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<th>Subject Title: Antimicrobial Susceptibility Manual</th>
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WHEN TO TEST

Criteria for Susceptibility Testing

I. Introduction

This section lists the susceptibility testing methods and required antimicrobials for each significant organism appropriate to the site of isolation. Perform susceptibility testing on pure cultures ONLY.

II. Reagents/Materials/Media

Analytical Process – Bacteriology Reagents_Materials_Media List QPCMI10001

III. Method

1. Select significant organisms as per procedure manual of body sites.

2. Identify the selected isolate as per Bacteria and Yeast Workup Manual.

3. For identical organisms, as defined in Bacteria and Yeast Workup Manual – Minimal workup, isolated within 1 day (24 hours) from blood and sterile sites for bacteria OR 7 days from blood and sterile sites for yeasts OR bacteria within 3 days from other sites do not require repeat susceptibility testing EXCEPT oxacillin and vancomycin screen for Staphylococcus, vancomycin screen for Enterococcus, meropenem screen for Enterobacteriaceae.

4. Refer susceptibility results back to like sites only and NEVER refer a sterile site to a non-sterile site. NEVER refer clinical isolates to isolates from infection control screens or vice versa.

5. For Infection Control Screens isolates of identical organisms (identified by minimal tests-see IC manual), full susceptibility only needs to be performed if there were no identical isolates in the past 3 months.

6. Refer the susceptibility result to the previous cultures with the statement “Susceptibility testing not done. Please refer to collected on date “.

7. Follow the table below as a guide for the appropriate method(s)/antimicrobial(s) to be setup

8. If the Vitek susceptibility panel or drug(s) are terminated, please set up a KB panel or KB drug(s) for that organism. For Staphylococcus species, vancomycin can only be tested by etest as there are no KB interpretations.

Reference Material: CLSI guidelines
### WHAT TO TEST:

<table>
<thead>
<tr>
<th>Organisms</th>
<th>Site Description</th>
<th>Method</th>
<th>Antimicrobial(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aerobic Gram Negative</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enterobacteriaceae</td>
<td>All sites/non-SPICE (except sterile)</td>
<td>Vitek → astn391</td>
<td>AM (on request ONLY)</td>
</tr>
<tr>
<td></td>
<td>Sterile sites OR on request (non-SPICE)</td>
<td>KB</td>
<td>KZ, ETP, TOB, AN</td>
</tr>
<tr>
<td></td>
<td>All sites+SPICE Organisms</td>
<td>KB</td>
<td>CIP, GM, TOB, AN</td>
</tr>
<tr>
<td></td>
<td>Early growth of <em>E. coli</em>, <em>K. pneumonia</em>, <em>K. oxytoca</em> or <em>P. mirabilis</em> from blood and sterile sites</td>
<td>BLACTA →</td>
<td></td>
</tr>
<tr>
<td>Proteus non-vulgaris sp</td>
<td>KB</td>
<td></td>
<td>AMC (on request ONLY)</td>
</tr>
<tr>
<td><em>E. coli, K. pneumonia, K. oxytoca</em> or <em>P. mirabilis</em>: If CAZ or CRO=I or R or BLACTA+ ONLY on specimens from:</td>
<td>add KB-ESBL →</td>
<td>AMC, ATM, CRO, CAZ, CPD, FOX, TZP, FEP, ETP, MEM</td>
<td></td>
</tr>
<tr>
<td>• MSH newborn:D1-M13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MSH Female 12-50yrs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>All sites - if ertapenem = I or R and meropenem MIC ≤0.25mg/L</td>
<td>Mero kbmems →</td>
<td>mems</td>
</tr>
<tr>
<td></td>
<td>Meropenem mic ≥0.5 mg/L or Meropenem screen &lt;25mm</td>
<td>βCARBA →</td>
<td></td>
</tr>
<tr>
<td>If BCARBA = pos</td>
<td>CARB-R PCR →</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If BCARBA = neg</td>
<td>Set up Rosco disks</td>
<td></td>
<td>mrp10, mrdp, mrbo, mrclx, tem</td>
</tr>
<tr>
<td>Enterobacteriaceae not growing on Vitek from all sites</td>
<td>KB →</td>
<td></td>
<td>AMP, KZ, CRO, CIP, SXT, CN, TZP, TOB, CAZ, ETP, MEM, CPD, AK, F</td>
</tr>
<tr>
<td>For Urine ONLY</td>
<td>If I or R to all of the following: amoxicillin/ampicillin, amox/clav, cephalaxin,</td>
<td>+ KB (kbxdru) →</td>
<td>FOS</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Organisms</th>
<th>Site</th>
<th>Method</th>
<th>Antimicrobial(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ciprofloxacin, nitrofurantoin and TMP/SMX</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If resistant to <strong>all</strong> routinely tested antimicrobials <em>(excluding aminoglycosides)</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Urine →</td>
<td>etest (etresis) →</td>
<td>CO, TGC, C/T</td>
<td></td>
</tr>
<tr>
<td>Urine →</td>
<td>etest (etresis) → +KB</td>
<td>CO, TGC, C/T, FOS</td>
<td></td>
</tr>
<tr>
<td>If resistant to <strong>all</strong> routinely tested antimicrobials <em>(including aminoglycosides)</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Urine →</td>
<td>etest (etresis) → + KB (kbxdr) →</td>
<td>CO, TGC, C/T, ATM, C, DX, MH, TE, FEP, FOS</td>
<td></td>
</tr>
<tr>
<td>Urine →</td>
<td>etest (etresis) → + KB (kbxdr) →</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. coli O:157</td>
<td>Enteric sites</td>
<td>Not tested</td>
<td></td>
</tr>
<tr>
<td>salmonella typhi</td>
<td>All sites</td>
<td>KB (kbsalbc) → + etest (etsalm) →</td>
<td>AMP, , CRO, SXT CI</td>
</tr>
<tr>
<td>salmonella species other than S. typhi</td>
<td>Enterics sites – routine</td>
<td>Not tested</td>
<td></td>
</tr>
<tr>
<td>On request ONLY upon microbiologist approval</td>
<td>KB (kbsalme) → + etest (etsalm) →</td>
<td>AMP, , SXT CI</td>
<td></td>
</tr>
<tr>
<td>Non-enteric sites</td>
<td>KB (kbsalbc) → + etest (etsalm) →</td>
<td>AMP, , CRO, SXT CI</td>
<td></td>
</tr>
<tr>
<td>Organisms</td>
<td>Site</td>
<td>Method</td>
<td>Antimicrobial(s)</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td><em>Shigella species</em></td>
<td>Non-Enteric sites</td>
<td>KB →</td>
<td>CRO</td>
</tr>
<tr>
<td></td>
<td>Enteric Sites - On request ONLY upon microbiologist approval</td>
<td>KB (kbsalme) → KB (etsalm)</td>
<td>AMP, SXT, CRO CI</td>
</tr>
<tr>
<td><em>Vibrio species</em></td>
<td>Enteric sites</td>
<td>Not tested</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sterile sites</td>
<td>Send to PHL</td>
<td></td>
</tr>
<tr>
<td><em>Acinetobacter species</em></td>
<td>All sites</td>
<td>Vitek →</td>
<td>astn391</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If Vitek mero=I/R, KB→ MEM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>If KB MEM = I/R</td>
<td>Send to NML for PCR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Add KB</td>
<td>AK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>etest (etresa) →</td>
<td>CO, TGC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>etest (etresis) →</td>
<td>CO, TGC ATM, DX, MH, TE, FEP, TIM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ KB (kbedxa) →</td>
<td></td>
</tr>
<tr>
<td><em>Pseudomonas aeruginosa</em></td>
<td>All sites</td>
<td>Vitek →</td>
<td>astn391</td>
</tr>
<tr>
<td></td>
<td>Sterile Sites</td>
<td>Add KB</td>
<td>TZP, CAZ, CIP, Add AN, TOB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>etest (etresa) →</td>
<td>CO, C/T ATM, FEP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KB (kbxdra) →</td>
<td></td>
</tr>
<tr>
<td><em>Mucoid P. aeruginosa</em></td>
<td>all sites not growing on Vitek</td>
<td>KB →</td>
<td>AMP, KZ, CRO, CIP, SXT, CN, TZP, TOB, CAZ, ETP, MEM, CPD, AK, F</td>
</tr>
</tbody>
</table>
### Organisms

