Transmission of antibiotic resistant bacteria

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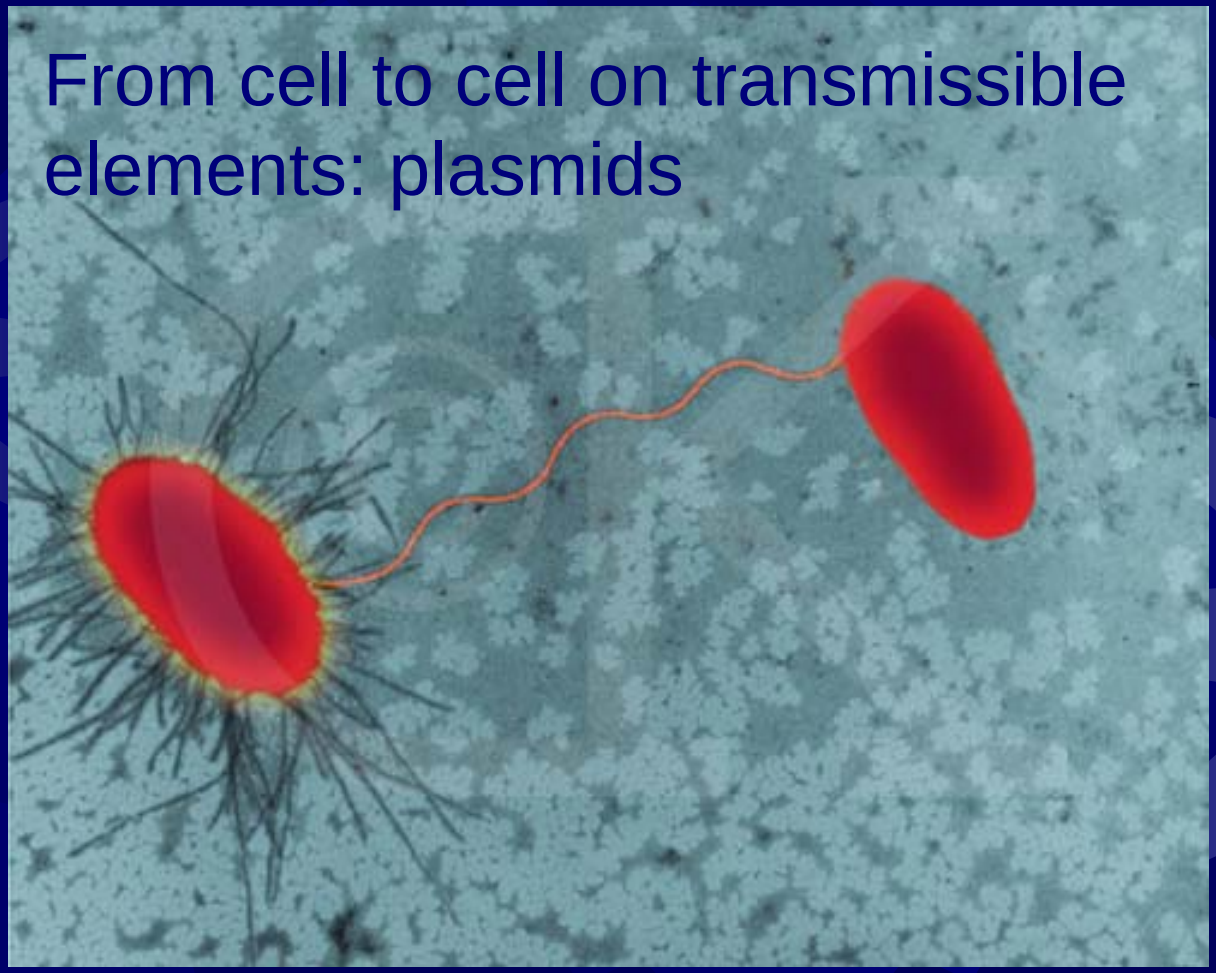
