

multiresistant bacteria

- extended spectrum beta-lactamases are produced by *Klebsiella pneumoniae*, *Escherichia coli* & other *Enterobacteriaceae*
- genetically coded resistance to broad spectrum beta lactam antibiotics such as extended spectrum penicillins, 3rd generation cephalosporins & aztreonam
- often co-resistant to cotrimoxazole, aminoglycosides & quinolones
- in vitro often appear sensitive to cephalosporins but are resistant in vivo
- treated with carbapenems or fourth generation cephalosporins

ESBLs

- intrinsic resistance to many beta lactam antibiotics including carbapenems as well as aminoglycosides
- cotrimoxazole remains the drug of choice
- susceptability testing is problematic but ticarcillin-clavulanate, ceftazidime & fluoroquinolones may be useful therapeutically

Stenotrophomonas

- intrinsic resistance to beta lactams & aminoglycosides
- treated with carbapenems (outbreaks with resistance are noted but treatment is often successful if two agents are used even if in-vitro resistance is demonstrated)
- sensitive strains are often covered with two agents (eg a carbapenem & an aminoglycoside)

Acinetobacter baumannii

- intrinsically resistant to many antibiotics through efflux pumps, loss of porins, altered target enzymes (eg DNA gyrase), beta lactamases, metallo-carbapenemases, aminoglycoside-modifying enzymes
- the most active agents are ciprofloxacin, gentamicin, tobramycin, ceftazidime, piperacillin-tazobactam, ticarcillin-potassium clavulanate, imipenem, meropenem, amikacin
- dual therapy with different antibiotic classes is recommended for serious infections
- may have in vivo activity even if in vitro resistance especially if agents are cycled
- nebulised drugs (eg colistin) may be used as an adjuvant in chronic bronchiectasis

Pseudomonas aeruginosa

- penicillin and cephalosporin intermediate resistance and some high level resistance may be seen
- intermediate resistance may not equate with clinical treatment failure
- vancomycin is recommended for meningitis caused by these organisms while ceftriaxone may be used for other infections

Streptococcus pneumoniae

hospital acquired MRSA

- penicillin binding protein mutation coded by the *mecA* gene on a transposon
- confers cross-resistance to multiple classes (tetracyclines, macrolides, sulphonamides & aminoglycosides)
- treatment includes vancomycin, teicoplanin, and sometimes rifampicin, fusidic acid, ciprofloxacin

community acquired MRSA

- similar mechanism to hospital acquired MRSA - conferred by *mecA* gene plus an additional gene (eg PVL, a virulence factor common in eastern Australia & Pacific strains; associated with necrotising pneumonia)
- treatment includes vancomycin, teicoplanin & clindamycin, sometimes rifampicin, fusidic acid, ciprofloxacin. Can be sensitive to clindamycin, cotrimoxazole & erythromycin

hVISA & VISA

- genes code for factors such as additional peptidoglycan synthesis & reduced need for peptidoglycan cross linking
- the significance of hVISA is uncertain - the minimum inhibitory concentration for vancomycin is the same as for MRSA but daughter strains have higher MIC
- usually sensitive to the antibiotics teicoplanin, linezolid, quinupristine-dalfopristin, cotrimoxazole

MRSE

- penicillin binding protein mutation coded by the *mecA* gene as per MRSA

VRE

- mechanisms include:
 - penicillin binding protein mutations
 - beta lactamase production
 - aminoglycoside-modifying enzymes
 - antibiotic drug efflux pumps
 - alterations in cell wall components coded by transposons described as Van A to F phenotypes (Van A & B most common)
 - may be treated with linezolid, teicoplanin (some), quinupristine-dalfopristin (*Enterococcus faecium* only)

VRSA & VRSE

- alterations in cell wall components coded by transposons - Van A gene transferred from VRE
- may be treated with linezolid, quinupristin-dalfopristine, cotrimoxazole, chloramphenicol

ESCAPPM

- a group of gram negative rods: *Enterobacter*, *Serratia*, *Citrobacter freundii*, *Aeromonas*, *Proteus vulgaris*, *Providencia*, *Morganella morganii*
- produce a rapidly inducible beta lactamase during therapy with cephalosporins (especially 3rd generation agents)
- may be treated with carbapenems, fourth generation cephalosporins, ciprofloxacin or aminoglycosides