<table>
<thead>
<tr>
<th>Organisms</th>
<th>Site</th>
<th>Method</th>
<th>Antimicrobial(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pseudomonas sp., Plesiomonas sp. and other afermenters</td>
<td>All sites</td>
<td>Not tested</td>
<td>CRO, CIP, SXT, AK, ETP, MEM, TZP, CN, TE</td>
</tr>
<tr>
<td></td>
<td>Blood and Sterile Sites</td>
<td>Send to PHL</td>
<td></td>
</tr>
<tr>
<td>Aeromonas species</td>
<td>Non-Enteric Sites</td>
<td>KB →</td>
<td>CRO, CIP, SXT, AK, ETP, MEM, TZP, CN, TE</td>
</tr>
<tr>
<td></td>
<td>Enteric Sites - routine</td>
<td>Not tested</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Enteric Sites - On request ONLY upon microbiologist approval</td>
<td>KB →</td>
<td>CRO, CIP, SXT, AK, ETP, MEM, TZP, CN, TE</td>
</tr>
<tr>
<td></td>
<td>If resistant to all routinely tested antimicrobials</td>
<td>KB →</td>
<td>C</td>
</tr>
<tr>
<td>Stenotrophomonas maltophilia</td>
<td>All sites</td>
<td>KB →</td>
<td>LVX, SXT</td>
</tr>
<tr>
<td></td>
<td>+ e-test →</td>
<td>TS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>If e-test and KB for sxt disagree</td>
<td>Send to PHL for MIC →</td>
<td>sxt</td>
</tr>
<tr>
<td></td>
<td>If resistant to all routinely tested antimicrobials</td>
<td>etest (etresa) →</td>
<td>CO, TGC</td>
</tr>
<tr>
<td></td>
<td>+ Send to PHL for MIC</td>
<td>taz, tcc, mn</td>
<td></td>
</tr>
<tr>
<td>Burkholderia cepacia</td>
<td>All sites</td>
<td>KB →</td>
<td>CAZ, SXT, MEM</td>
</tr>
<tr>
<td></td>
<td>+ e-test →</td>
<td>TS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>If e-test and KB for sxt disagree</td>
<td>Send to PHL for MIC →</td>
<td>sxt</td>
</tr>
<tr>
<td></td>
<td>If resistant to all routinely tested antimicrobials</td>
<td>etest (etresa) →</td>
<td>CO, TGC</td>
</tr>
<tr>
<td></td>
<td>+ Send to PHL for MIC</td>
<td>lev, tcc</td>
<td></td>
</tr>
<tr>
<td>Haemophilus species</td>
<td>All sites</td>
<td>beta-lactamase</td>
<td>CRO, CIP, AMP</td>
</tr>
<tr>
<td></td>
<td>Blood and Sterile sites</td>
<td>beta-lactamase +KB</td>
<td></td>
</tr>
</tbody>
</table>

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<th>Site</th>
<th>Method</th>
<th>Antimicrobial(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Helicobacter pylori</em></td>
<td>Gastric biology - On request ONLY</td>
<td>e-test → AC, CH, LX, MZ, TC, RI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ Send to Mayo Clinic</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Moraxella catarrhalis</em></td>
<td>All sites</td>
<td>Not tested</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blood and Sterile Sites</td>
<td>Send to PHL</td>
<td></td>
</tr>
<tr>
<td><em>Neisseria gonorrhoeae</em></td>
<td>All sites</td>
<td>Send to PHL</td>
<td></td>
</tr>
<tr>
<td><em>Neisseria meningitides</em></td>
<td>All sites</td>
<td>Send to PHL</td>
<td></td>
</tr>
<tr>
<td>Other fastidious Gram</td>
<td>All sites</td>
<td>Not tested</td>
<td></td>
</tr>
<tr>
<td>negatives (e.g. HACEK</td>
<td>Blood and Sterile Sites</td>
<td>Send to PHL</td>
<td></td>
</tr>
<tr>
<td>group, <em>Pasteurella</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Campylobacter</em> species</td>
<td>All sites</td>
<td>Not tested</td>
<td></td>
</tr>
</tbody>
</table>

**Gram Positive:**

<p>| <em>Staphylococcus aureus</em>   | All sites                                 | Vitek → Oxacillin Screen → Vancomycin Screen → astp580 ox va |                  |
|                          | Early growth from bloods and sterile sites | + Denka →       |                  |
| If Vitek SXT = I/R       |                                          | add KB → SXT   |                  |
| If MRSA                   |                                          | add KB → MUP   |                  |
| If KB-MUP=R (&lt;19mm)       |                                          | add e-test → MU |                  |
| If MRSA from MRSA Screen |                                          | add e-test → FU |                  |
| Test and TE and SXT=R     |                                          |                |                  |
| For MRSA all sites,      |                                          | add e-test → BPR|                  |
| on request ONLY          |                                          |                |                  |
| If Vancomycin is ≥2 mg/L  |                                          | add macro-e-test → VA, TP |          |
| from Vitek OR growth on Vanco Screen plate | | add e-test → VA, TP |          |
| Blood and Sterile sites  |                                          | add KB → LZD DPC|                  |
| Vancomycin MIC ≥2 mg/L   |                                          | add e-test → LZD DPC|          |
| and MRSA/BORSA or if     |                                          |                |                  |
| requested                |                                          |                |                  |
| If Vancomycin MIC ≥2 mg/L|                                          | add KB → LZD DPC|                  |
| and MRSA/BORSA and resistant to all other routinely tested antimicrobials | | add e-test → LZD DPC|          |</p>
<table>
<thead>
<tr>
<th>Organisms</th>
<th>Site</th>
<th>Method</th>
<th>Antimicrobial(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>requested</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If resistant to all routinely tested antimicrobials or if requested</td>
<td>add e-test</td>
<td>TGC</td>
<td></td>
</tr>
<tr>
<td>If not growing on Vitek from all sites</td>
<td>add KB panel</td>
<td>add Breakpoint panel</td>
<td>kbgpc etstanv</td>
</tr>
</tbody>
</table>

Coagulase-negative

*Staphylococcus* NOT

*Staphylococcus lugdunensis*

<table>
<thead>
<tr>
<th>Blood Cultures</th>
<th>Method</th>
<th>Antimicrobial(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not tested</td>
<td>Except: BC endocarditis</td>
<td>astp580</td>
</tr>
</tbody>
</table>

Urine

<table>
<thead>
<tr>
<th>Method</th>
<th>Antimicrobial(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not tested</td>
<td>astp580</td>
</tr>
<tr>
<td>Vitek</td>
<td>kbgpc etstanv</td>
</tr>
</tbody>
</table>