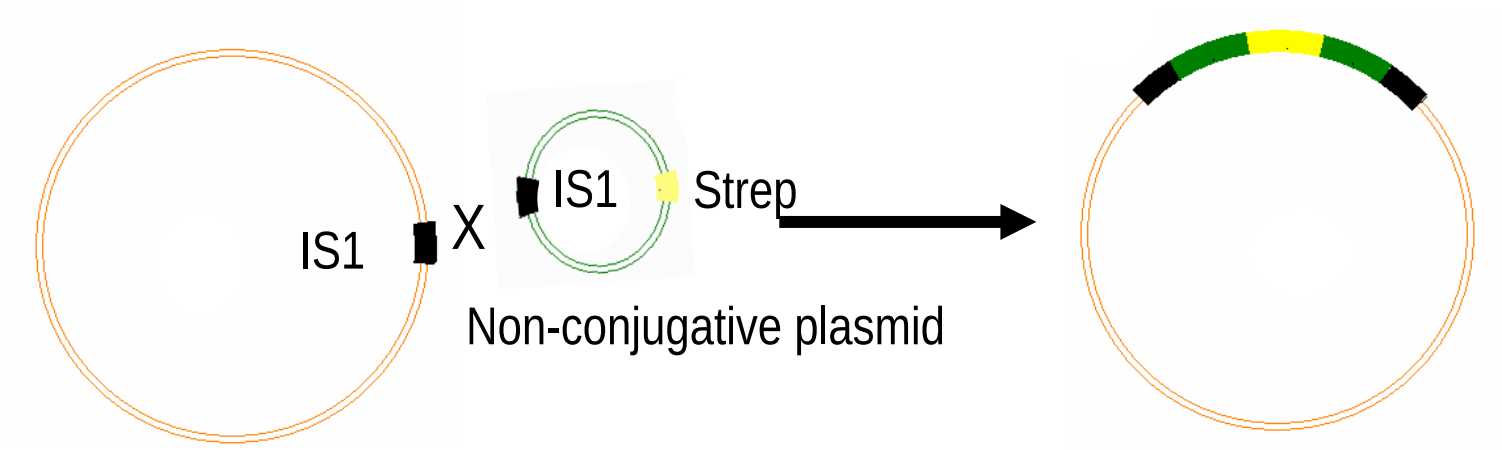
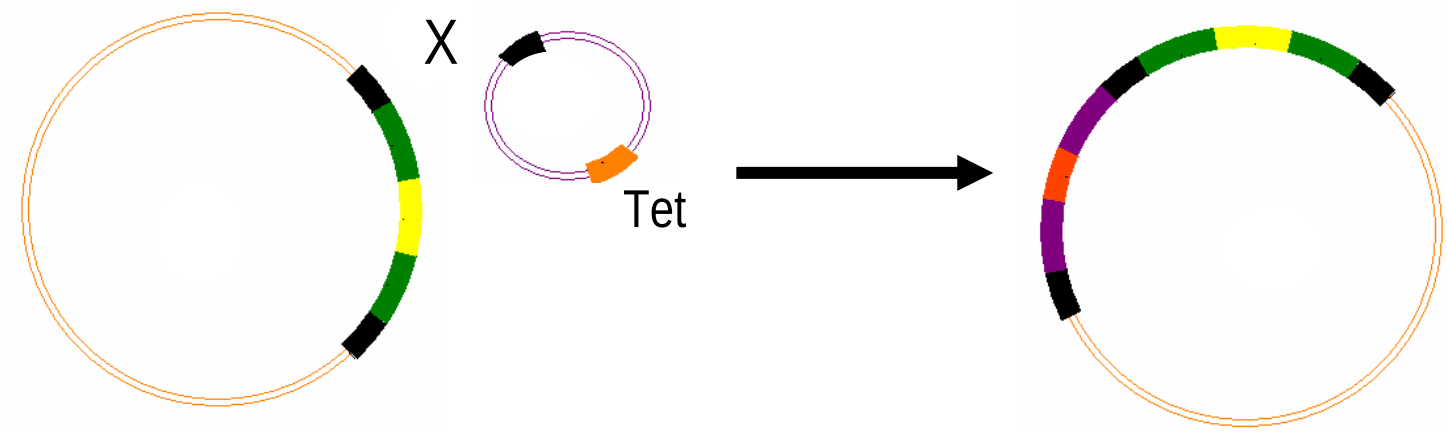
Transfer of Resistance:

