

**BUGS: Clinical Microbiology made Simple (or, All you Need to Know on 3 sides of A4)**

NB This crib-sheet only deals with bacteria and not other pathogens like viruses and fungi.

There are three sections:

1. GRAM STAINING
2. CLINICALLY IMPORTANT BACTERIA
3. WHICH BACTERIA CAUSE WHICH INFECTIONS?

**1. GRAM STAINING**

Bacteria can be seen under the microscope by performing a Gram stain.

The Gram stain appearance depends on the cell wall structure. Since this is also relevant to antibiotic sensitivity, Gram stain appearance is incredibly helpful in deciding on an antibiotic even before you know the full identity of the organism.



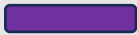

Gram Positive organisms look Purple/dark blue under the microscope.

Gram negative organisms look red under the microscope

The *shape* of the organism is described as cocci (round) or bacilli/rods (rod-shaped)

**2. CLINICALLY IMPORTANT BACTERIA**

Some of the *most important* bacteria you will *commonly* come across in clinical medicine according to Gram stain appearance:

	Gram positive	Gram negative
<b>Cocci</b>	Staphylococci  <i>Staphylococcus aureus</i> Other staphylococci  Streptococci <i>Streptococcus pyogenes</i> ('Group A strep') <i>Streptococcus pneumoniae</i> (aka pneumococcus)  Enterococci	<i>Neisseria meningitidis</i> (aka meningococcus)   <i>Neisseria gonorrhoeae</i> (aka gonococcus)
<b>Bacilli</b>	<i>Clostridioides difficile</i>  <i>Listeria sp</i>	<i>E. coli</i>  <i>Klebsiella</i> <i>Pseudomonas</i>

In addition, remember anaerobes –grow in the absence of oxygen. Live in the bowel where there is little oxygen. They are a mixture of organisms with different Gram stain properties but are usually all lumped together since the antibiotic treatment for all is the same – see Drugs crib-sheet

## Key facts about clinically important bacteria from the Table

### 1: GRAM POSITIVE COCCI

- a) **Staphylococci**
- b) **Streptococci**
- c) **Enterococci**

a) *Staphylococci*: ***Staphylococcus aureus***. A virulent pathogen which causes skin and soft tissue infections, cellulitis/wound infections, deep abscesses, vertebral discitis, osteomyelitis and endocarditis in intravenous drug users. Usual treatment: flucloxacillin. If resistant, that means it is MRSA (methicillin resistant *S. aureus*; methicillin is flucloxacillin).

Other staphylococci – often all lumped together and called ‘coagulase negative staphylococci’. They are normal skin microbiota. Rarely cause infection, but when they do it is when they are attached to a biomaterial like a central line, a joint prosthesis or a prosthetic heart valve.

b) *Streptococci*: There are lots but the two you will come across most are ***Streptococcus pyogenes*** (aka the ‘Group A strep’) and ***Streptococcus pneumoniae*** (aka pneumococcus).

***Streptococcus pyogenes*** (Group A strep) is a very dangerous pathogen and causes cellulitis, wound infections, bacterial tonsillitis (which untreated can lead to glomerulonephritis and rheumatic fever), scarlet fever, necrotising fasciitis, puerperal fever (post-childbirth – now rare in the UK thankfully but used to be a major cause of maternal death).

***Streptococcus pneumoniae*** - the most important cause of community acquired pneumonia. Another dangerous pathogen. Used to be called the ‘old man’s friend’ because it took elderly people’s lives relatively peacefully and quickly and in a less horrible way than many causes of death before modern medicine. However, important to remember it is *also a very important cause of bacterial meningitis*.

c) *Enterococci*. Live in the bowel (hence *entero*). Therefore a common cause of UTI and also associated with bowel sepsis. Relatively low-grade pathogens unlike those described above.

### 2. GRAM POSITIVE BACILLI

The important ones to remember are:

- a) *Clostridioides difficile* which causes antibiotic-associated diarrhoea and colitis
- b) *Listeria* which is a cause of meningitis in neonates, immunocompromised and elderly people. It can also infect women in pregnancy.

### 3. GRAM NEGATIVE COCCI

The important ones to remember are:

- a) *Neisseria meningitidis* (meningococcus) causes sepsis and meningitis
- b) *Neisseria gonorrhoeae* (gonococcus) causes gonorrhoea

#### 4. GRAM NEGATIVE BACILLI

- a) The Enterobacterales family: e.g. *E. coli*, *Klebsiella* and others
- b) *Pseudomonas*

- a) *E. coli* lives in the bowel, so a common cause of UTI, urinary sepsis and abdominal sepsis. Lots of other Gram-negative bacilli are in the same family (Enterobacterales). They also live in the bowel and all behave pretty similarly. Examples: *Klebsiella*, *Proteus*, *Serratia* etc. Can be extremely **antibiotic resistant**, especially *Klebsiella*.
- b) *Pseudomonas*. This is an environmental organism which like to live in damp places like taps, mop buckets etc. It's an opportunistic pathogen so doesn't normally cause infection in healthy people, but it can cause serious sepsis in immunocompromised/critical care patients. It's important remember *Pseudomonas* because it's very antibiotic resistant and only certain antibiotics cover it. These will be listed in the 'Drugs' cribsheet.

### 3. Which bacteria cause what infections?

Clinical infection	Most important/common pathogens
Skin and soft tissue infections	<i>Staphylococcus aureus</i> <i>Streptococcus pyogenes</i> (Group A strep)
Urinary tract	<i>Escherichia coli</i> Enterococci (bowel organisms excluding anaerobes)
Abdominal sepsis	<i>Escherichia coli</i> Enterococci Anaerobes (all bowel organisms)
Community Acquired Pneumonia	<i>Streptococcus pneumoniae</i> Also, some 'atypical' organisms which do not stain by Gram stain, such as <i>Legionella</i> , <i>Mycoplasma</i> and <i>Chlamydia</i>
Hospital Acquired Pneumonia	<i>Pseudomonas</i> <i>Escherichia coli</i> <i>Klebsiella</i> /other coliforms <i>Staphylococcus aureus</i> (Note these often tend to be resistant strains)
Bacterial Meningitis	<i>Neisseria meningitidis</i> <i>Streptococcus pneumoniae</i> <i>Listeria</i>
Sexually Transmitted Infections	Please see Dr Thompson's lecture for a summary

That's it! If you're familiar with these three pages you'll be in a great position for the Drugs crib-sheet 😊.