm-related tolerance also contributes to therapy failure



# Innovative Solutions to Combat Biofilms and Antimicrobial Resistance: Advancing with Marine Bioactives and Microbiome Research

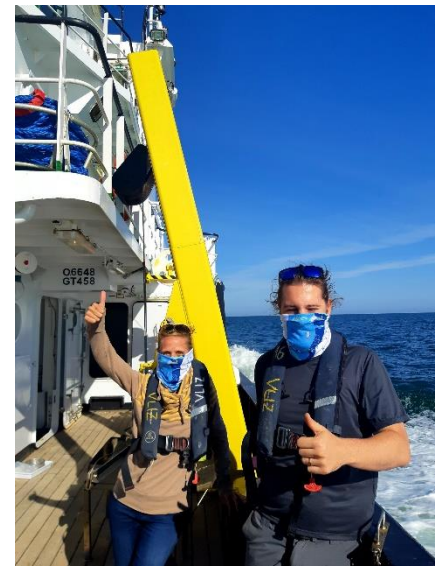
- Antimicrobial resistance is a global burden leading to excess mortality worldwide
- The problem is made worse by biofilm-associated antimicrobial tolerance
- There is an urgent need for new antimicrobial agents/antibiotics
- Where do we find these?

# The ProBio project (2020-2022)



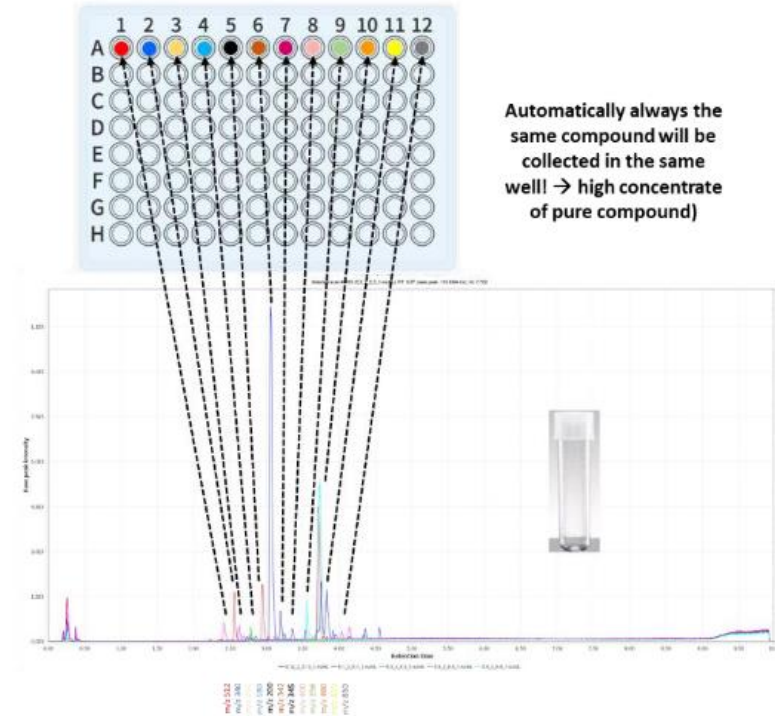
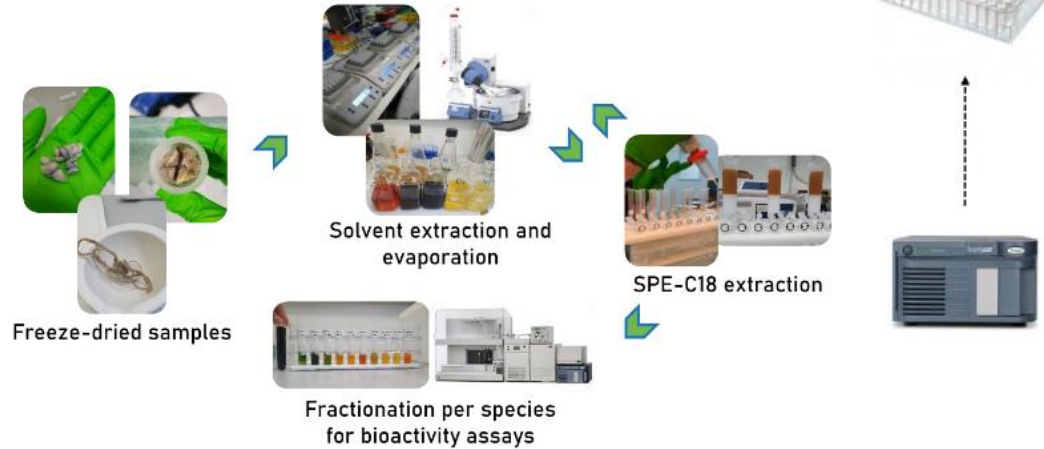
# Overview of workflow