commensal ⟷ pathogen

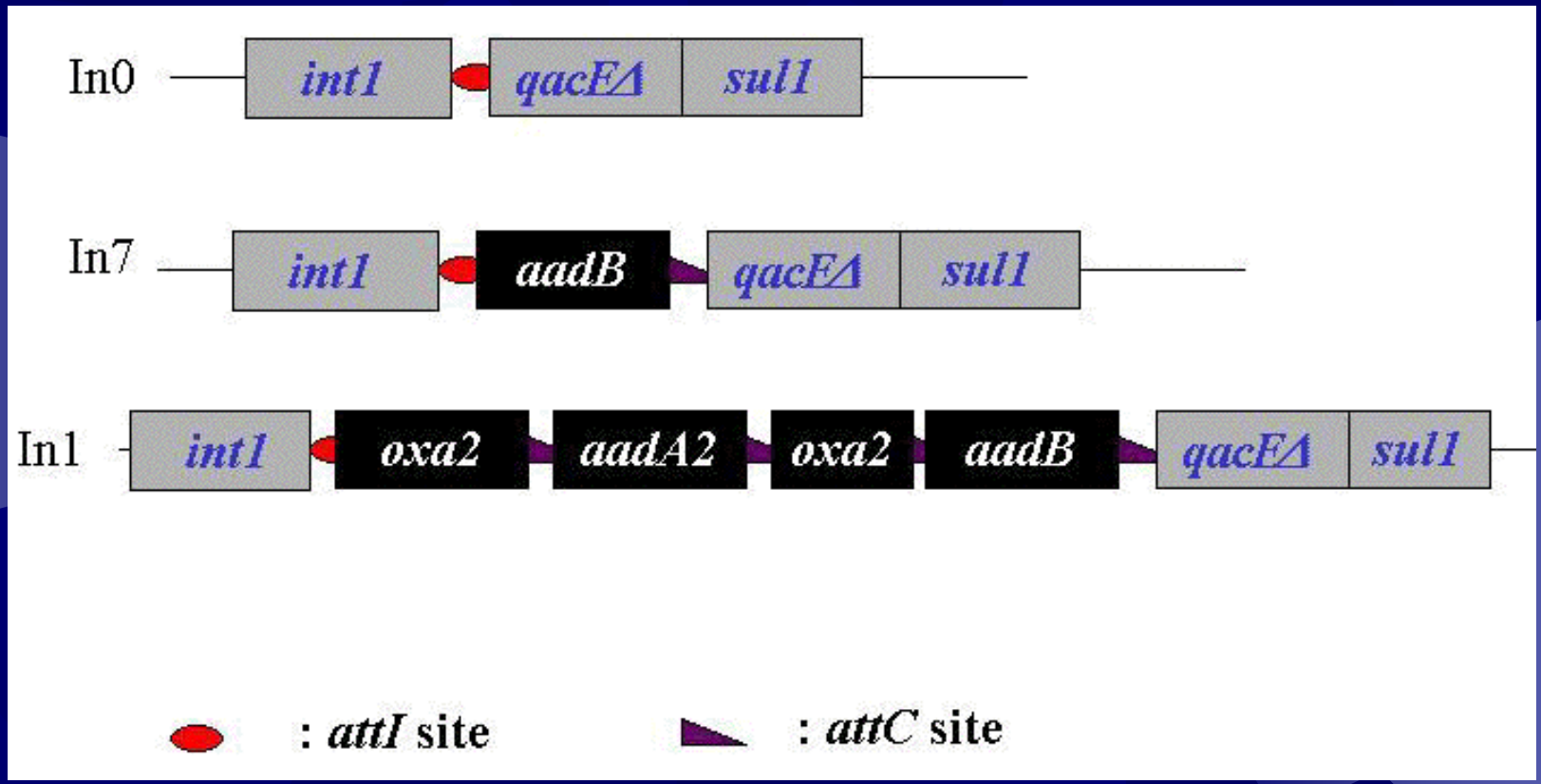


Elements within plasmids (transposons)





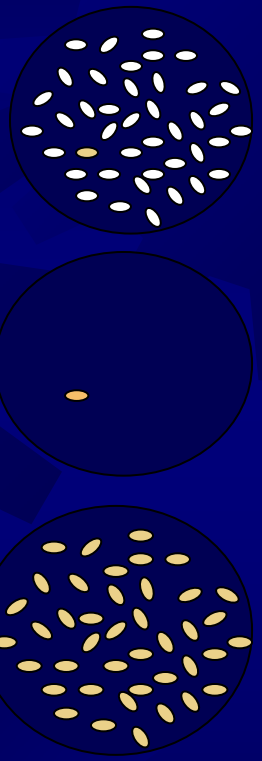
Integrons



Cassettes of antibiotic resistance genes

Mutation to resistance: Darwinian evolution

- Mutation in any gene occurs in ~1 cell per 10 million
- Mutations that give resistance are selected
- Overnight, one cell can give 1000 million progeny



