Antibiotics in PICU

- In deciding about antibiotic use we need to consider five things: (i) probability of bacterial infection (i.e., fever, temperature instability, increasing IT ratio, CRP/procalcitonin); (ii) community or hospital/PICU-acquired?; (iii) are there signs of severe sepsis (e.g., increased inotropic requirement with no other likely cause, worsening hypoxaemia associated with new CXR infiltrates); (iv) likely pathogens; (v) likely antimicrobial susceptibility.

- **Before antibiotics** are started cultures (blood, urine, tracheal aspirate +/- BAL) should be taken. Consider an LP, especially in infants, but this should not be done if there is any reduction in level of consciousness or any haemodynamic instability. Blood cultures should never be taken from a central line alone. Always take a clean peripheral sample (and a central line specimen if CVC sepsis is being considered).

- Widespread use of broad spectrum antibiotics (e.g., carbapenems, 3rd/4th generation cephalosporins) is associated with resistant Gram-negative bacteria and fungi. Currently Starship does not have endemic spread of carbapenem resistant gram negatives (including NDM-1) but broad use of carbapenems could promote their emergence for which there is no effective antibiotic. Similarly the use of vancomycin provides selection pressure for vancomycin-resistant enterococcus (VRE).

- **Nystatin** should be charted for all children receiving antibiotics.

- Surgical prophylactic antibiotics are important at the time of skin incision and during surgery. They should be given 30-60 minutes prior to skin incision. Continuing antibiotics does not prevent infection and leads to resistance.

- The default dose for all antibiotic doses for children in PICU is the severe infection dose in the “Drug Doses” handbook by Frank Shann.

- The two commonest ICU-acquired infections are bacteraemia (which may be due to CVC related sepsis) and ventilator associated pneumonia (VAP).

- **CVC related sepsis** is very uncommon if the catheter is <5-7 days old. There is no role for either guidewire changes of catheters or routine placement of new catheters as they do not reduce the rates of sepsis. If CVC sepsis is suspected, peripheral and central cultures should be taken. If the catheter is very old, if CVC sepsis is strongly suspected or if the cultures are positive the catheter should be replaced at a new site or removed.

- **VAP** is also very uncommon in the first 5-7 days. Indications for treatment are a new/persistent infiltrate on CXR together with at least two of: altered secretions (purulent or increased volume), fever/hypothermia, raised (>15) or low (<4) WCC, increased left shift in WCC, deterioration in oxygenation or increased ventilation requirement.

- **Tracheal aspirates** (TA) have low specificity due to frequent contamination with URT organisms and colonisation in longer term patients. Never start antibiotics for a positive TA alone. They can be used to guide therapy (especially if a gram negative organism is present) if there is an indication for treatment by clinical criteria for VAP. In immunocompromised and longer term patients, a blind BAL is a better option.

- **Aspiration pneumonitis** is not an indication for antibiotics.
**Standard Treatment Antibiotics**

- **Septicaemia/septic shock, i.e. sick child**
  - **Normal CSF**  
    flucloxacillin and gentamicin
  - **CSF unknown**  
    flucloxacillin and cefotaxime
  - **Central line present or suspected MRSA**  
    REPLACE flucloxacillin with vancomycin

- **Pneumonia (community acquired)**
  - **Moderately unwell**  
    cefuroxime
  - **Severely unwell**  
    flucloxacillin and gentamicin
    ± erythromycin (if considering mycoplasma)
    ± clindamycin (MRSA)

- **Meningitis**  
  cefotaxime**
  PLUS amoxicillin if <3 months of age
  PLUS vancomycin if (i) no LP or (ii) G+ cocci in CSF or CSF pneumococcal Ag positive

- **Encephalitis**  
  acyclovir

- **Peritonitis/?NEC**  
  amoxicillin, gentamicin, metronidazole

- **Osteomyelitis/septic arthritis**  
  flucloxacillin

- **Cellulitis/adenitis**
  - **Limbs or torso**  
    flucloxacillin
  - **Head, neck, bites**  
    amoxicillin and clavulanic acid

- **UTI (sick)**  
  amoxicillin and gentamicin

- **Pertussis**  
  erythromycin

**NB: dosing different to Shann book (i) 100mg/kg LD, then 50mg/kg (max 2G) 6hrly, (ii) suspected/possible pneumococcus:100mg/kg LD, then 75mg/kg (max 2G) 6hrly.**