If not growing on Vitek from all sites | add KB panel | add Breakpoint panel | kbgpc etstanv |
<table>
<thead>
<tr>
<th>Organisms</th>
<th>Site</th>
<th>Method</th>
<th>Antimicrobial(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Staphylococcus lugdunensis</em></td>
<td>All sites</td>
<td>Vitek</td>
<td>astp580</td>
</tr>
<tr>
<td><em>Staphylococcus pseudointermedius</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Staphylococcus intermedius</em></td>
<td>All sites</td>
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</tr>
<tr>
<td><em>Micrococcus</em> species</td>
<td>All sites</td>
<td>Not tested</td>
<td></td>
</tr>
<tr>
<td><em>Aerococcus</em> species</td>
<td>Blood &amp; Sterile sites</td>
<td>Send to PHL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All other sites</td>
<td>Not tested</td>
<td></td>
</tr>
<tr>
<td><em>Enterococcus</em> species</td>
<td>Urines</td>
<td>Vitek</td>
<td>astgp67 va</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ Screen plate →</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>If Amp and Nitro =I/R OR Penicillin allergy and Nitro I/R add KB →</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blood &amp; Sterile sites</td>
<td>KB →</td>
<td>AMP, High level gm500 and st2000, va</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ Screen plate →</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All sites</td>
<td>KB →</td>
<td>DPC (excluding respiratory), TGC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ Screen plate →</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All sites</td>
<td>KB →</td>
<td>AMP va</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ Screen plate →</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All sites, if VA=R or vanA positive, <em>E. faecalis</em> or <em>E. faecium</em></td>
<td>add macro e-test →</td>
<td>VA, TP DPC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>add KB →</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>add e-test →</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All sites, if resistant to all routinely tested antimicrobials or if requested</td>
<td>add e-test →</td>
<td>DPC</td>
</tr>
<tr>
<td></td>
<td>All sites (excluding respiratory), if daptomycin is requested</td>
<td>add e-test →</td>
<td>DPC</td>
</tr>
<tr>
<td>Organisms</td>
<td>Site</td>
<td>Method</td>
<td>Antimicrobial(s)</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------------------</td>
<td>---------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><em>Streptococcus pneumoniae</em></td>
<td>Blood &amp; Sterile sites</td>
<td>TREK Sensititre panel→</td>
<td>TX, PG, LX, EM, VA,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If Clindamycin is requested,</td>
<td>DA, E</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Double Disk KB →</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All other sites</td>
<td>Double Disk KB →</td>
<td>DA, E</td>
</tr>
<tr>
<td></td>
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<td>+ KB →</td>
<td>OX, LVX, VA</td>
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<tr>
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<td>If OX=R, then TREK Sensititre panel →</td>
<td>TX, PG, LX, EM, VA,</td>
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<tr>
<td><em>Group A, B, C, G Streptococcus</em></td>
<td>Blood and Sterile sites</td>
<td>Double Disk KB →</td>
<td>DA, E</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ KB →</td>
<td>P, VA</td>
</tr>
<tr>
<td></td>
<td>Urine for Group A, C, G on request ONLY</td>
<td>KB →</td>
<td>LVX, VA</td>
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<tr>
<td></td>
<td>Urine, GBS on request ONLY:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- female &gt;12 and &lt;60 years old (with significant amount)</td>
<td>KB →</td>
<td>LVX, VA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ Double Disk KB →</td>
<td>DA, E</td>
</tr>
<tr>
<td></td>
<td>- female &gt;12 and &lt;60 years old (with insignificant amount)</td>
<td>KB →</td>
<td>VA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ Double Disk KB →</td>
<td>DA, E</td>
</tr>
<tr>
<td></td>
<td>- male or female &lt;12 or &gt;60 years old</td>
<td>KB →</td>
<td>LVX</td>
</tr>
<tr>
<td></td>
<td>- Vaginal GBS screens, on request ONLY or patient is Penicillin allergic.</td>
<td>Double Disk KB →</td>
<td>DA, E</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+KB →</td>
<td>VA</td>
</tr>
<tr>
<td></td>
<td>Other sites, on request ONLY</td>
<td>Double Disk KB →</td>
<td>DA, E</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ KB →</td>
<td>LVX, VA</td>
</tr>
<tr>
<td><em>Streptococcus bovis, viridans Streptococcus</em></td>
<td>Blood &amp; Sterile sites:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>One morphotype →</td>
<td>e-test →</td>
<td>TX, PG, VA</td>
</tr>
<tr>
<td></td>
<td>&gt;1 morphotype →</td>
<td>Not tested</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Urine, on request ONLY</td>
<td>KB →</td>
<td>VA, LVX</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ e-test →</td>
<td>PG</td>
</tr>
<tr>
<td></td>
<td>Other sites, on request ONLY</td>
<td>KB →</td>
<td>VA, LVX</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ e-test →</td>
<td>PG</td>
</tr>
<tr>
<td><em>Streptococcus anginosus</em> group and small colony-</td>
<td>Blood &amp; Sterile sites</td>
<td>e-test →</td>
<td>TX, PG, VA</td>
</tr>
<tr>
<td></td>
<td>Urine, on request ONLY</td>
<td>KB →</td>
<td>LVX</td>
</tr>
<tr>
<td>Organisms</td>
<td>Site</td>
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<td>------------------</td>
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<tr>
<td><strong>ß-haemolytic</strong></td>
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<td></td>
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<tr>
<td><em>Streptococcus</em></td>
<td>Other sites, on request</td>
<td>Double Disk KB</td>
<td>DA, E</td>
</tr>
<tr>
<td></td>
<td>ONLY</td>
<td>+ KB</td>
<td>LVX, VA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ e-test</td>
<td>PG, TX</td>
</tr>
<tr>
<td><strong>Listeria species</strong></td>
<td>All sites</td>
<td>Not tested</td>
<td></td>
</tr>
<tr>
<td><strong>Corynebacterium species</strong></td>
<td>All sites</td>
<td>Not tested</td>
<td></td>
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<tr>
<td><strong>Bacillus species</strong></td>
<td>All sites</td>
<td>Not tested</td>
<td></td>
</tr>
<tr>
<td><strong>Nocardia species</strong></td>
<td>All sites</td>
<td>Not tested</td>
<td>Send to PHL on special request</td>
</tr>
<tr>
<td><strong>Anaerobes</strong></td>
<td>All sites</td>
<td>Not tested</td>
<td>Send to PHL on special request</td>
</tr>
<tr>
<td><strong>Yeasts</strong></td>
<td>Blood and Sterile sites</td>
<td>Not tested</td>
<td>Send to PHL</td>
</tr>
<tr>
<td></td>
<td>Other non-sterile sites</td>
<td>Not tested</td>
<td>Send to PHL on special request</td>
</tr>
</tbody>
</table>
WHAT TO REPORT:

Urine – Gram Positive Susceptibility Reporting 1 – *Staphylococcus* species, MRSA

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th>Staphylococcus species</th>
<th>MRSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td>X¹</td>
<td>X¹, 5</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>X²</td>
<td>X², 5</td>
</tr>
<tr>
<td>Ceftobiprole</td>
<td></td>
<td>X¹⁴</td>
</tr>
<tr>
<td>Cloxacillin</td>
<td>X²</td>
<td>X², 5</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>X³,¹¹</td>
<td>X³, 6, 11</td>
</tr>
<tr>
<td>Fusidic Acid</td>
<td></td>
<td>X⁶, 7</td>
</tr>
<tr>
<td>Mupirocin</td>
<td></td>
<td>X⁶, 8</td>
</tr>
<tr>
<td>Nitrofurantoin</td>
<td>X</td>
<td>X⁶</td>
</tr>
<tr>
<td>Rifampin</td>
<td></td>
<td>X⁶</td>
</tr>
<tr>
<td>Tigecycline</td>
<td>X⁴⁰</td>
<td>X⁴⁰</td>
</tr>
<tr>
<td>Trimethoprim/Sulfa</td>
<td>X¹⁴</td>
<td>X¹⁴</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>X¹²</td>
<td>X⁵, ²</td>
</tr>
</tbody>
</table>

¹ Base on Penicillin or beta-lactamase result
² Base on Oxacillin/cefoxitin result; for *Staphylococcus pseudointermedius* base on Oxacillin result
³ Adults only (>13 y); base on Tetracycline result
⁴ Report if patient is allergic to Penicillin OR if *Staphylococcus* species is resistant to All other antimicrobial agents.
⁵ DO NOT report if isolated from Infection Control Screening test
⁶ For Infection Control Screening test, include Isolate Comment “Susceptibility results are provided for infection control purposes only.”
⁷ Report only if resistant to Mupirocin as Isolate Comment “Fusidic acid MIC = xx mg/L. There are no standards to interpret this result as susceptible or resistant. Published literatures suggest MICs <2mg/L may correlate with susceptibility. For help with interpretation, please consult the microbiologist-on-call. (Refs: Int J Antimicrob Agents 1999;22:S45-S58; J Clin Micro 1995;33(7):1712-1715.”
⁸ For KB result that is S, report as Isolate Comment “Mupirocin zone size = xx mm. There are no standards to interpret this result as susceptible or resistant. Published literatures suggest MICs <2 mg/L and zones of inhibition ≥19mm may correlate with susceptibility. For help with interpretation, please consult the microbiologist-on-call. (Refs: J Clin Micro 1990;28(3); 608-609; AMMI Canada 2006 abstract P2.27.”
⁹ For e-test results that are S, report as Isolate Comment “Mupirocin MIC = xx mg/L. There are no standards to interpret this result as susceptible or resistant. Published literatures suggest MICs <2 mg/L and zones of inhibition ≥19mm may correlate with susceptibility. For help with interpretation, please consult the microbiologist-on-call. (Refs: J Clin Micro 1990;28(3); 608-609; AMMI Canada 2006 abstract P2.27.”
¹⁰ Report with interpretation and MIC and Isolate comment as above if e-test is R.
¹¹ For *S. aureus* or MRSA, vancomycin MIC=2.0 mg/L, result with ISOLATE comment: “This isolate has a vancomycin MIC of 2 mg/L which is associated with an increased risk of treatment failures. Consultation with infectious diseases or medical microbiology is advised.”
¹² Report if I/R to All other antimicrobial agents OR if requested.
If I/R, add comment “Doxycycline results are based on testing tetracycline which may overcall doxycycline resistance. If you wish this isolate to be tested with doxycycline directly, please contact the microbiology laboratory.”