Mutant emerges randomly

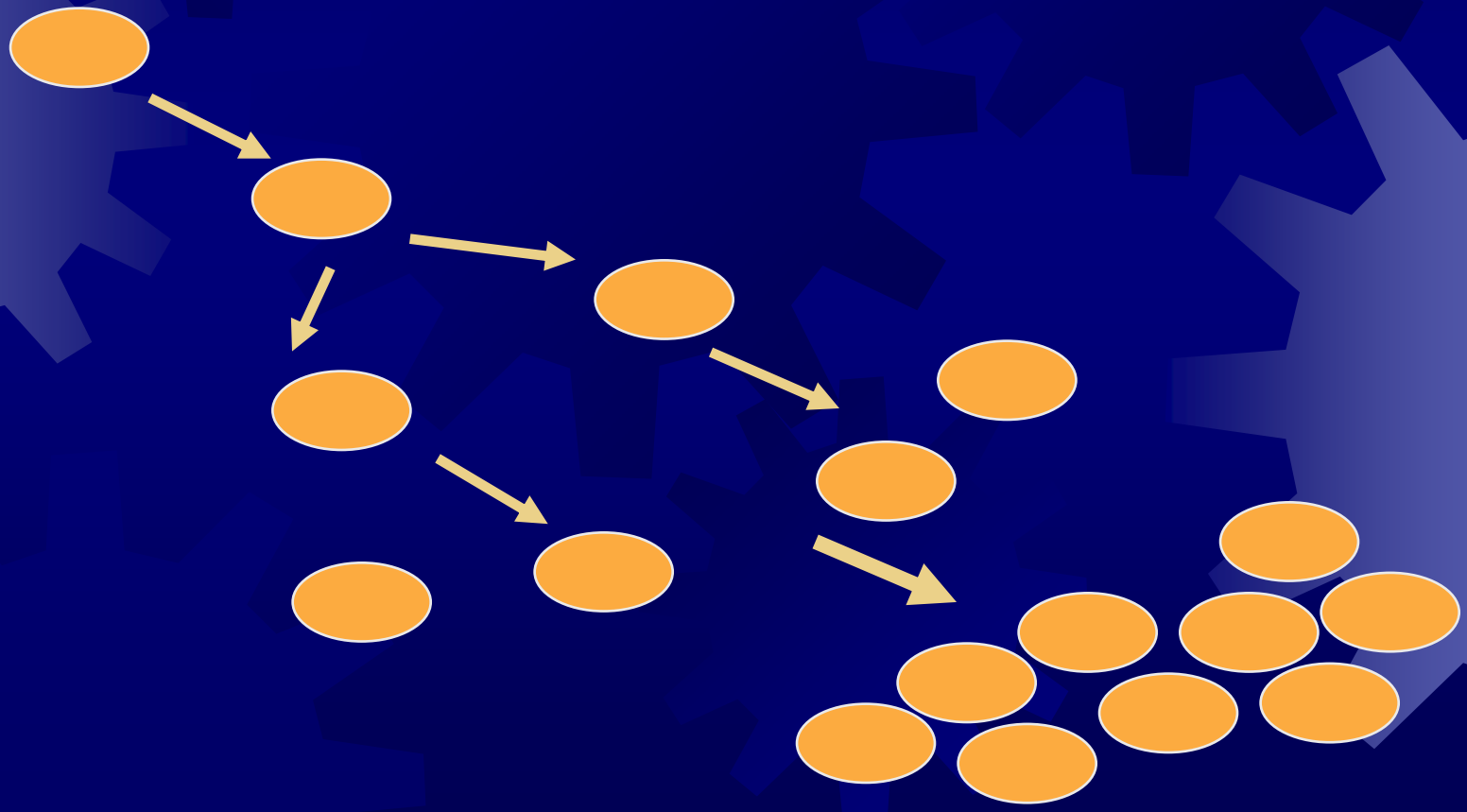
Sensitive cells killed by antibiotic

Mutant's progeny overrun

- during therapy (people or animals)
- dependent upon antibiotic use in animals, hospital or community

