Superbugs: setting the scene

Clinical Senate Debate

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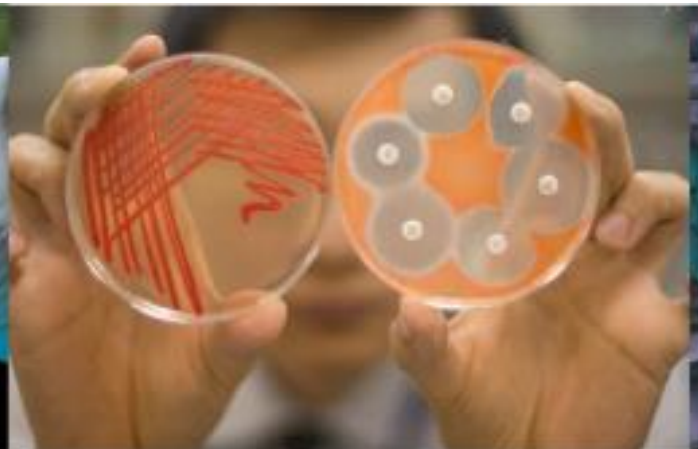
Department of **Health**
Public Health

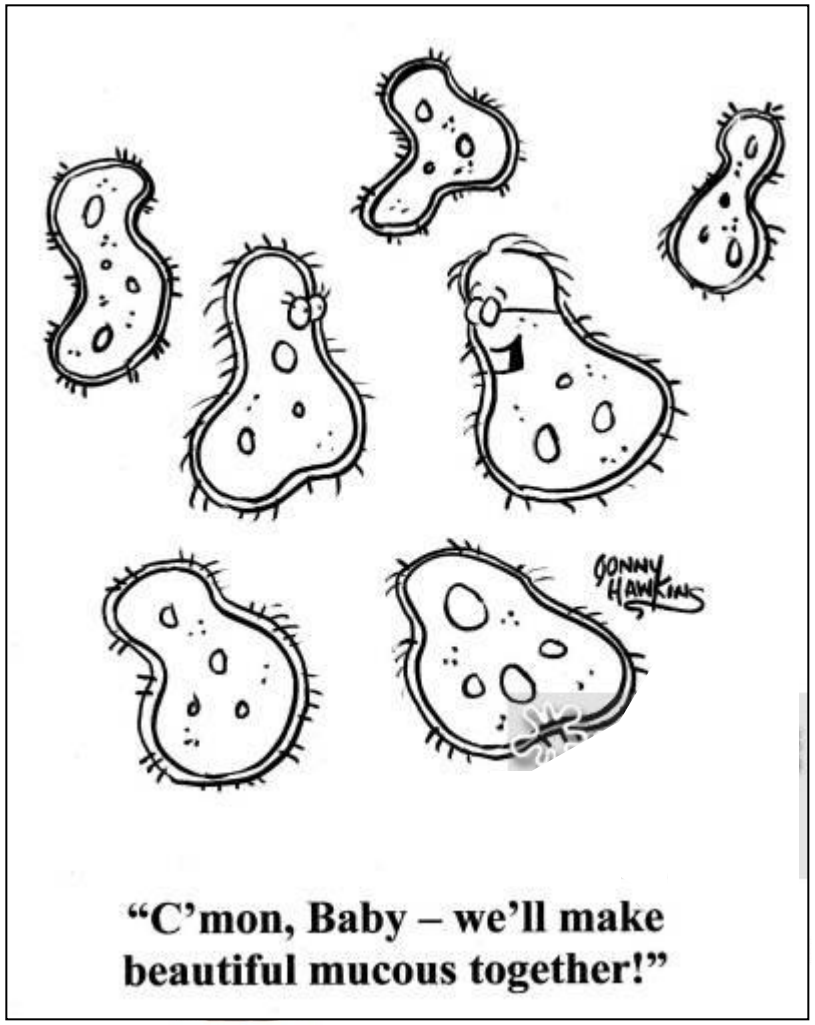
Outline

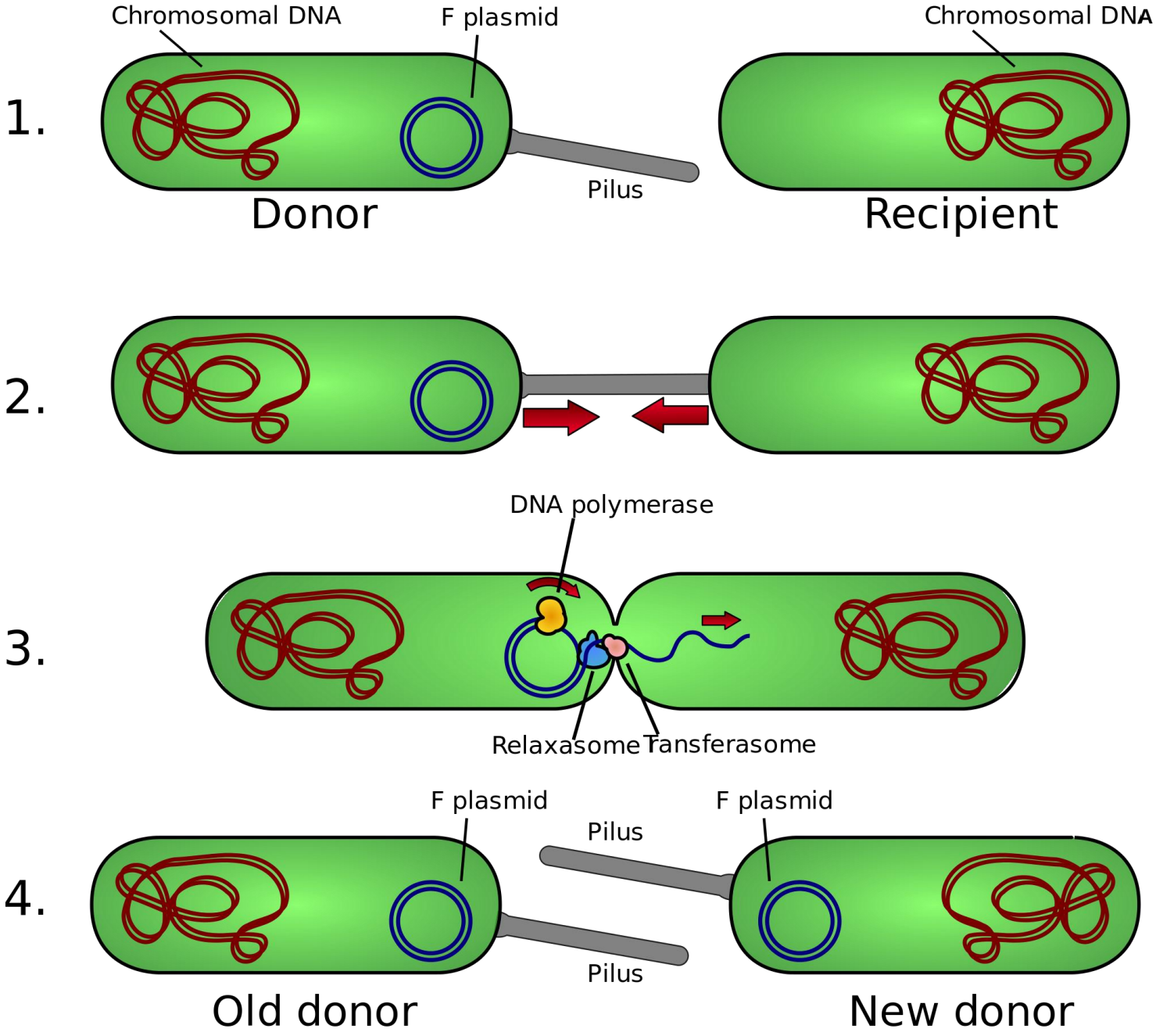
- What are ‘Superbugs’?
- What are the drivers for antimicrobial resistance?
- What can we do about it?