Base on KB results if Vitek = I/R

Report with comment:
There are no CLSI standards for this drug. EUCAST suggests MICs ≤2 mg/L correlate with susceptibility. Please consult the microbiologist-on-call with any questions. For research use only.
There are no CLSI standards for this drug. EUCAST suggests MICs >2 mg/L correlate with resistance. Please consult the microbiologist-on-call with any questions. For research use only.

**Note:** *S. saprophyticus* and coagulase-negative-*Staphylococcus* - **DO NOT** report susceptibilities. Report with Isolate Comment - “Susceptibility testing of this organism is not routinely done because infections respond to concentrations achieved in urine of antimicrobial agents commonly used to treat acute, uncomplicated urinary tract infections e.g. nitrofurantoin, trimethoprim/sulfa or fluoroquinolones. Suggest repeat specimen with request for susceptibility testing if patient does not respond to empiric therapy.”

**Note:** If all antimicrobial agents are resistant, inform the Microbiologist on-call.
Urine – Gram Positive Susceptibility Reporting – 2 – *Enterococcus species, Streptococcus species, Aerococcus species*

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th><em>Enterococcus species</em>&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Group A, B, C, G <em>Streptococcus</em></th>
<th><em>Streptococcus anginosus group</em></th>
<th><em>Aerococcus species</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td>X&lt;sup&gt;20&lt;/sup&gt;</td>
<td>Routinely not tested</td>
<td>Routinely not tested</td>
<td>See Below&lt;sup&gt;18&lt;/sup&gt;</td>
</tr>
<tr>
<td>Clindamycin</td>
<td></td>
<td>X&lt;sup&gt;10, 11&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daptomycin</td>
<td>X&lt;sup&gt;13&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erythromycin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fosfomycin</td>
<td>X&lt;sup&gt;12&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>X&lt;sup&gt;4&lt;/sup&gt;</td>
<td>X&lt;sup&gt;6, 9, 17&lt;/sup&gt;</td>
<td></td>
<td>X&lt;sup&gt;6&lt;/sup&gt;</td>
</tr>
<tr>
<td>Linezolid</td>
<td>X&lt;sup&gt;2, 16&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrofurantoin</td>
<td>X&lt;sup&gt;20&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penicillin G</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tetracycline</td>
<td>X&lt;sup&gt;1, 20&lt;/sup&gt;</td>
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</tr>
<tr>
<td>Tigecycline</td>
<td>X&lt;sup&gt;14&lt;/sup&gt;</td>
<td></td>
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<tr>
<td>Vancomycin</td>
<td>X&lt;sup&gt;3, 8&lt;/sup&gt;</td>
<td></td>
<td></td>
<td>X&lt;sup&gt;12&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

1 Adults only (>13 y)
2 Report if Vancomycin is R, except for *E. gallinarum* and *E. casseliflavus*.
3 Test but **DO NOT** report unless Vancomycin R or Enterococcus resistant to **All** other antimicrobial agents
4 Report if Ampicillin, Nitrofurantoin and Tetracycline are ALL I/R.
5 If isolated from Infection Control Screening test, include Isolate Comment “Susceptibility results are provided for infection control purposes only.”
6 Adults only (>18 y)
7 Report “This organism is intrinsically susceptible to penicillin. If treatment is required AND this patient cannot be treated with penicillin, empiric treatment with nitrofurantoin or levofloxacin is generally successful for bacteriuria. If advice regarding antimicrobial treatment is desired, please contact the medical microbiologist on-call.”
8 *E. gallinarum* and *E. casseliflavus*, report as R with the statement "This organism always has intrinsic non-transmissible resistance to vancomycin. The patient does not require isolation."
9 For male or female <12 or >60 years old, report with additional isolate comment “Susceptibility completed as requested” (do not remove original comments). If Levofloxacin is R or patient is <18y, consult the Microbiologist.
10 For female >12 and <60 years old (with **significant amount**) reported with the isolate comment “Susceptibility testing completed as requested. Note: clindamycin should NOT be used to treat bacteriuria, they are provided to help guide intrapartum chemoprophylaxis (if this patient is pregnant).” (do not remove original comments)
11 For female >12 and <60 years old (with **insignificant amount**), report with additional isolate comment “Susceptibility testing completed as requested for intrapartum chemoprophylaxis” (do not remove original comments).
12 Report if R to clindamycin
13 *Streptococcus anginosus* group are generally susceptible to penicillin and levofloxacin. If susceptibility testing for this organism is required, please contact the microbiology laboratory within 48 hours.
14 Report if I/R to **All** other antimicrobial agents OR if requested.
15 Report if requested base on etest results
16 Report if Ampicillin, Nitrofurantoin, Tetracycline and Levofloxacin are ALL I/R
For female >12 and <60 years old (with insignificant amount) do NOT report.

“Aerococcus species are usually susceptible to beta-lactams and vancomycin. If you would like susceptibility testing to be completed, please contact the Microbiology Laboratory.”

Report for I/R to ampicillin and nitrofurantoin. For *E. faecalis* report interpretation. For *E. faecium* report with with zone diameter in isolate canned comment FSeS.

If “S” for *E. faecalis* add Isolate Message “*E. faecalis* is generally susceptible to fosfomycin for treatment of acute uncomplicated cystitis.”

**Note:** If all antimicrobial agents are resistant, inform the Microbiologist on-call.
### Urine - Gram Negative Susceptibility Reporting

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th>Enterobacteriaceae</th>
<th>Acinetobacter spp.</th>
<th>P. aeruginosa</th>
<th>Aeromonas spp.</th>
<th>S. maltophilia</th>
<th>B. cepacia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amikacin</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ampicillin</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Amoxicillin/Clavulanate</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Aztreonam</td>
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<td>Cefepime</td>
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</tr>
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</tr>
<tr>
<td>Nitrofurantoin</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Piperacillin/Tazobactam</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Tetracycline</td>
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<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ticarcillin/Clavulanate</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Tigecycline</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Trimethoprim/Sulfa</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Tobramycin</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

1. Adults only (>18 y)
2. Report if I/R
3. Report if I/R OR if I/R to 3 of the 4 antimicrobial agents: amikacin, ciprofloxacin, 3rd Generation Cephalosporins, Septra OR if requested
4. Report if I/R OR if I/R to 3 of the 4 antimicrobial agents: amikacin, ciprofloxacin, 3rd Generation Cephalosporins, Piperacillin/tazobactam OR if requested
5. Report MIC from PHL if I/R OR if I/R to All other antimicrobial agents
6. Report ceftriaxone only if I/R to Cephalxin
8. Report for E. coli, Klebsiella pneumonia & Proteus mirabilis only.
9. Do not report for Salmonella species.
10 For _E. coli_, _Klebsiella_ species and _Proteus_ species that are confirmed to have an ESBL of any class, report all penicillins and first, second and third generation cephalosporins and piperacillin/tazobactam as R.

11 For _Enterobacteriaceae_ other than _E. coli_, _Klebsiella_ species and _Proteus_ species where ESBL testing is not done, if any one of cefotaxime/ceftriaxone or ceftazidime=R, report all penicillins and first, second and third generation cephalosporins and piperacillin/tazobactam as R.

12 For _Citrobacter_ spp., _Enterobacter_ spp., _Hafnia_ spp., _Morganella morganii_, _Proteus penneri_, _Proteus vulgaris_, _Providencia_ species, _Serratia_ species, report all penicillins and first, second and third generation cephalosporins and piperacillin/tazobactam as R; report with comment “Resistance to extended-spectrum penicillins, beta-lactam/beta-lactamase inhibitor combinations (e.g. piperacillin-tazobactam), and cephalosporins may develop during therapy. These agents should be avoided and will be reported as resistant regardless of their in vitro susceptibility results. If you have questions, please contact the medical microbiologist on call.”

13 Report if both Gentamicin and Tobramycin are I/R.

14 Report with comment if I/R to All other Antimicrobial Agents OR if only aminoglycoside is S OR if requested

15 Reflex from Cefazolin tested in Vitek2

16 If isolated from Infection Control Screening test, include Isolate Comment “Susceptibility results are provided for infection control purposes only.”