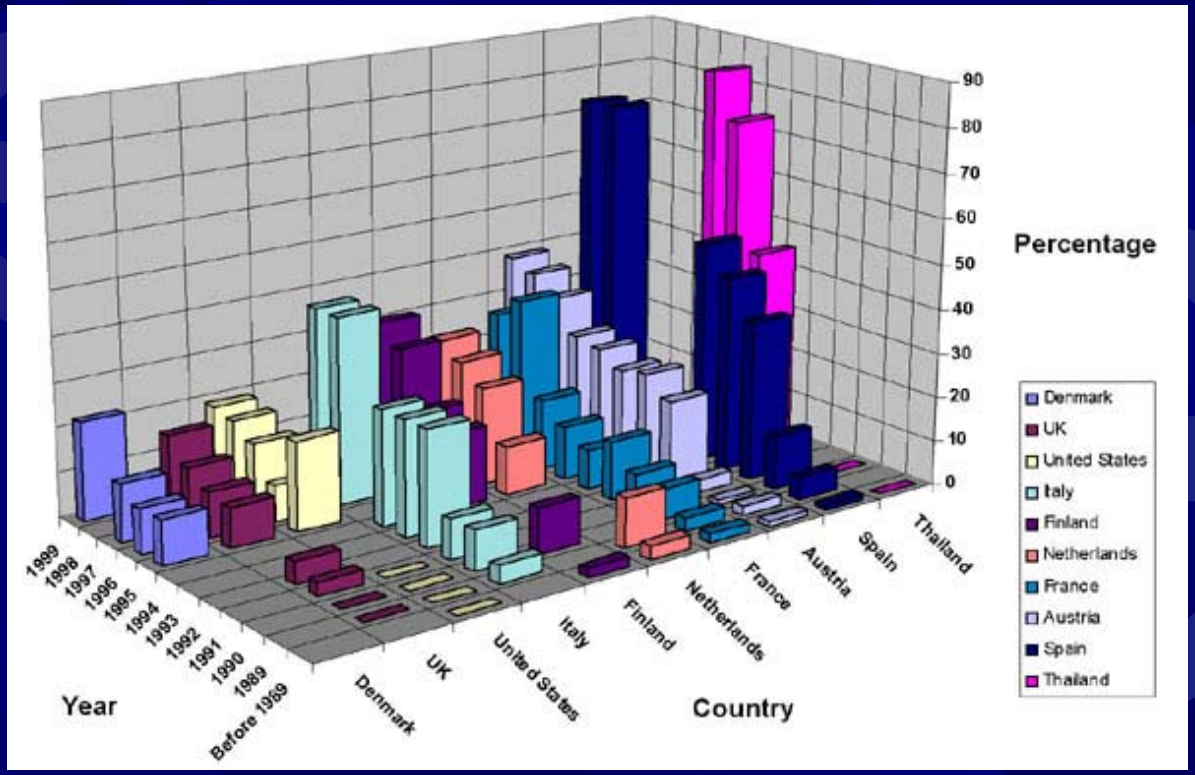
How does resistance transfer?

If chromosmally mediated: only to daughter cells



Worldwide e.g. FQ^R in campylobacter

Different problems, different antibiotic resistances and different bacterial species



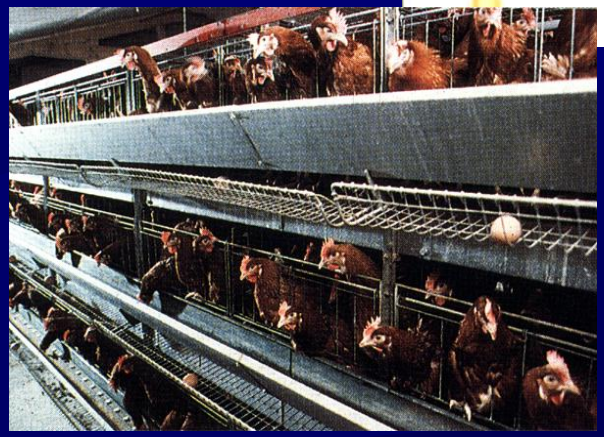
~15% resistance in U.K., i.e. 9000 resistant infections,
but up to 75000 of 500 000 possible infections

