Perspectives on math. modelling of antimicrobial and insecticide efficiency

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Context

Within-host dynamics of parasites (interactions dynamics of four parasite "strains").

- $N_s \rightarrow$ fully sensitive to the drug.
- $N_m \rightarrow$ with mutational (or 'genomic') resistance only.
- $N_p \rightarrow$ with plasmidic resistance only.
- $N_{m.p} \rightarrow$ with both form of resistances.

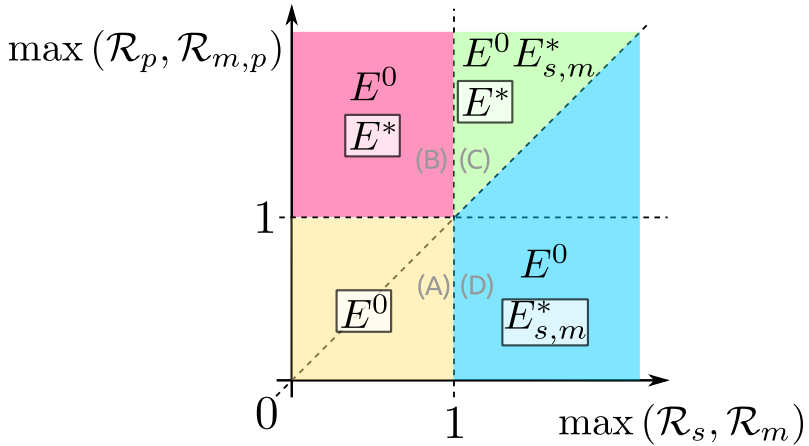
Svara & Rankin, BMC Evol Biol, 2011.
Tazzyman & Bonhoeffer, Evolution, 2014.
Djidjou-Demasse *et al.*, J Math Biol, 2021.

Non trivial dynamics

Threshold parameters(effective reproduction numbers):

- $\mathcal{R}_j$'s describe both the ecological and micro-evolutionary (or, 'eco-evolutionary') conditions of strain persistence, that is, their effective genetic contribution to each next generation.

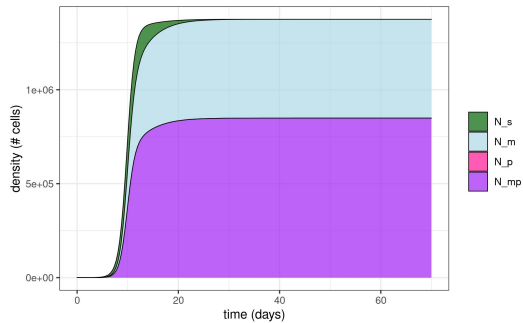
Non trivial dynamics



Djidjou-Demasse *et al.*, J Math Biol, 2021.

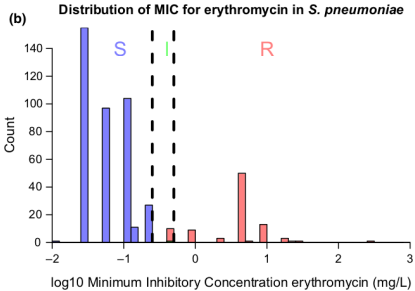
Non trivial dynamics

- Costs of mutation and plasmid compensate each other: $N_{m.p}$ performs at least as well than N_s. $1 < \min\{\mathcal{R}_p; \mathcal{R}_m\} \leq \max\{\mathcal{R}_p; \mathcal{R}_m\} < \mathcal{R}_s \leq \mathcal{R}_{m.p}$.



Djidjou-Demasse *et al.*, J Math Biol, 2021.

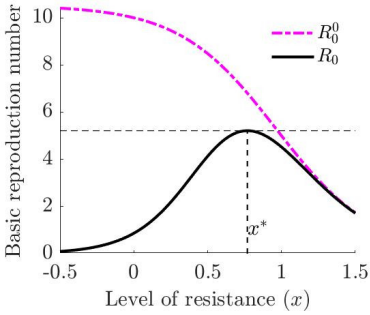
AMR is a continuous trait

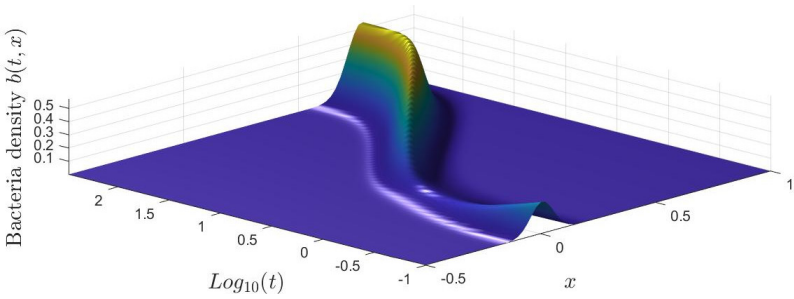


- "Resistant" (R) if MIC $> \mathcal{C}_1$.
- "Normal exposure" (S) if MIC $< \mathcal{C}_0$.
- "Increased exposure" (I) if $\mathcal{C}_0 <$ MIC $< \mathcal{C}_1$.

Denamur *et al.*, Hoboken, NJ: Wiley-Blackwell, 2010.
EUCAST 2019 nomenclature.

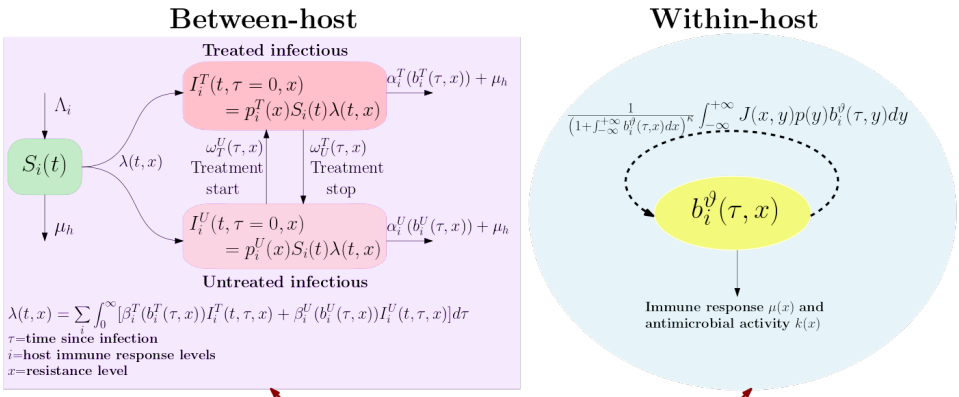
AMR is a continuous trait





Djidjou-Demasse *et al.*, PCI Math Comp Biol, 2021.

AMR is a continuous trait



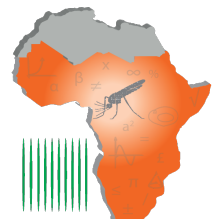
β_i^ϑ, α_i^ϑ are function of the microbial load b_i^ϑ
$\vartheta \in \{T,U\}$, T=treated and U=untreated

Luther Mann *et al.*, in progress.

About insecticide efficiency ...

African Consortium in Modelling for Effective Vector Control (ACoMVeC)

- Support capacity-building efforts for mathematical modelling across sub-Saharan Africa.
- PhD-students Modellers across Africa (2023-2026).



https://crid-cam.net/vacancies/

https://mivegec.ird.fr
https://ept.sn/