17 Report if I/R to All other Antimicrobial Agents OR if only aminoglycoside is S OR if requested.

18 Report if I/R to All other Antimicrobial Agents including aminoglycoside OR if requested.

19 Report with comment if I/R to All other Antimicrobial Agents including aminoglycoside OR if requested.

20 Report if I/R to all routinely tested antimicrobials including colistin (excluding aminoglycosides)

21 Adults only (>13 y)

22 Report if I/R to All ciprofloxacin, amoxicillin/clavulanic acid and trimethoprim/sulfamethoxazole

23 Report if I/R to all of the following: amoxicillin/ampicillin, amox/clav, cephalaxin, ciprofloxacin, nitrofurantoin and TMP/SMX. Report _E. coli_ with interpretation. Report other _Enterobacteriaceae_ with zone diameter and Isolate Message. For _E. coli_ where fosfomycin is not reported, add Isolate Message “_E. coli_ is generally susceptible to fosfomycin for treatment of acute uncomplicated cystitis.”

24 Report if I/R to All antimicrobial Agents

25 Report with: “Resistance to non-carbapenem beta-lactam antimicrobials may develop in _Aeromonas_ species during therapy. Choosing a non-beta-lactam antimicrobial should be considered for serious infections. Consultation with infectious diseases or medical microbiology is advised.”

**Note:** _Pseudomonas_ species (other than _P. aeruginosa_), fastidious gram-negative bacteria & non-fermenters - DO NOT report susceptibility result. Report with ISOLATE comment “In vitro susceptibility testing for this organism is not routinely performed and/or is unreliable. If advice on antimicrobial therapy is required, please contact the Medical Microbiologist”.

If all antimicrobial agents are resistant, inform the Microbiologist on-call.
Enterics

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th>Shigella species</th>
<th>Salmonella species other than Salmonella typhi</th>
<th>Salmonella typhi</th>
<th>Vibrio cholerae</th>
<th>Aeromonas species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amikacin</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>6</td>
</tr>
<tr>
<td>Amoxicillin/Clavulanic acid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>X(^1,10)</td>
<td>X(^5)</td>
<td>X(^4)</td>
<td>X(^4)</td>
<td>X(^6)</td>
</tr>
<tr>
<td>Ertapenem</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X(^6)</td>
</tr>
<tr>
<td>Gentamicin</td>
<td></td>
<td>X(^6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meropenem</td>
<td></td>
<td>X(^6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piperacillin/Tazobactam</td>
<td></td>
<td>X(^6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trimethoprim/Sulfadiazine</td>
<td>X</td>
<td>X(^2)</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Tetracycline</td>
<td></td>
<td>X(^2)</td>
<td></td>
<td></td>
<td>X(^2), X(^5), X(^8)</td>
</tr>
</tbody>
</table>

1 Adults only (>18 y).
2 Not tested or reported from enteric isolates.
3 Adults only (>13 y)
4 On request, ONLY upon Microbiologist approval
5 Report if intermediate or resistant to all: Amoxicillin/Clavulanic acid, Ceftriaxone, Ciprofloxacin, Trimethoprim/Sulfadiazine, Tetracycline.
6 Report if I/R to all other Antimicrobial Agents
7 Report if I/R to all ciprofloxacin, amoxicillin/clavulanic acid and trimethoprim/sulfamethoxazole
8 Report with “Resistance to non-carbapenem beta-lactam antimicrobials may develop in Aeromonas species during therapy. Choosing a non-beta-lactam antimicrobial should be considered for serious infections. Consultation with infectious diseases or medical microbiology is advised.”
9 Report MIC with comment "This isolate has a ciprofloxacin MIC of \(\text{mg/L}\). There is the risk of ciprofloxacin treatment failures in infections caused by ciprofloxacin-susceptible Shigella with ciprofloxacin MICs between 0.125 and 1 mg/L. Consultation with medical microbiology or infectious diseases is advised.”
10 Report MIC with comment "This isolate has a ciprofloxacin MIC of \(\text{mg/L}\). There is the risk of ciprofloxacin treatment failures in infections caused by ciprofloxacin-susceptible Shigella with ciprofloxacin MICs between 0.125 and 1 mg/L. Consultation with medical microbiology or infectious diseases is advised.”

Note: *E. coli* O157, *Campylobacter spp.*, and *Yersinia spp.* - DO NOT report susceptibility result. Report with ISOLATE comment "In vitro susceptibility testing for this organism is not routinely performed and/or is unreliable. If advice on antimicrobial therapy is required, please contact the Medical Microbiologist”.

If all antimicrobial agents are resistant, inform the Microbiologist on-call.
Respiratory and Miscellaneous Non-Sterile Sites - Gram Positive Susceptibility Reporting – 1 – *Staphylococcus*

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th><em>Staphylococcus</em> species</th>
<th>MRSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefazolin</td>
<td>X²</td>
<td>X² 6</td>
</tr>
<tr>
<td>Ceftobiprole</td>
<td>X⁵</td>
<td>X³ 12</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>X</td>
<td>X⁶</td>
</tr>
<tr>
<td>Cloxacillin</td>
<td>X²</td>
<td>X²  6</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>X³ 10</td>
<td>X³ 5 10</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>X</td>
<td>X⁶</td>
</tr>
<tr>
<td>Fusidic Acid</td>
<td>X³ ²</td>
<td></td>
</tr>
<tr>
<td>Mupirocin</td>
<td>X³ 8</td>
<td></td>
</tr>
<tr>
<td>Rifampin</td>
<td>X³</td>
<td></td>
</tr>
<tr>
<td>Tigecycline</td>
<td>X²</td>
<td>X²</td>
</tr>
<tr>
<td>Trimethoprim/Sulfa</td>
<td>X¹¹</td>
<td>X¹¹</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>X¹⁻⁴</td>
<td>X⁶  4</td>
</tr>
</tbody>
</table>

¹ Report if Oxacillin R
² Base on Oxacillin/Cefoxitin result; for *Staphylococcus pseudointermedius* base on Oxacillin result
³ For Infection Control Screen, include Isolate Comment “Susceptibility results are provided for infection control purposes only.”
⁴ For *S. aureus* or MRSA, vancomycin MIC=2.0 mg/L, result with ISOLATE comment: “This isolate has a vancomycin MIC of 2 mg/L which is associated with an increased risk of treatment failures. Consultation with infectious diseases or medical microbiology is advised.”
⁵ Adults only (>13yrs); base on Tetracycline result. DO NOT report on respiratory specimen.
⁶ DO NOT report if isolated from Infection Control Screen.
⁷ Report only if resistant to Mupirocin as Isolate Comment “Fusidic acid MIC = xx mg/L. There are no standards to interpret this result as susceptible or resistant. Published literatures suggest MICs <2 mg/L may correlate with susceptibility. For help with interpretation, please consult the microbiologist-on-call. (Refs: Int J Antimicrob Agents 1999;22:S45-S58; J Clin Micro 1995;33(7):1712-1715.”
⁸ For Infection Control Screens:
For KB result that is S, report as Isolate Comment “Mupirocin zone size = xx mm. There are no standards to interpret this result as susceptible or resistant. Published literatures suggest MICs <2 mg/L and zones of inhibition ≥19mm may correlate with susceptibility. For help with interpretation, please consult the microbiologist-on-call. (Refs: J Clin Micro 1990;28(3); 608-609; AMMI Canada 2006 abstract P2.27.”
For e-test results that are S, report as Isolate Comment “Mupirocin MIC = xx mg/L. There are no standards to interpret this result as susceptible or resistant. Published literatures suggest MICs <2 mg/L and zones of inhibition ≥19mm may correlate with susceptibility. For help with interpretation, please consult the microbiologist-on-call. (Refs: J Clin Micro 1990;28(3); 608-609; AMMI Canada 2006 abstract P2.27.” Report with interpretation and MIC and Isolate comment as above if e-test is R.
9 Report if I/R to All other antimicrobial agents OR if requested.
10 If I/R, add comment “Doxycycline results are based on testing tetracycline which may overcall doxycycline resistance. If you wish this isolate to be tested with doxycycline directly, please contact the microbiology laboratory.”
11 Base on KB result if Vitek = I/R
12 Do not report if Vitek result = ICR-neg/clindamycin=S/erythromycin=R. Report with comment: "If clindamycin susceptibility testing is required, please contact the microbiology laboratory within 48 hours."
13 Report with comment:
   There are no CLSI standards for this drug. EUCAST suggests MICs ≤2 mg/L correlate with susceptibility. Please consult the microbiologist-on-call with any questions. For research use only.
   There are no CLSI standards for this drug. EUCAST suggests MICs >2 mg/L correlate with resistance. Please consult the microbiologist-on-call with any questions. For research use only.