**Standard Surgical Prophylaxis**

Cardiac surgery  
cephazolin (50mg/kg pre-induction and at the end of bypass, extra 25mg/kg during if >4hrs). No post-operative antibiotics

Sternal closure/reopening  
vancomycin 15mg/kg (max 500mg) x 1 dose

ECMO cannulation  
cephazolin (50mg/kg) x 1 dose

Abdominal surgery (variable due to the range of procedures)

  - **“Standard” risk**  
    cefoxitin
  - **“High risk”, perforation**  
    amoxicillin, gentamicin, metronidazole

Spinal surgery/neurosurgery  
cephazolin
Antibiotics for PICU acquired infections

- first line treatment is flucloxacillin and gentamicin or
- amoxicillin and gentamicin if low likelihood of staphylococcal infection or
- cefuroxime if VAP without systemic/haemodynamic changes or
- amoxicillin, gentamicin and metronidazole for GI tract sepsis

MRSA is uncommon in PICU. Although flucloxacillin won’t cover the majority of coagulase-negative Staphs, many of these isolates are contaminants, or the infection is indolent, so adding/replacing with vancomycin if an MRSE is isolated will not result in adverse clinical outcomes.

Indications for vancomycin

Signs of serious sepsis PLUS
- Known MRSA colonisation
- High risk of coagulate negative Staph infection: such as a VP shunt or previous coagulate negative Staph sepsis with CVC
- A central line alone is NOT an absolute indication to use vancomycin rather than flucloxacillin as first-line treatment for PICU acquired sepsis
- Multi-focal serious sepsis (likely to be Staph) but cultures awaited/unknown

Indications for meropenem or amikacin (discuss with ID)

Signs of serious sepsis PLUS
- Known colonisation or infection with ESBL
- Recent treatment with 3rd or higher gen cephalosporins, quinolones, pip/tazo, timentin, carbapenems
- Prolonged hospital admission with multiple antibiotic exposure ± immunosuppressed

STOPPING ANTIBIOTICS or SCALING DOWN ANTIBIOTICS

- All antibiotics should have a stop or review date charted
- Antibiotics should be ceased after 48-72 hours if cultures are negative.
- Antibiotics should be narrowed at 48-72 hours if cultures positive.
- “Possible” VAP is treated with antibiotics for 5 days; “definite/very likely” VAP is treated for 7 days.
- If it is not appropriate to stop antibiotics (because of a high probability of bacterial infection or signs of severe sepsis), antibiotic therapy can be scaled down when 48 hour cultures are negative. Appropriate antibiotics to scale down to depend on the clinical context, but include amoxicillin and gentamicin for culture-negative severe pneumonia or sepsis. When scaling down antibiotics, the standard guidelines above can be followed for the treatment of focal infections.
Are there signs of a bacterial infection?
Fever or temperature instability, plus either an increase in the IT ratio of 0.1 or more, or increased or low WCC.

Is it likely to be a PICU- or hospital-acquired infection?
PICU/NICU stay >7 days?

If NO, follow standard guidelines above

If cultures negative after 48 hours cease antibiotics

Flucloxacillin and gentamicin (no clear source) or Cefuroxime (likely chest source, not “unstable”) or Amoxicillin, gentamicin, metronidazole if GI sepsis

Are there signs of severe sepsis?
Hypotension or increased vasoactive drug requirement with no other likely cause, worsening hypoxaemia associated with new CXR infiltrates

No
Yes

Is there an indication for vancomycin?
Known MRSA colonisation
A central line alone is NOT an absolute indication to use vancomycin over flucloxacillin as first-line treatment for PICU acquired sepsis
High risk of methicillin-resistant coagulase negative Staph infection: e.g. VP shunt or previous MRSE sepsis with CVC
Multifocal or severe Staph disease prior to susceptibilities

Yes
No

PICU Consultant approval required:
Vancomycin and gentamicin

Flucloxacillin and gentamicin

If cultures negative after 48 hours: cease antibiotics or change to amoxicillin and gentamicin or flucloxacillin and gentamicin

Is there a high likelihood of gentamicin-resistant Gram-negative sepsis?
Known colonisation or infection with ESBL gram negative organism?
Recent treatment with 3rd or higher gen cephalosporins, quinolones, pip/tazo, timentin, carbapenems

No
Yes

PICU and ID Consultant approval required:
Meropenem +/- Vancomycin +/- Amikacin