

# Gram Positive versus Gram Negative bacteria



In 1884 Christian Gram, a Danish bacteriologist, performed a test that introduced dye to the bacteria, to identify if bacteria had a peptidoglycan wall or a mesh-like layer of amino acids and sugars. This method is called "**Gram staining**" and it is used to distinguish between **Gram positive** and **Gram negative** bacteria. Gram positive bacteria contain a thick peptidoglycan layer (with teichoic acids), that stain **purple** while Gram negative bacteria lack the teichoic acids in their cell wall and therefore, stain **pink /red**.

## Commonly encountered **Gram Negative Bacteria**

| Commonly Encountered Gram Negative Bacteria*         | Common Sites of Infection*   | Usual Drug of Choice   | Comments<br>*common but not all inclusive  |
|--|--|--|--|
| <b>“SPICE” Organisms</b>                             |  |  |  |
| <b>S</b> <i>Serratia</i> spp.                        | <ul style="list-style-type: none"> <li>respiratory system</li> <li>intra-abdominal</li> <li>urinary system</li> <li>blood</li> <li>wounds</li> <li>surgical sites</li> </ul> | <ul style="list-style-type: none"> <li>Carbapenems (e.g. meropenem)</li> <li>Fluoroquinolones (e.g. ciprofloxacin)</li> <li>Aminoglycosides (e.g. gentamicin)</li> </ul> | Can develop resistance to cephalosporins (e.g. ceftriaxone) while on treatment, therefore not used for serious infections. Nitrofurantoin-cystitis only  |
| <b>P</b> <i>Providencia</i> spp.                     |  |  |  |
| <b>I</b> ndole positive<br>• <i>Proteus vulgaris</i> |  |  |  |
| <b>C</b> <i>Citrobacter</i> spp.                     |  |  |  |
| <b>E</b> <i>Enterobacter</i> spp.                    |  |  |  |
| <b>Other Organisms</b>                               |  |  |  |
| <i>Hafnia</i> spp.                                   | respiratory symptom, gastro-intestinal, urinary system, blood  | carbapenems, fluoroquinolones, aminoglycosides   |  |
| <i>Morganella morganii</i>                           | urinary system, intra-abdominal, skin, soft tissue, wounds   | carbapenems, fluoroquinolones, aminoglycosides   |  |
| <i>Proteus mirabilis</i>                             | urinary system   | cefazolin, ceftriaxone, ciprofloxacin, piperacillin/tazobactam,  |  |
| <i>Acinetobacter</i> spp.                            | respiratory system, heart, urinary system, blood, wound  | ertapenem, meropenem, ciprofloxacin, moxifloxacin  |  |
| <i>Pseudomonas aeruginosa</i>                        | respiratory tract, blood, urinary tract, wounds, surgical sites  | piperacillin-tazobactam, meropenem, ceftazidime, tobramycin, gentamicin, ciprofloxacin   | <b>Respiratory:</b> causes VAP<br><b>Multidrug resistance (MDR):</b> colistin, ceftolozane/tazobactam<br><b>Tobramycin, gentamicin:</b> not used as first line due to toxicity and penetration reasons |

**Note:** This is only an introduction to the gram negative bacteria. If you have any questions or suggestions please email: [Linda.Jorgoni@uhn.ca](mailto:Linda.Jorgoni@uhn.ca) , or [Linda.Dresser@uhn.ca](mailto:Linda.Dresser@uhn.ca).

### **References**

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