Use of antibiotics in Animals

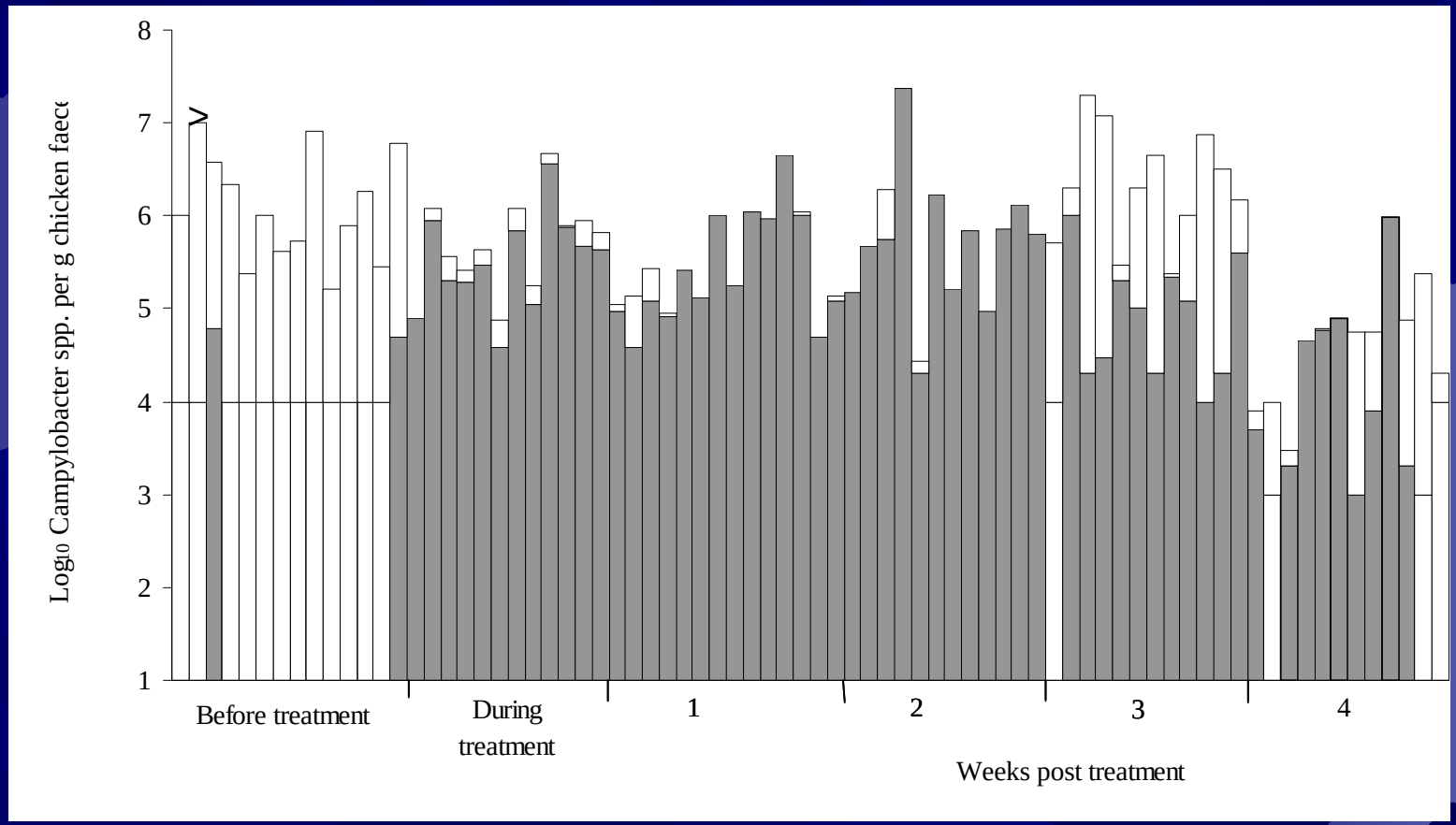
- Agents of similar chemical structure to those used in man e.g. avoparcin growth promoter and vancomycin-resistant enterococci. (Use withdrawn in EC).
- Dosing many animals not the individual, increases selection pressure e.g fluoroquinolones used for therapy in poultry and ciprofloxacin-resistant Campylobacter

Cross infection/contamination

- on farm, abbatoir or food processing
- spread of resistant strains among animals and to people
- spread of resistant strains by and among people

