Can we control antimicrobial resistance through effective education and better diagnosis?

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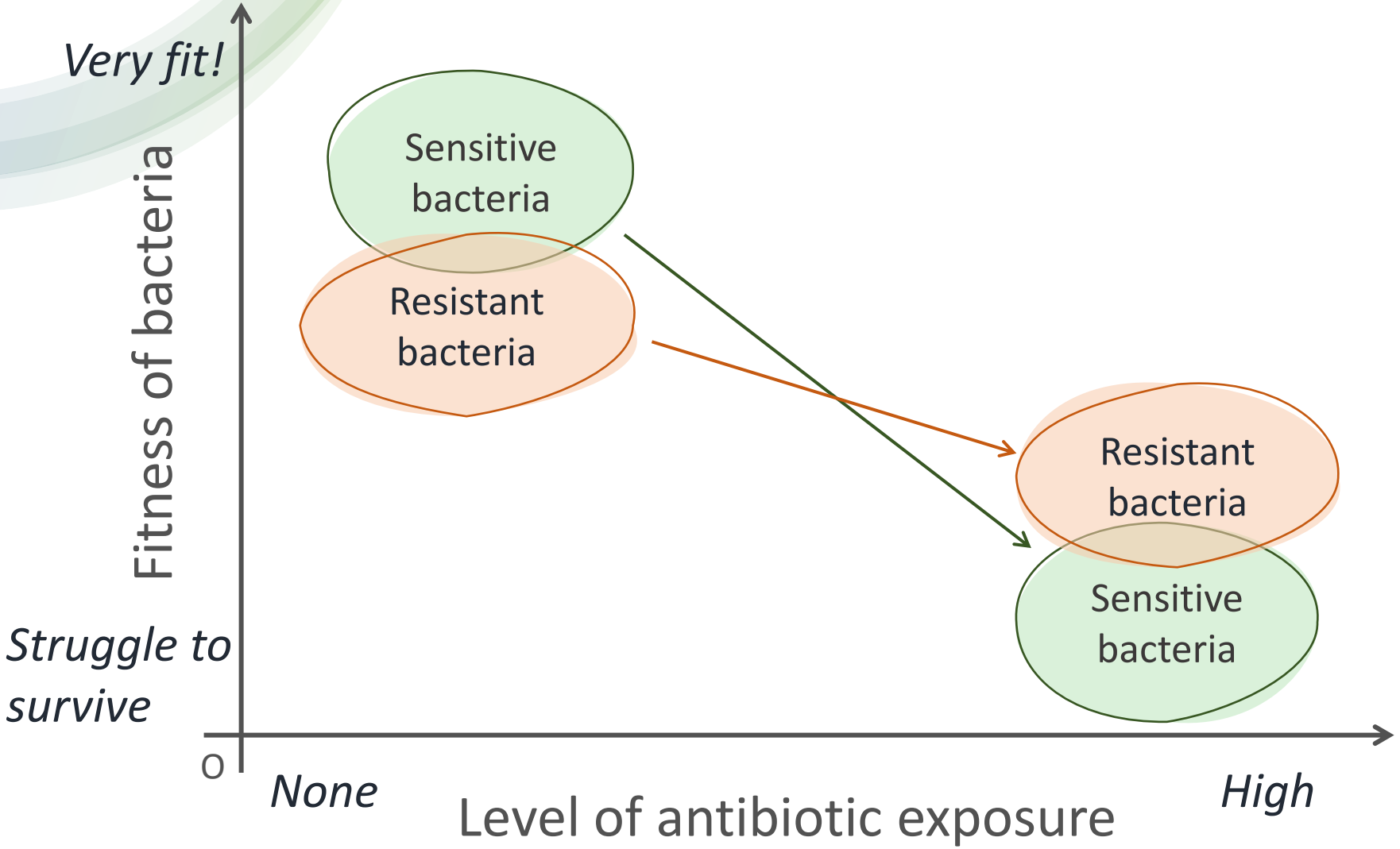