**Note:** For organisms isolated from **ears and eyes** and susceptibility result is reported, add comment “These susceptibility testing results are based on guidelines for systemic antimicrobial agents and may not accurately represent activity of topical agents.”

If all antimicrobial agents are resistant, inform the Microbiologist on-call.
### Respiratory and Miscellaneous Non-Sterile Sites - Gram Positive Susceptibility Reporting

- **Enterococcus, Streptococcus, Corynebacterium spp., Bacillus spp., viridans**
- **Streptococcus, Listeria spp., Aerococcus species**

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th>Enterococcus¹</th>
<th>S. pneumoniae</th>
<th>Group A, B, C, G Streptococcus</th>
<th>S. anginosus group</th>
<th>Aerococcus species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td></td>
<td>X</td>
<td>Routinely not tested. See below². For special request:</td>
<td>Routinely not tested. See below¹⁰. For special request:</td>
<td>Routinely not tested. See below¹¹.</td>
</tr>
<tr>
<td>Ceftriaxone-meningitis</td>
<td></td>
<td>X⁶</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftriaxone-non-meningitis</td>
<td></td>
<td>X⁶</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clindamycin</td>
<td></td>
<td>X¹³</td>
<td>X⁴-¹²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daptomycin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erythromycin</td>
<td></td>
<td>X¹³-²</td>
<td>X¹-²-¹²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Levofloxacin</td>
<td></td>
<td>X¹⁹-¹¹</td>
<td>X¹-²-¹¹-¹²-¹³</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linezolid</td>
<td></td>
<td>X¹⁵</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moxifloxacin</td>
<td></td>
<td>X¹²-¹¹</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penicillin G</td>
<td></td>
<td>X³</td>
<td></td>
<td></td>
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<tr>
<td>Penicillin-oral</td>
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<td>X¹¹</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penicillin-IV meningitis</td>
<td></td>
<td>X¹¹</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pencillin-IV non-meningitis</td>
<td></td>
<td>X¹¹</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tigecycline</td>
<td></td>
<td>X¹⁹</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vancomycin</td>
<td></td>
<td>X²</td>
<td>X⁶</td>
<td>X¹⁴-¹⁹</td>
<td></td>
</tr>
</tbody>
</table>

¹ If isolated from Infection Control Screening test, include Isolate Comment “Susceptibility results are provided for infection control purposes only.
² DO NOT report on GBS Screen or vaginal swab
³ *E. gallinarum* and *E. casseliflavus*, report as R with the statement “This organism always has intrinsic non-transmissible resistance to vancomycin. The patient does not require isolation.”
⁴ Report as R if D-zone is present
⁵ Report Erythromycin for respiratory specimens only
⁶ Report if Pen I or R
⁷ Report “This organism is intrinsically susceptible to penicillin. If treatment is required and this patient cannot be treated with penicillin, please contact the Microbiology Department within 48 hours to request sensitivity testing.”
⁸ Base on Oxacillin result if S. OR
⁹ if Oxacillin is R, base on Penicillin MIC
9 Base on Levofloxacin result. Report on MSH and UHN patients.
10 DO NOT report on MSH, UHN patients.
11 Adults only (>18 yrs)
12 Report with additional isolate comment “Susceptibility completed as requested” (do not remove original comments).
13 If Vancomycin and Ampicillin are R except for E. gallinarum and E. casseliflavus.
14 If requested (excluding respiratory), base on etest result.
15 If Levofloxacin is R or patient is <18y, consult the Microbiologist.
16 Report only if either Clindamycin or Erythromycin are I or R.
17 Base on Penicillin MIC from TREK.
18 “Streptococcus anginosus group are generally susceptible to penicillin, clindamycin, and levofloxacin. If susceptibility testing for this organism is required, please contact the microbiology laboratory within 48 hours.”
19 Report if I/R to All other antimicrobial agents OR if requested.
20 “Aerococcus species are usually susceptible to beta-lactams and vancomycin. If you would like susceptibility testing to be completed, please contact the Microbiology Laboratory.”

Note: Listeria species – DO NOT report susceptibility result. Report with ISOLATE comment –“Routine in vitro susceptibility testing of this organism is unreliable. Listeria spp. should be considered resistant to all cephalosporins. The recommended regimen for therapy is ampicillin. If additional advice on antimicrobial therapy is required, please contact the Medical Microbiologist.”

Corynebacterium species, Bacillus species, viridans Streptococcus - DO NOT report susceptibility result. Report with ISOLATE comment ”In vitro susceptibility testing for this organism is not routinely performed and/or is unreliable. If advice on antimicrobial therapy is required, please contact the Medical Microbiologist”.

For organisms isolated from ears and eyes and susceptibility result is reported, add comment “These susceptibility testing results are based on guidelines for systemic antimicrobial agents and may not accurately represent activity of topical agents.”

If all antimicrobial agents are resistant, inform the Microbiologist on-call.
### Respiratory and Miscellaneous Non-Sterile Sites - Gram Negative Susceptibility Reporting – 1 – Enterobacteriaceae, *Acinetobacter* species, *Pseudomonas aeruginosa*, *Aeromonas* species

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th>Enterobacteriaceae&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Acinetobacter spp.&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Pseudomonas aeruginosa&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Aeromonas spp.&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amikacin</td>
<td>X&lt;sup&gt;13&lt;/sup&gt;</td>
<td>X&lt;sup&gt;13&lt;/sup&gt;</td>
<td>X&lt;sup&gt;14&lt;/sup&gt;</td>
<td>X&lt;sup&gt;14&lt;/sup&gt;</td>
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<tr>
<td>Ampicillin</td>
<td>X&lt;sup&gt;2, 9, 10&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amoxicillin/Clavulanate</td>
<td>X&lt;sup&gt;11&lt;/sup&gt;</td>
<td></td>
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</tr>
<tr>
<td>Aztreonam</td>
<td>X&lt;sup&gt;18&lt;/sup&gt;</td>
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<td>X&lt;sup&gt;17&lt;/sup&gt;</td>
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<tr>
<td>Cefazolin</td>
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<td>X&lt;sup&gt;17&lt;/sup&gt;</td>
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<td>Cefepime</td>
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<td></td>
<td>X&lt;sup&gt;17&lt;/sup&gt;</td>
<td>X&lt;sup&gt;17&lt;/sup&gt;</td>
</tr>
<tr>
<td>Ceftazidime</td>
<td></td>
<td>X&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
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<tr>
<td>Ceftiraxone</td>
<td>X&lt;sup&gt;4, 9, 10&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftolozane/Tazobactam</td>
<td>X&lt;sup&gt;14&lt;/sup&gt;</td>
<td></td>
<td>X&lt;sup&gt;13&lt;/sup&gt;</td>
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</tr>
<tr>
<td>Chloramphenicol</td>
<td>X&lt;sup&gt;18&lt;/sup&gt;</td>
<td></td>
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<td>Ciprofloxacin</td>
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<td></td>
<td>X&lt;sup&gt;1&lt;/sup&gt;</td>
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<tr>
<td>Colistin</td>
<td>X&lt;sup&gt;14&lt;/sup&gt;</td>
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<td>X&lt;sup&gt;15&lt;/sup&gt;</td>
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<tr>
<td>Doxycycline</td>
<td>X&lt;sup&gt;18&lt;/sup&gt;</td>
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<td></td>
<td></td>
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<tr>
<td>Ertapenem</td>
<td>X&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
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<tr>
<td>Gentamicin</td>
<td>X&lt;sup&gt;11&lt;/sup&gt;</td>
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<tr>
<td>Minocycline</td>
<td>X&lt;sup&gt;18&lt;/sup&gt;</td>
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<td></td>
</tr>
<tr>
<td>Meropenem</td>
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<td>X</td>
<td></td>
<td>X&lt;sup&gt;8&lt;/sup&gt;</td>
</tr>
<tr>
<td>Piperacillin/Tazobactam</td>
<td>X&lt;sup&gt;4, 9, 11&lt;/sup&gt;</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Tetracycline</td>
<td>X&lt;sup&gt;14, 41&lt;/sup&gt;</td>
<td></td>
<td></td>
<td>X&lt;sup&gt;41, 41&lt;/sup&gt;</td>
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<tr>
<td>Ticarcillin/Clavulanate</td>
<td>X&lt;sup&gt;18&lt;/sup&gt;</td>
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<td></td>
<td>X&lt;sup&gt;14&lt;/sup&gt;</td>
</tr>
<tr>
<td>Tigecycline</td>
<td>X&lt;sup&gt;14&lt;/sup&gt;</td>
<td>X&lt;sup&gt;14&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trimethoprim/Sulfa</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Tobramycin</td>
<td>X&lt;sup&gt;11&lt;/sup&gt;</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