- Sampling
- Focus on approx. 50 species



# Overview of workflow

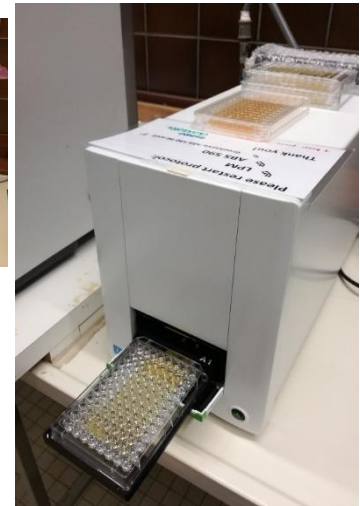
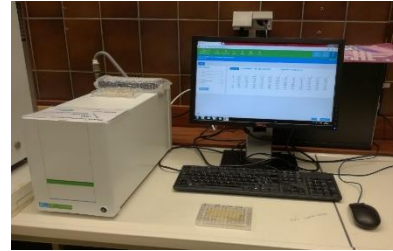
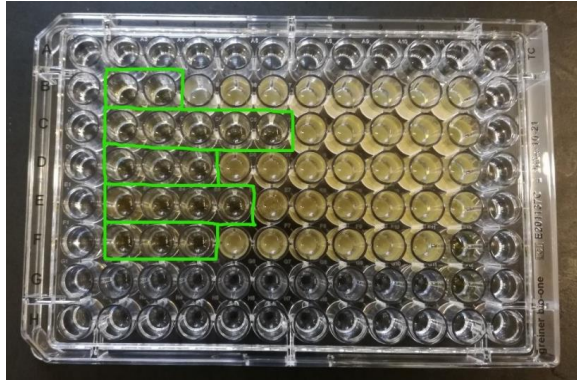
- Sample preparation
- Fractionation (96 tubes/organism)



Dr. Geert Goeminne  
Dr. Keylla Bicalho

# Overview of workflow

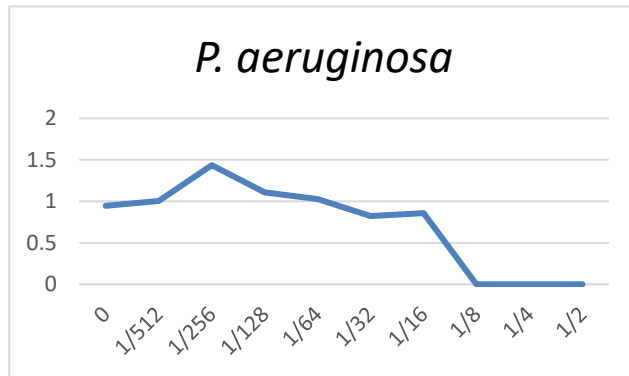
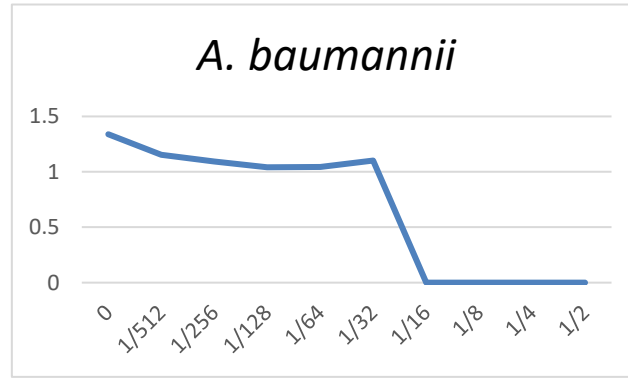
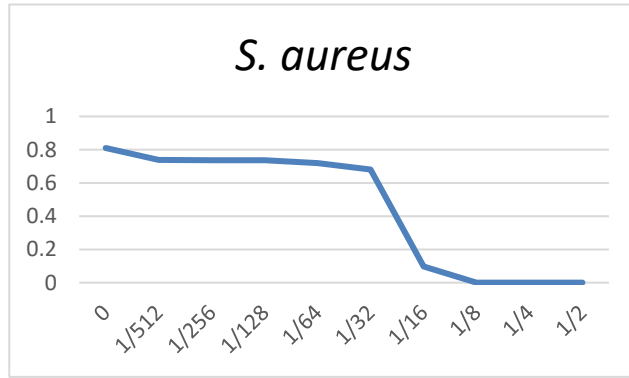
- Bioactivity assays
- Testing of growth inhibitory activity against
  - *Staphylococcus aureus*
  - *Pseudomonas aeruginosa*
  - *Acinetobacter baumannii*
  - *Candida albicans*