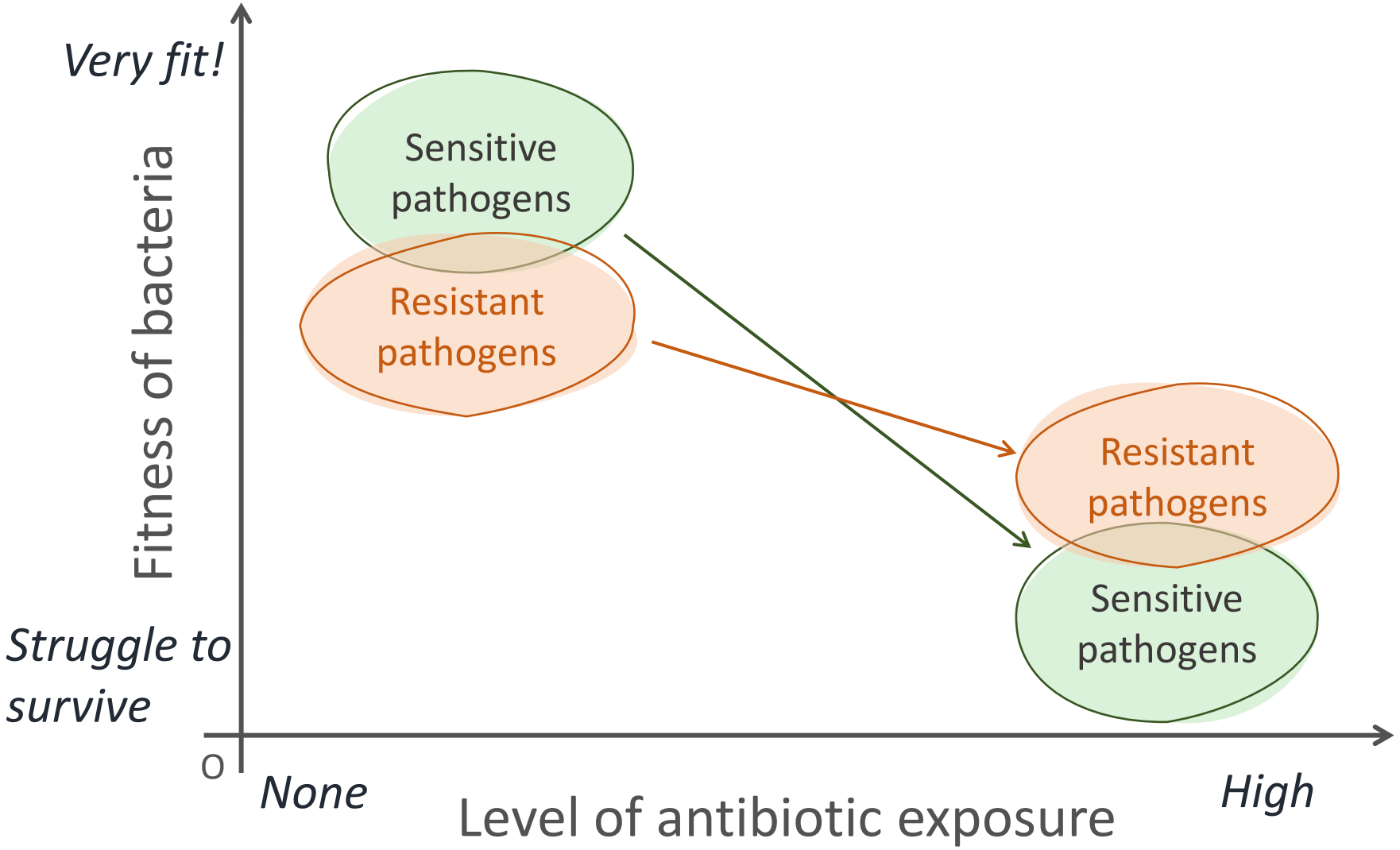
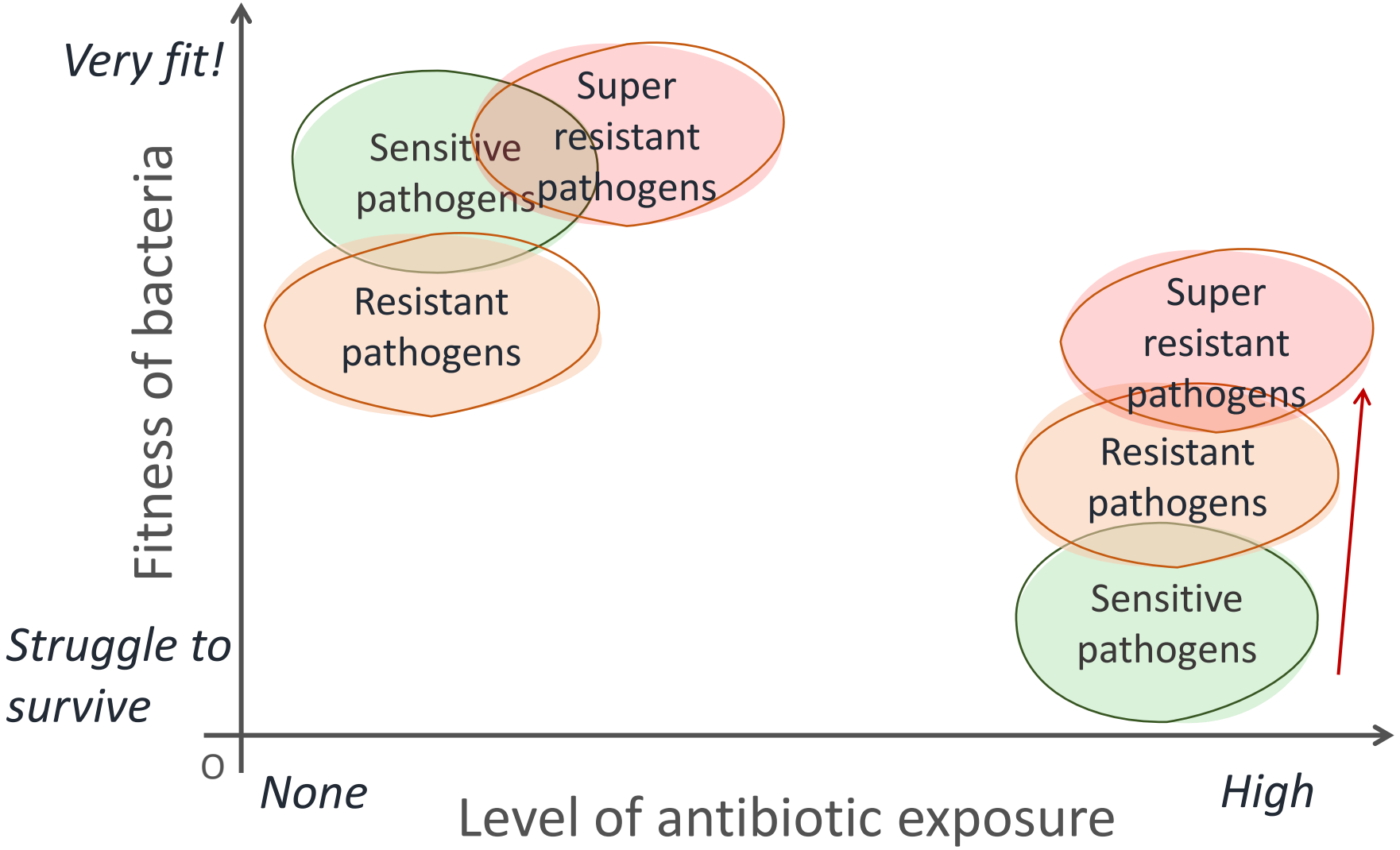
Antimicrobial resistance (AMR)