1 Adults only (>18 y)
2 Always report *Klebsiella* spp., *Enterobacter* spp., *H. alvei*, *Citrobacter* spp., *Pantoea agglomerans*, *Proteus vulgaris*, *Proteus penneri*, *Providencia* species & *Serratia* species as R.
3 Always report *Enterobacter* spp., *Citrobacter* spp., *Pantoea agglomerans*, *H. alvei*, *Proteus vulgaris*, *Proteus penneri*, *Providencia* species & *Serratia* species as R.
4 Report only if R. For *Enterobacteriaceae* if cefotaxime/ceftriaxone or ceftazidime R, report both as R
5 Report if I/R OR if I/R to 3 of the 4 antimicrobial agents: amikacin, ciprofloxacin, 3rd Generation Cephalosporins, Septra OR if requested
6 Report if Genta is R
7 *Citrobacter* spp., *Enterobacter* spp., *Hafnia* spp., *Morganella morganii*, *Proteus penneri*, *Proteus vulgaris*, *Providencia* species, *Serratia* species, report all penicillins and first, second and third generation cephalosporins and piperacillin/tazobactam as R; report with comment “Resistance to extended-spectrum penicillins, beta-
lactam/beta-lactamase inhibitor combinations (e.g. piperacillin-tazobactam), and cephalosporins may develop during therapy. These agents should be avoided and will be reported as resistant regardless of their in vitro susceptibility results. If you have questions, please contact the medical microbiologist on call.

8. Report only if I or R

9. For *E. coli*, *Klebsiella* species and *Proteus* species that are confirmed to have an ESBL of any class, report all penicillins and first, second and third generation cephalosporins and piperacillin/tazobactam as R.

10. For *Enterobacteriaceae* other than *E. coli*, *Klebsiella* species and *Proteus* species where ESBL testing is not done, if any one of cefotaxime/ceftriaxone or ceftazidime=I/R, report all penicillins and first, second and third generation cephalosporins and piperacillin/tazobactam as R.

11. Do not report for *Salmonella* species.

12. Report if I/R OR if I/R to 3 of the 4 antimicrobial agents: amikacin, ciprofloxacin, 3rd Generation Cephalosporins, Piperacillin/tazobactam OR if requested.

13. Report if both Gentamicin and Tobramycin are I/R.

14. Report with comment if I/R to All other Antimicrobial Agents OR if only aminoglycoside is S OR if requested.

15. Report if I/R to All other Antimicrobial Agents OR if only aminoglycoside is S OR if requested.

16. If isolated from Infection Control Screening test, include Isolate Comment “Susceptibility results are provided for infection control purposes only.”

17. Report if I/R to all routinely tested antimicrobials including colistin (excluding aminoglycosides)

18. Report if I/R to All other Antimicrobial Agents including aminoglycoside OR if requested.

19. Report with comment if I/R to All other Antimicrobial Agents including aminoglycoside OR if requested.

20. Adults only (>13 y)

21. Report if I/R to All ciprofloxacin, amoxicillin/clavulanic acid and trimethoprim/sulfamethoxazole

22. Report if I/R to All other Antimicrobial Agents

23. Report with “Resistance to non-carbapenem beta-lactam antimicrobials may develop in *Aeromonas* species during therapy. Choosing a non-beta-lactam antimicrobial should be considered for serious infections. Consultation with infectious diseases or medical microbiology is advised.”

**Note: Pseudomonas species (other than P. aeruginosa), fastidious Gram-negative bacteria & non–fermenters** - DO NOT report susceptibility result. Report with ISOLATE comment "In vitro susceptibility testing for this organism is not routinely performed and/or is unreliable. If advice on antimicrobial therapy is required, please contact the Medical Microbiologist".

For organisms isolated from ears and eyes and susceptibility result is reported, add comment “These susceptibility testing results are based on guidelines for systemic antimicrobial agents and may not accurately represent activity of topical agents.”

If all antimicrobial agents are resistant, inform the Microbiologist on-call.
## Respiratory and Miscellaneous Non-Sterile Sites - Gram Negative Susceptibility Reporting – 2 – *Haemophilus* species, *M. catarrhalis*, *S. maltophilia*, *B. cepacia*, *Pseudomonas* species (other than *P. aeruginosa*), fastidious gram-negative bacteria, non-fermenters, *Neisseria meningitides*, *H. pylori*.

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th><em>Haemophilus</em> species</th>
<th><em>S. maltophilia</em></th>
<th><em>Burkholderia cepacia</em></th>
<th><em>H. pylori</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin</td>
<td>X^2</td>
<td></td>
<td></td>
<td>X, *</td>
</tr>
<tr>
<td>Beta-lactamase</td>
<td>X^4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftazidime</td>
<td>X^2</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td></td>
<td></td>
<td>X^10</td>
<td></td>
</tr>
<tr>
<td>Clarithromycin</td>
<td></td>
<td></td>
<td>X^2</td>
<td></td>
</tr>
<tr>
<td>Colistin</td>
<td>X^2</td>
<td>X^2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>X^1,^2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meropenem</td>
<td></td>
<td></td>
<td>X^10</td>
<td></td>
</tr>
<tr>
<td>Metronidazole</td>
<td></td>
<td></td>
<td>X^11</td>
<td></td>
</tr>
<tr>
<td>Rifampin</td>
<td></td>
<td></td>
<td>X^10</td>
<td></td>
</tr>
<tr>
<td>Tetracycline</td>
<td></td>
<td></td>
<td>X^10</td>
<td></td>
</tr>
<tr>
<td>Ticarcillin/Clavulanate</td>
<td>X^2</td>
<td>X^2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tigecycline</td>
<td>X^2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trimethoprim/Sulfa</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Adults only (>18 y)
2 If beta-lactamase is negative, report with comment “This isolate is beta-lactamase negative. Beta-lactamase negative isolates are generally susceptible to amoxicillin. Susceptibility testing can be completed if requested.” If beta-lactamase is positive, report with comment “This isolate is beta-lactamase positive. Beta-lactamase positive isolates are resistant to ampicillin but generally susceptible to amoxicillin-clavulanic acid. Susceptibility testing can be completed if requested.”

3 Report with comment if I/R to all other drugs; report without interpretation;
4 Report with comment “NOTE: There are no standardized interpretive breakpoints for *Stenotrophomonas maltophilia* and moxifloxacin but in general, levofloxacin and moxifloxacin minimum inhibitory concentrations (MICs) correlate well with each other. Ref: J Chemother. 2008 Feb;20(1):38-42.”

5 Report with comment if I/R to all other drugs based on PHL MIC result
6 Report with comment if I/R to all other drugs
7 MSH etest result:
   Report with isolate comment “Amoxicillin MIC = ____ mg/L. There are no CLSI standards for amoxicillin and *H. pylori*. EUCAST ECOFF states that amoxicillin MIC <=0.125mg/L correlate with wild-type *H. pylori* isolates.

   \*   \*   \*

   NOTE: Amoxicillin and clarithromycin susceptibility testing performed in-house using Etest strips (bioMerieux) following the manufacturer’s instructions. Verification of this method has been completed but with only a
limited number of isolates and few resistant strains. Please take this into consideration when interpreting these results. Full susceptibility testing results using gold standard methods at the Mayo Clinic to follow.”

8 Mayo Clinic MIC result:
Suppress MSH amoxicillin & clarithromycin etest results and remove previous comment.
Report Mayo clinic MIC for antimicrobial agent within isolate comment:

```
“Amoxicillin MIC ____mg/L
Metronidazole MIC ____mg/L
Ciprofloxacin MIC ____mg/L
Clarithromycin MIC ____mg/L
Tetracycline MIC ____mg/L
```

as reported by the Mayo Clinic Mayo Medical Laboratories
Rochester Main Campus, 200 First Street SW, Rochester, MN
55905. Mayo Clinic Specimen No______.

There are no CLSI standards for the following drugs. EUCAST ECOFF states the following MICs correlate with wild-type organisms:

- Amoxicillin MIC <= 0.125 mg/L
- Metronidazole MIC <= 8 mg/L
- Levofloxacin MIC <= 1 mg/L*
- Tetracycline MIC <= 1 mg/L

*There is not a wild-type ECOFF for ciprofloxacin.”