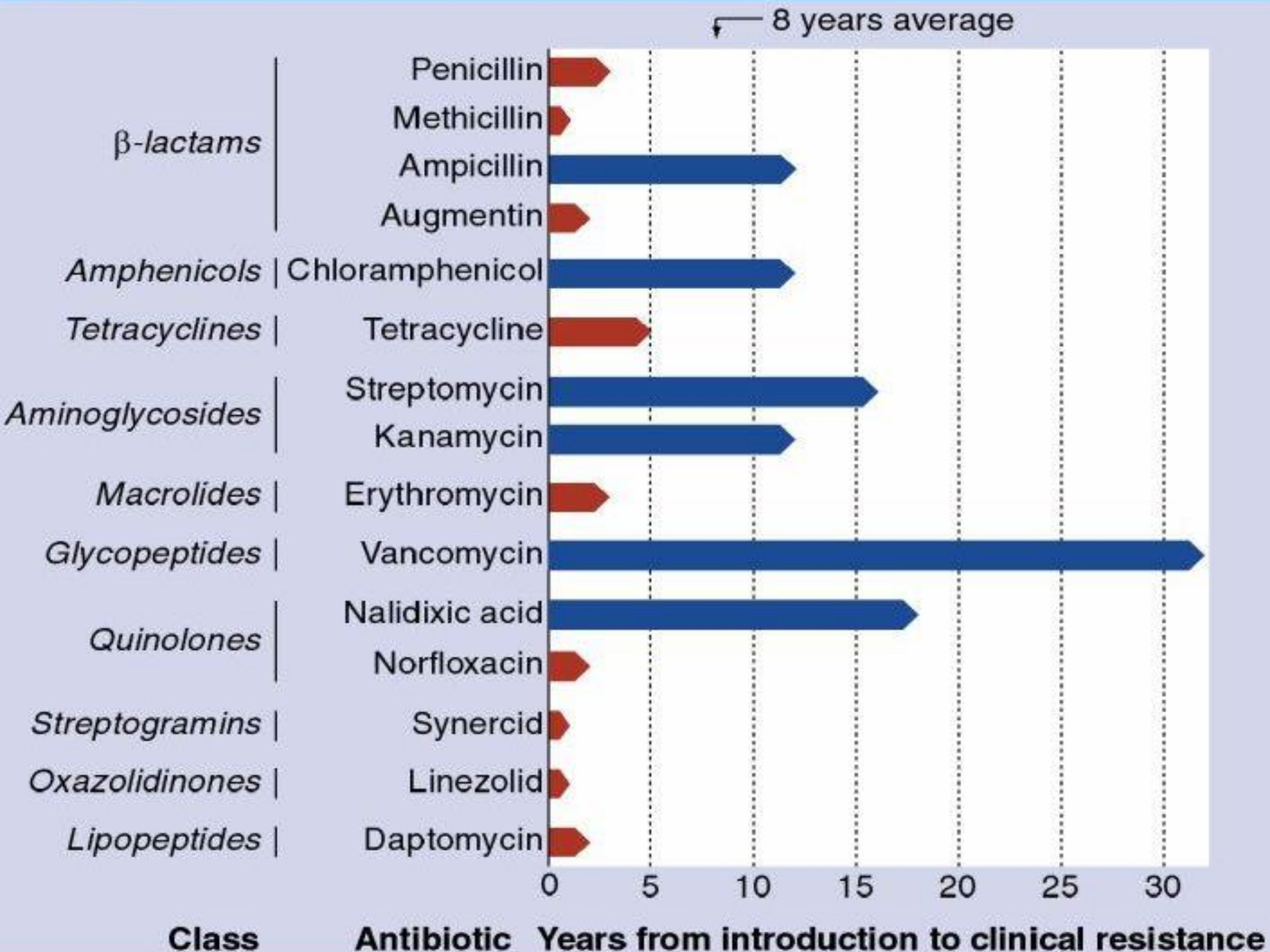




What are ‘Superbugs’?

- Lay term for ‘multi-resistant organisms’ (MROs)
- All microorganisms exhibit resistance; bacterial antibiotic resistance the largest threat
- AMR arises due to natural selection
  - resistance genes are already there
  - antibiotic use *induces* them
  - non-use makes resistance *dissipate*
- Superbugs are promiscuous!




1.
Chromosomal DNA
F plasmid
Chromosomal DNA
Pilus
Donor
Recipient
2.
3.
DNA polymerase
Relaxasome
Transferasome
4.
F plasmid
Pilus
F plasmid
Pilus
Old donor
New donor


8 years average
β-lactams
Penicillin
Methicillin
Ampicillin
Augmentin
Amphenicols
Chloramphenicol
Tetracyclines
Tetracycline
Aminoglycosides
Streptomycin
Kanamycin
Macrolides
Erythromycin
Glycopeptides
Vancomycin
Quinolones
Nalidixic acid
Norfloxacin
Streptogramins
Synercid
Oxazolidinones
Linezolid
Lipopeptides
Daptomycin
0
5
10
15
20
25
30
Class
Antibiotic
Years from introduction to clinical resistance

Types of MROs

- Methicillin-resistant *Staphylococcus aureus* (MRSA)
- Vancomycin-resistant enterococci (VRE)
- Extended spectrum beta-lactamase (ESBL) organisms
- Carbapenemase-producing *Enterobacteriaceae* (CPE).