The AMR problem

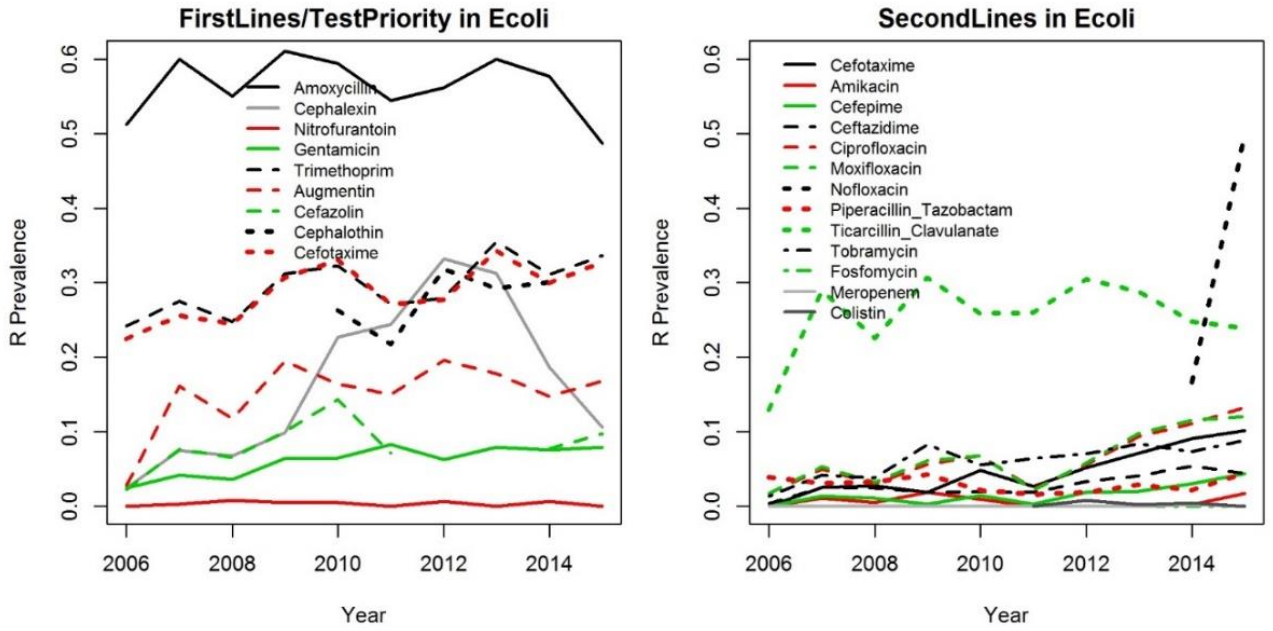


The AMR problem



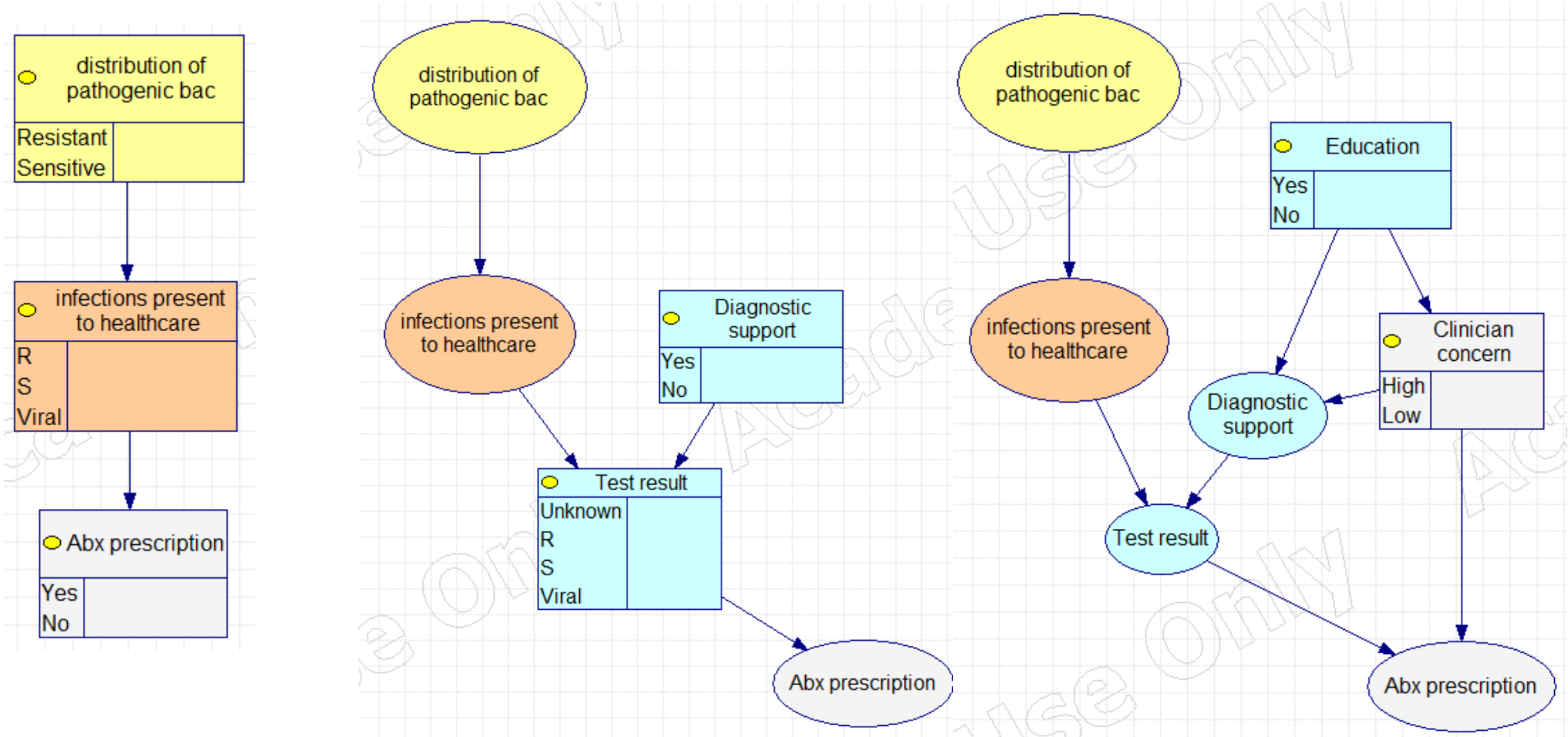
The AMR problem

- Every year > 500,000 young children present to emergency departments (ED) in Australia. Of these, 100,000 presentations are due to suspected infection [1]
- Of febrile children presenting to ED, approximately 7% had evidence of significant