- If active against planktonic organisms: anti-biofilm assays

# Some fractions show broad antimicrobial activity

## Example: F2 from *Echiichthys vipera*



Kleine pieterman  
Lesser weever

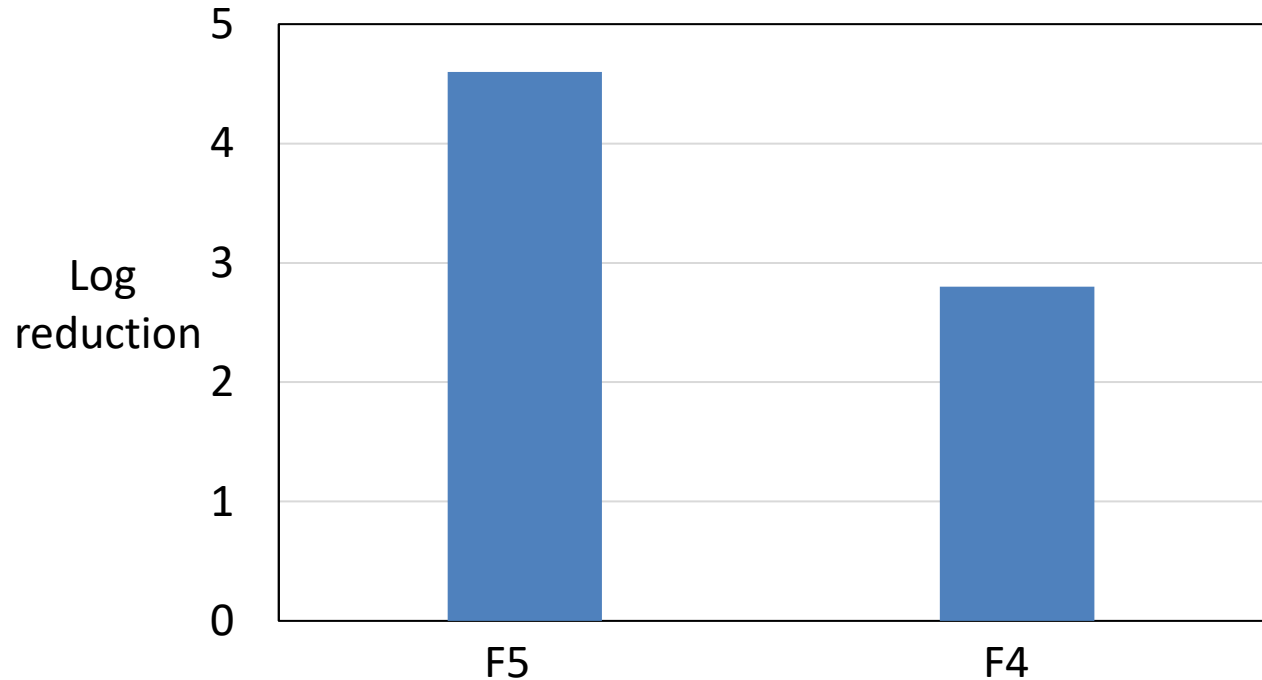


Some fractions show strong biofilm inhibition  
Example: F4 and F5 from *Alcyonium digitatum*