Others…

- MDR and XDR tuberculosis
- Ceftriaxone-resistant *N. gonorrhoeae*
- Penicillin-resistant *S. pneumoniae*
- Ceftriaxone-resistant *Salmonellae*
- MDR *Shigella* species

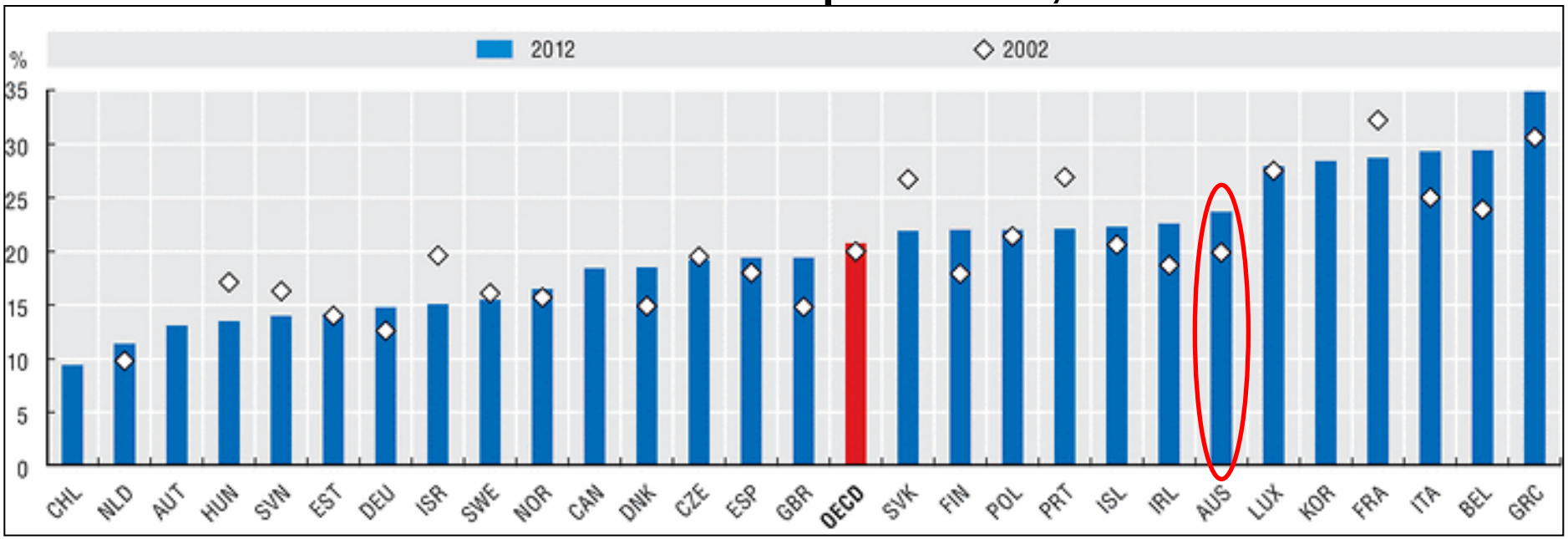
Why is it a concern?

- Affect on the community
  - Increased costs – in US, >$20B in direct societal costs*
  - 25 000 deaths/yr in US
- Patient outcomes
  - Longer hospital stays
  - Higher mortality rates
  - Altered natural flora
  - Toxicity of remaining antibiotics
  - Some organisms will have *no* antibiotics effective against them
- Affect on the health system
  - Increased costs (antibiotics, PPE, extra staff time)
  - Tying up of resources (single rooms; staff)

*WHO. Antimicrobial resistance: global report on surveillance 2014. Geneva: WHO, 2014

- Antibiotic use is greater than OECD average (2x that of The Netherlands)