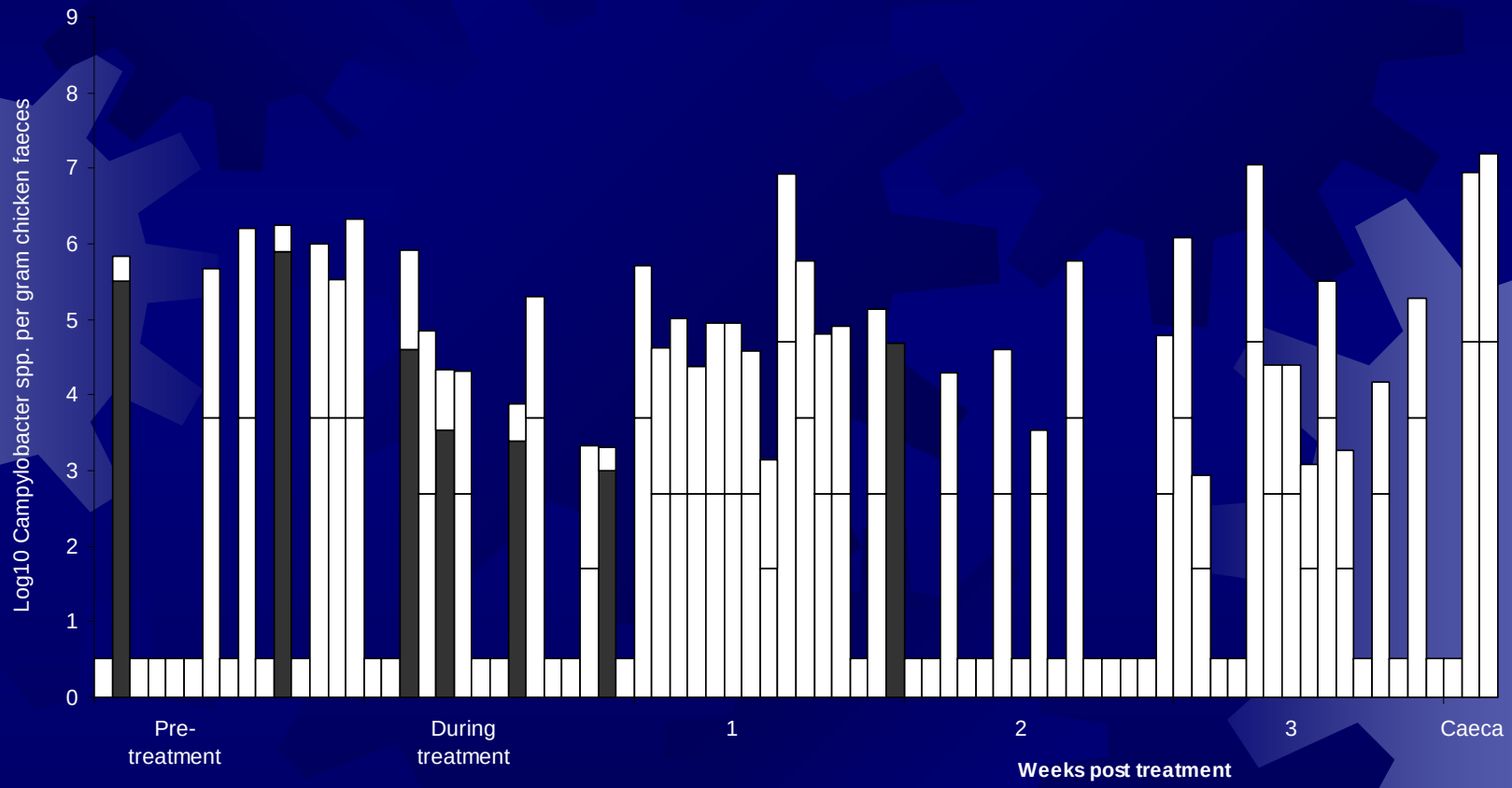


FQ resistance in a free range poultry flock



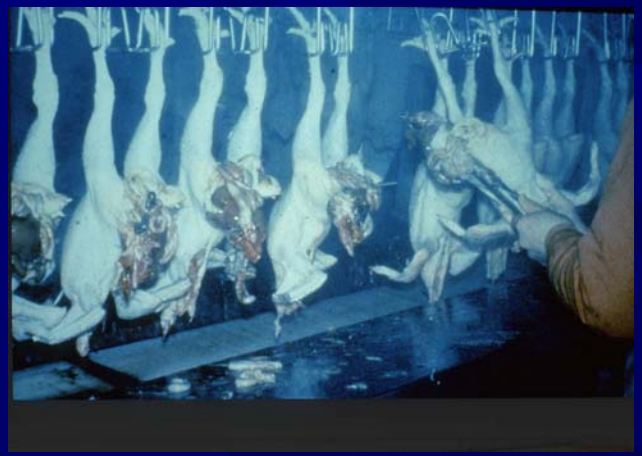
Humphrey *et al.*, 2005

Tetracycline resistance in a poultry flock



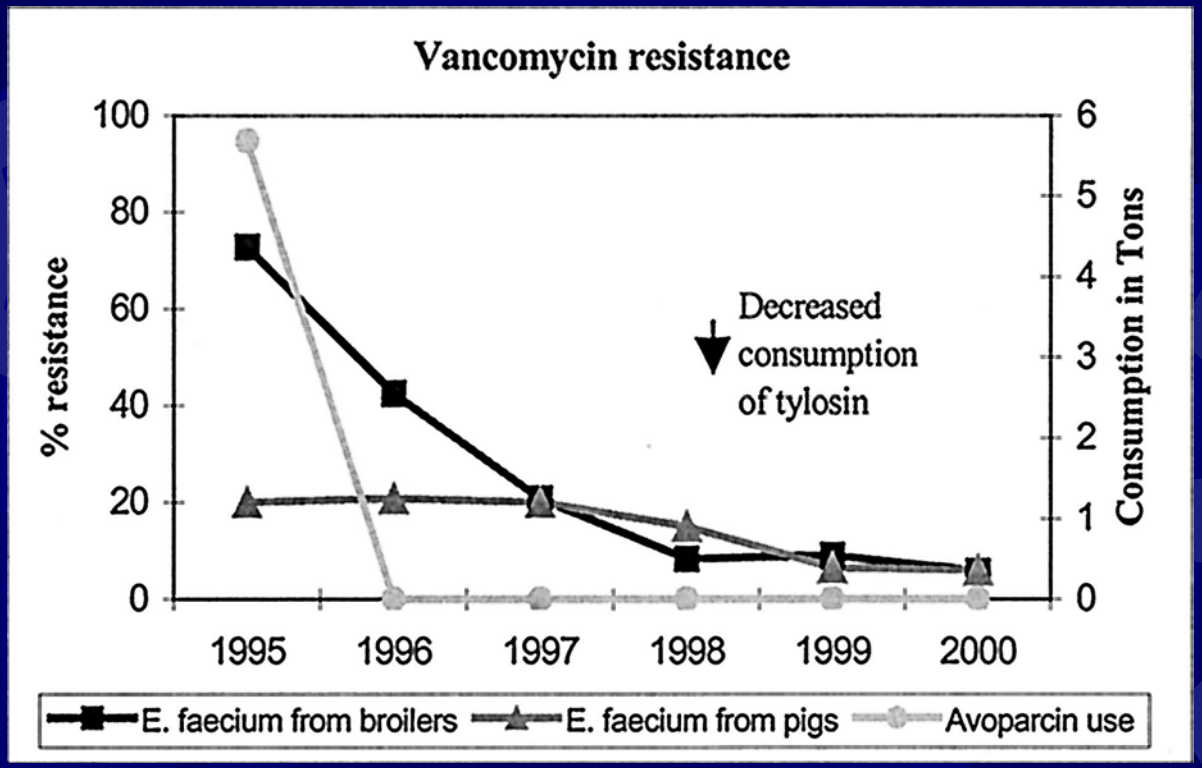
Piddock *et al.*, Data submitted for publication

Food processing



Global travel and imported food

Absence of antibiotic pressure - numbers can fall……



Aarestrup et al., 2001

….BUT resistance can be maintained without direct pressure

- Transmissible resistance: acquisition of many genes
- e.g. Lactococcus from cheese[1]
- Exposure to any agent can maintain plasmid e.g. no use of streptomycin, but 20% Enterobacteriaceae resistant[2]
- Chromosomal resistance, no fitness burden: e.g. FQ^R

[1]Perreten et al., 1997; [2]Chiew et., 1998

In conclusion

Controlling antibiotic resistant organisms depends upon whether the mechanism

- is transferrable between bacteria or only to daughter cells.
- has several genes on one element.
- is mediated by a single genetic event and confers resistance to agents used for eradication.
  - also mediates environmental survival.
  - also plays a role in pathogenicity.

The antibiotic, the resistance mechanism and species of bacterium!