*A. baumannii*



Dodemansduim  
Dead man's fingers

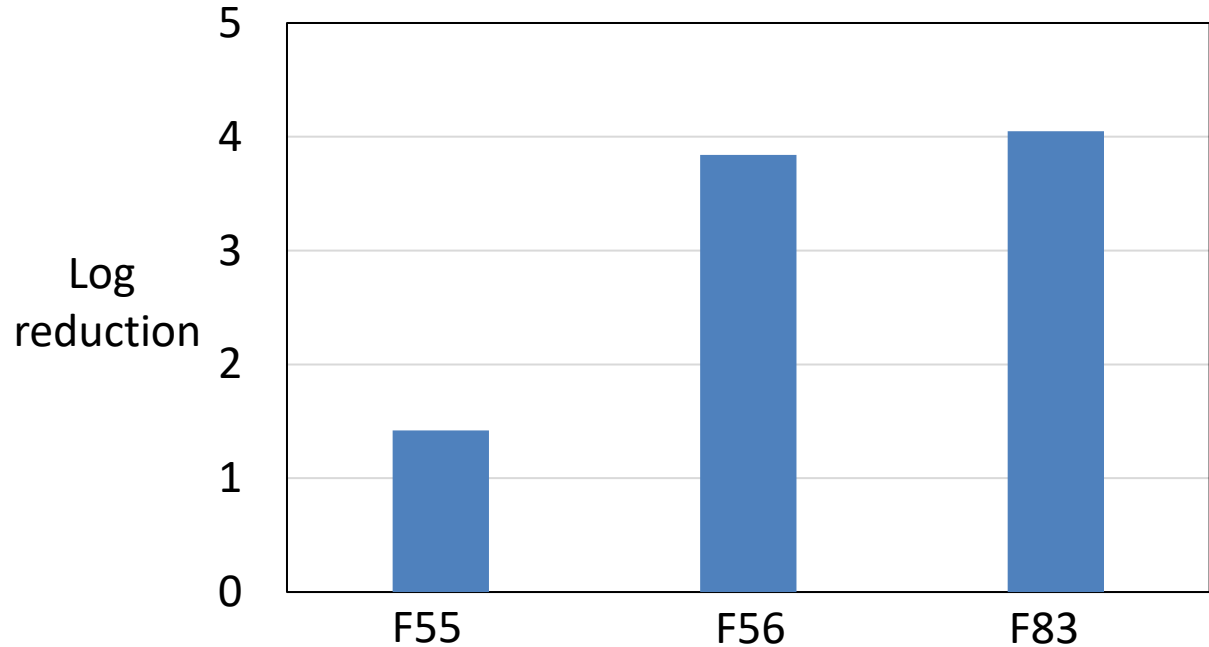


Some fractions show strong biofilm eradication  
Example: F55, F56 and F83 from *Ophiura ophiura*

*S. aureus*



Gewone slangster  
Serpent star



# Innovative Solutions to Combat Biofilms and Antimicrobial Resistance: Advancing with Marine Bioactives and Microbiome Research

- Various marine organisms from the Belgian part of the North Sea contain compounds with antimicrobial *and* antibiofilm activity against clinically relevant pathogens
- What are these compounds?
- What is the role of the microbiome in the production of these compounds?
- Expanding this approach to marine species found in other parts of the world may lead to discovery of interesting lead antimicrobial compounds

# Innovative Solutions to Combat Biofilms and Antimicrobial Resistance: Advancing with Marine Bioactives and Microbiome Research

Tom Coenye – [Tom.Coenye@UGent.be](mailto:Tom.Coenye@UGent.be)