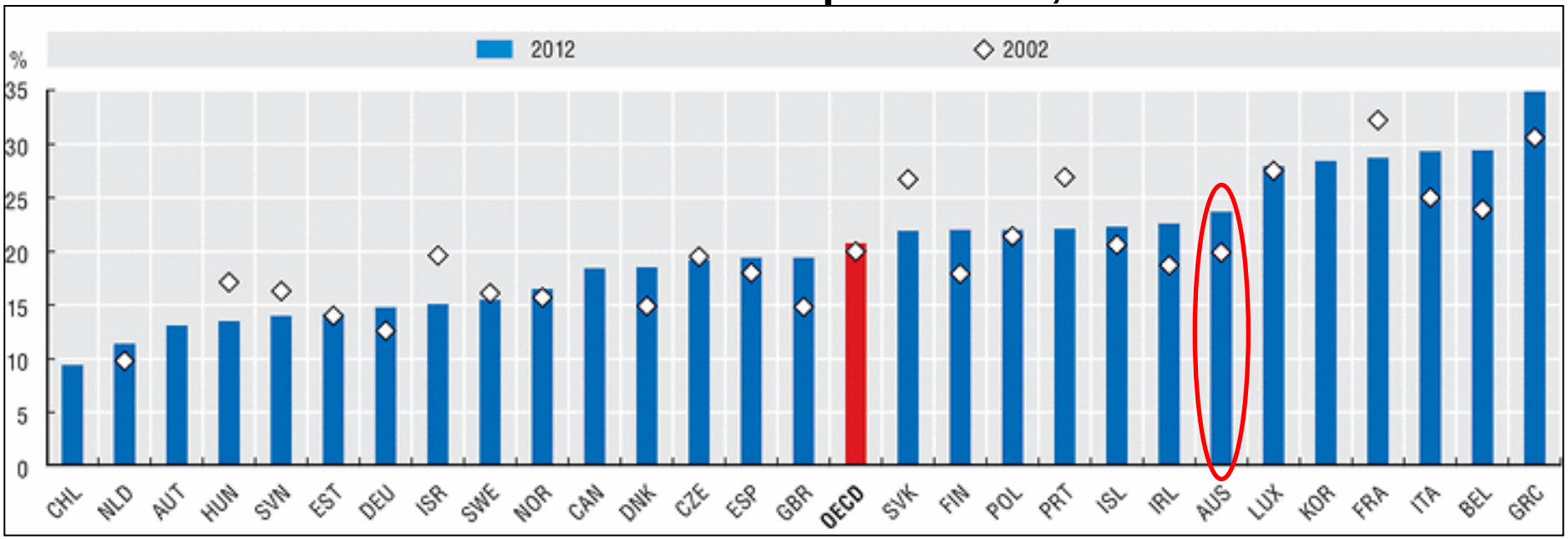
Overall volume of antibiotics prescribed, 2002 and 2012



Source: OECD (2014),*Health Statistics* (database). http://dx.doi.org/10.1787/888933249573

- Antibiotic use is greater than OECD average (2x that of The Netherlands), but
- Our rates of resistance are relatively low (esp. WA)

Overall volume of antibiotics prescribed, 2002 and 2012



Source: OECD (2014),*Health Statistics* (database). http://dx.doi.org/10.1787/888933249573

What are the drivers for antimicrobial resistance?

- Overuse, misuse, or just *use* of antibiotics
  - Agriculture
  - Veterinary care
  - Primary care
  - Clinical medicine
- Globalisation
- International travel
  - Medical tourism
  - 88% Swedish travellers to India colonised with ESBL*
- Environmental contamination with antibiotics

***Source:** T Tangden et al. Antimicrob. Agents Chemother.September 2010 vol. 54

Agriculture/veterinary medicine/aquaculture

- 50% of the US's AB production used in animals
  - therapeutics
  - 'growth promoters'
- Growth promoters shown to lead to AMR
  - Sweden banned them in 1986; EU in 2006
- Australian farmers relatively light users
- Limited systematic surveillance
- Little known about use in companion animals

Primary care

- GPs are the largest prescribers in human health
- Patients overestimate benefit and underestimate harm*
- Patient expectations
- GP prescriber habits
- Time pressures
- Diagnostic uncertainty

Suboptimal choices

***Source:** *JAMA Intern Med*. 2015;175(2):274-286

Clinical medicine

- Clinicians focus on the patient, not the population
- Tradition of autonomy of individual doctors
- 30-50% prescriptions not in accordance with antibiotic guidelines
- Biggest users
  - ICU
  - Surgery – prophylaxis and treatment
  - Immunosuppresed patients

What can we do about it?