bacterial infection (may benefit from abx), half of whom had a urinary tract infection [2]
- 1/4 febrile children received antibiotic prescription in ED
- How about primary care?
- Adult and elderly population?
- Non-clinical antibiotic use?



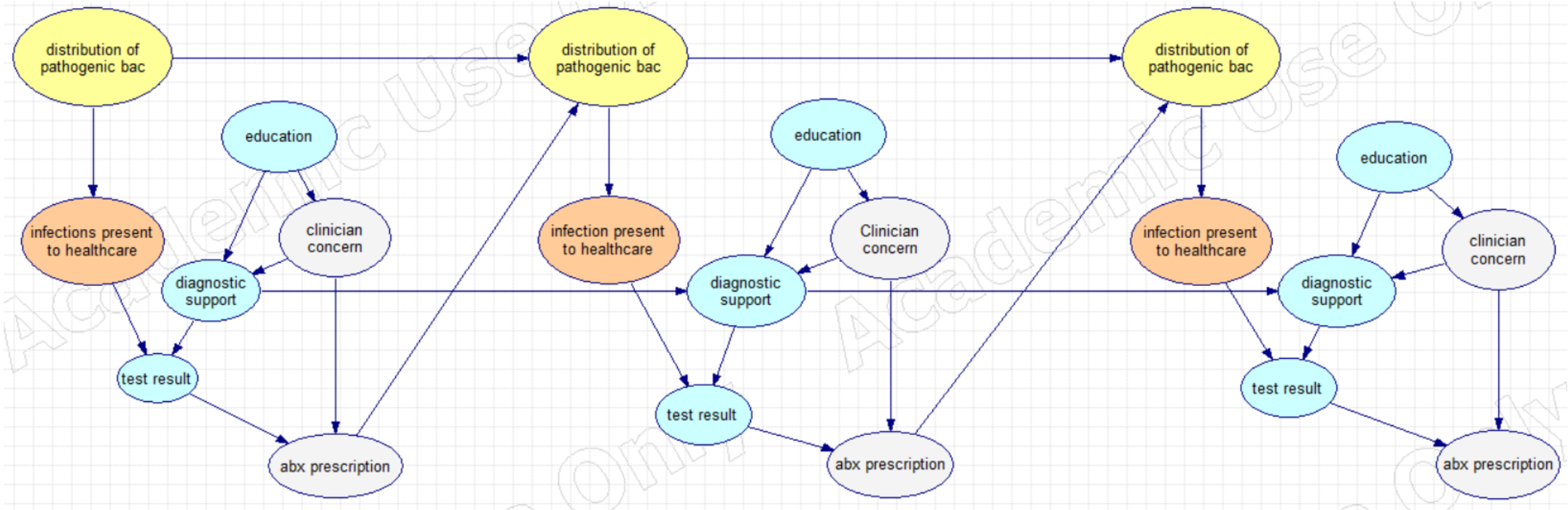
[1] Australian Institute of Health and Welfare (AIHW) report.
[2] Craig *et.al. BMJ*, 20, 340 (2010)