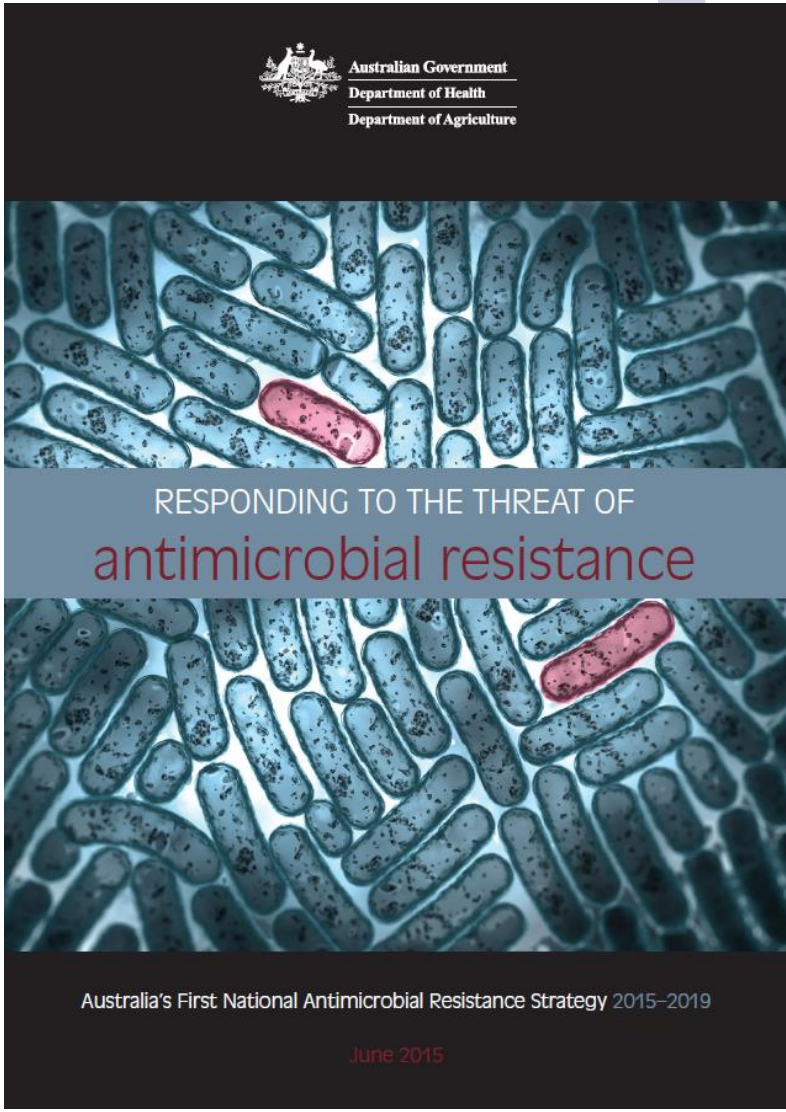
1. Prevent AMR from developing
   - Prevent infections in the first place
     - infection prevention and control practices
     - vaccines
     - sanitation
   - Surveillance
   - Antimicrobial stewardship
     - the ‘5 Rs’: right patient, right drug, right dose, right route, and the right time
   - Community awareness
   - ‘One health’ approach

What can we do about it?

2. Manage MROs when they do arise
   - Surveillance
   - Screening
   - Infection prevention and control practices
   - Develop new antibiotics (but v. few in pipeline)

Activities to curb AMR

- International
  - WHO's Global Action Plan
  - Obama's 2014 executive order
  - Chennai Declaration 2012
- National
  - AMR Strategy – 'One health' approach
  - CARalerts
  - CPE guidelines
- State
  - WAMRO
  - ACCESS Typing and Research lab
  - Gram negative reference laboratory
  - State wide ICP IT system
  - CPE/VRE/MRSA guidelines



Conclusion

- Origins of AMR are complex, so is the solution
  - Health, Trade, Agriculture, Veterinary medicine, Environment, Tourism, Customs
- The science is in
  - Use less antibiotics and use them better
- Political will is building
  - Internationally (WHO; US; UK)
  - Nationally
- We have solutions
  - Antimicrobial stewardship
  - Infection prevention and control

Focus of today