Modelling the problem domain

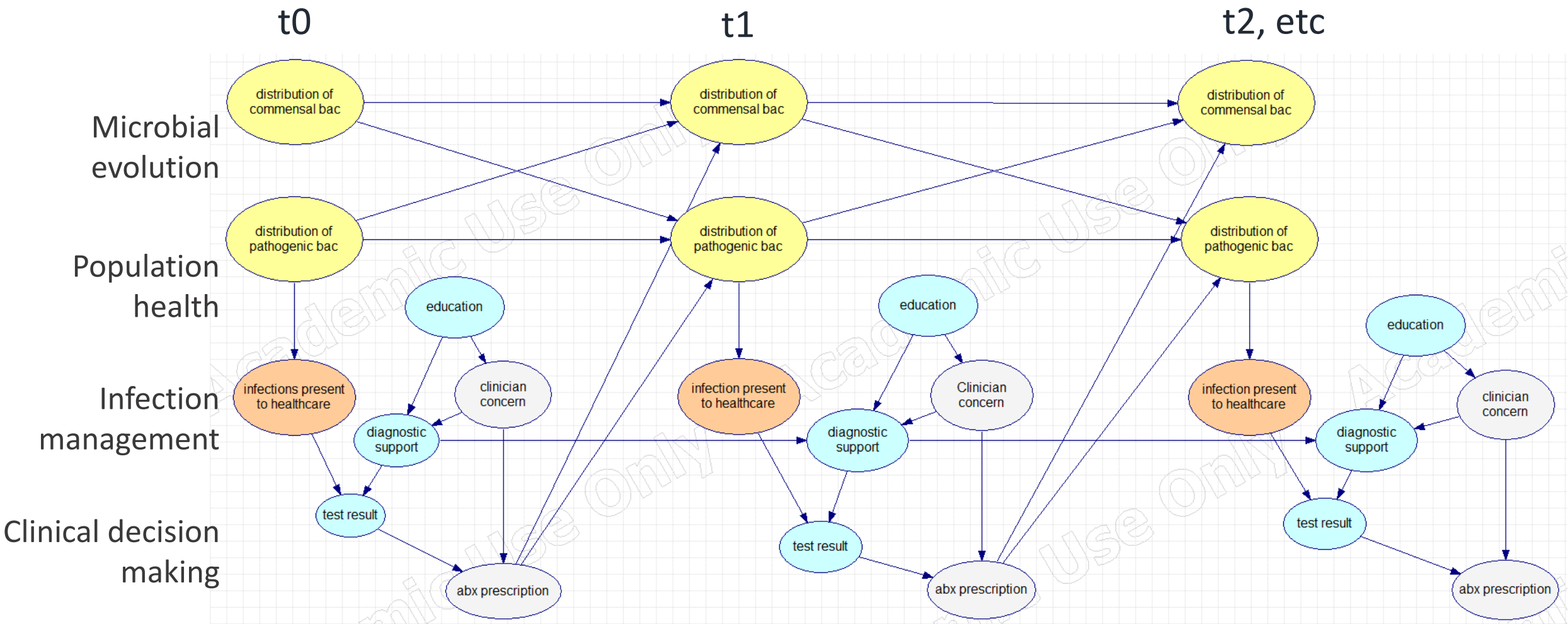


Modelling the problem domain

t0 t1 t2, etc



Modelling the problem domain



Example events and parameters of interest

Microbial evolution	Prevalence of amoxicillin resistance in E.coli, WA in 2015	~50%
	Annual increase of AMR prevalence in population	<5%
	Typical size of E.coli population	~10^8
	Rate of chromosomal mutation per bacterial generation (not necessarily mean taking over by resistant bacteria)	~10^-8
	Rate of horizontal gene transfer between cells per bacterial generation	~10^-6
Population health	Size of Australian population under 10yo in 2021	3,153,780 (12% of total)
	Young children present to ED each year in Australia	>500,000
Infection management	Paediatric infection episodes present to ED	100,000 each year
	Relative attribution of bac vs non-bac causes	1:9
Clinical decision making	Rate of antibiotic prescription in ED	?1/3
	Influence of education on decision making	???

Challenges so far

- Define variables (highly variable and interactive dynamics)
  - Translate molecular activities of bacteria into an evolutionary trend of AMR in host/human population
  - Switch concepts between individual vs population health
- Parameterisation
  - require well-defined variables
  - relying on literature and domain expert knowledge, as data collection can be slow/difficult (but important to scope out how/what data can be collected)
  - extensive simulations may be needed to account for uncertainties

A lot of interesting questions can be explored

- Can we slow down the AMR through effective education and better diagnosis?
- How effective/accurate the interventions need to be?
- Is the answer different for different infections? E.g., UTI vs respiratory tract infections
- What is role of human behaviour (concern) in this picture
- Introducing utilities?
- Trade-off between individual vs population, current vs future benefits/costs

Acknowledgement

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How should we define utility?