9 Report from MSH etest result. Replace with Mayo Clinic MIC when available. Add MIC to isolate comment added from amoxicillin.

10 Report from Mayo Clinic MIC ONLY. Add MIC to comment added from amoxicillin.

11 Do NOT Report. For verification purposes only.

Note: **Pseudomonas species (other than P. aeruginosa), fastidious gram-negative bacteria, non-fermenters and N. meningitidis** - DO NOT report susceptibility result. Report with ISOLATE comment: “In vitro susceptibility testing for this organism is not routinely performed and/or is unreliable. If advice on antimicrobial therapy is required, please contact the Medical Microbiologist”.

For **M. catarrhalis** - DO NOT report susceptibility result. Report with ISOLATE comment: “The majority of Moraxella catarrhalis are resistant to ampicillin. In vitro susceptibility testing for this organism is not routinely performed and/or is unreliable. If advice on antimicrobial therapy is required, please contact the Medical Microbiologist”.

For organisms isolated from **ears and eyes** and susceptibility result is reported, add comment “These susceptibility testing results are based on guidelines for systemic antimicrobial agents and may not accurately represent activity of topical agents.”

If all antimicrobial agents are resistant, inform the Microbiologist on-call.
Spinal Fluids – Gram Positive Susceptibility Reporting

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th>Staphylococcus species</th>
<th>Enterococcus species</th>
<th>Strep. pneumoniae</th>
<th>viridans Strep. S. bovis</th>
<th>Strep. anginosus group</th>
<th>Group A,B,C,G Streptococcus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftobiprole</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftriaxone-meningitis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cloxacillin</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daptomycin</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HLGR</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HLSR</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linezolid</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penicillin IV-meningitis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tigecycline</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trimethoprim/Sulfa</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vancomycin</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Report if Oxacillin R
2 Report only if requested.
3 HLGR = High Level Gentamicin Resistant; HLSR = High Level Streptomycin Resistant. Report based on HLGR using canned message (See Blood and Sterile Fluids HLGR Results Reporting).
4 Report only if Pen is I/R
5 Report based on Ampicillin result
6 E. gallinarum and E. casseliflavus report as R with the statement: “This organism always has intrinsic non-transmissible resistance to vancomycin. The patient does not require isolation.”
7 Report if Vancomycin and Ampicillin are R except E. gallinarum and E. casseliflavus.
8 For S. aureus or MRSA, vancomycin MIC=2.0 mcg/L, result with ISOLATE comment: “This isolate has a vancomycin MIC of 2 mg/L which is associated with an increased risk of treatment failures. Consultation with infectious diseases or medical microbiology is advised.”
9 Report if I/R to All other antimicrobial agents OR if requested.
10 Report if requested, base on etest result
11 Base on KB result if Vitek = I/R
12 Base on Oxacillin/cefotaxin result; for Staphylococcus pseudointermedius base on Oxacillin result
13 Base on KB result if Vitek = I/R
14 For MRSA only; report with comment: There are no CLSI standards for this drug. EUCAST suggests MICs <=2 mg/L correlate with susceptibility. Please consult the microbiologist-on-call with any questions. For research use only.
15 For MRSA only; report with comment: There are no CLSI standards for this drug. EUCAST suggests MICs >2 mg/L correlate with resistance. Please consult the microbiologist-on-call with any questions. For research use only.

Note: Listeria species – DO NOT report susceptibility result. Report with ISOLATE comment –“Routine in vitro susceptibility testing of this organism is unreliable. Listeria spp. should be considered resistant to all cephalosporins. The recommended regimen for therapy is ampicillin. If additional advice on antimicrobial therapy is required, please contact the Medical Microbiologist.”
**Corynebacterium species, Bacillus species** - DO NOT report susceptibility result. Report with ISOLATE comment "In vitro susceptibility testing for this organism is not routinely performed and/or is unreliable. If advice on antimicrobial therapy is required, please contact the Medical Microbiologist".

If all antimicrobial agents are resistant, inform the Microbiologist on-call.
### Spinal Fluids – Gram Negative Susceptibility Reporting – 1 – Enterobacteriaceae and *Acinetobacter* spp., *Salmonella* species including *S. typhi*, *Shigella* species

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th>Enterobacteriaceae</th>
<th>Acinetobacter species</th>
<th><em>Salmonella</em> species including <em>S. typhi</em></th>
<th><em>Shigella</em> species</th>
<th><em>Aeromonas</em> species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amikacin</td>
<td>X³</td>
<td>X³</td>
<td>X³</td>
<td>X⁸</td>
<td>X³</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>X³,  X⁴,  X⁵</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftazidine</td>
<td></td>
<td>X²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftolozane/Tazobactam</td>
<td></td>
<td>X¹³</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>X³,  X⁴,  X⁵</td>
<td>X</td>
<td>X</td>
<td>X⁸</td>
<td>X</td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X¹⁰</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X¹</td>
</tr>
<tr>
<td>Colistin</td>
<td>X¹³</td>
<td>X¹²</td>
<td>X¹¹</td>
<td>X¹¹</td>
<td>X¹¹</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>X⁹</td>
<td>X⁹</td>
<td>X¹¹</td>
<td></td>
<td>X²</td>
</tr>
<tr>
<td>Meropenem</td>
<td></td>
<td>X⁴</td>
<td>X</td>
<td></td>
<td>X¹⁴,  X¹⁵</td>
</tr>
<tr>
<td>Tetracycline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trimethoprim/Sulfa</td>
<td>X⁹</td>
<td>X⁹</td>
<td>X⁹</td>
<td>X⁹</td>
<td>X⁹</td>
</tr>
<tr>
<td>Tobramycin</td>
<td>X⁹</td>
<td>X⁹</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Adults only (>18 y)
2. Report only if R.
3. Report if I/R OR if I/R to 3 of the 4 antimicrobial agents: amikacin, ciprofloxacin, 3rd Generation Cephalosporins, Septra OR if requested.
4. Always report *Klebsiella* spp., *Enterobacter* spp., *H. alvei*, *Citrobacter* spp., *Pantoea agglomerans*, *Proteus vulgaris*, *Proteus penneri*, *Providencia* species & *Serratia* species as R.
5. For *E. coli*, *Klebsiella* species and *Proteus* species that are confirmed to have an ESBL of any class, report all penicillins and third generation cephalosporins and piperacillin/tazobactam as R.
6. For *Enterobacteriaceae* other than *E. coli*, *Klebsiella* species and *Proteus* species where ESBL testing is not done, if any one of cefotaxime/ceftriaxone or ceftazidime=R, report all penicillins and third generation cephalosporins as R.
7. For *Citrobacter* spp., *Enterobacter* spp., *Hafnia* spp., *Morganella morganii*, *Proteus penneri*, *Proteus vulgaris*, *Providencia* species, *Serratia* species, report all penicillins and first, second and third generation cephalosporins and piperacillin/tazobactam as R; report with comment “Resistance to extended-spectrum penicillins, beta-lactam/beta-lactamase inhibitor combinations (e.g. piperacillin-tazobactam), and cephalosporins may develop during therapy. These agents should be avoided and will be reported as resistant regardless of their in vitro susceptibility results. If you have questions, please contact the medical microbiologist on call.”
8. Report if both Gentamicin and Tobramycin are I/R.
9. Report if I/R to Ceftriaxone
10. Report only if I or R
11. Report with comment if I/R to All other antimicrobial agents OR if only aminoglycoside is S OR if requested.
12. Adults only (>13 y)
13. Report if I/R to All ciprofloxacin, amoxicillin/clavulanic acid and trimethoprim/sulfamethoxazole
14. Report if I/R to All other Antimicrobial Agents
15. Report with “Resistance to non-carbapenem beta-lactam antimicrobials may develop in *Aeromonas* species during therapy. Choosing a non-beta-lactam antimicrobial should be considered for serious infections. Consultation with infectious diseases or medical microbiology is advised.”
Note: If all antimicrobial agents are resistant, inform the Microbiologist on-call

Spinal Fluids – Gram Negative Susceptibility Reporting – 2 – *Pseudomonas aeruginosa*, *Pseudomonas* spp. (other than *P. aeruginosa*), fastidious Gram-negative bacteria, non-fermenters, *M. catarrhalis*, *N. meningitidis*, *Stenotrophomonas maltophilia*, *Burkholderia cepacia*, *Haemophilus species*.

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th><em>P. aeruginosa</em></th>
<th><em>S. maltophilia</em></th>
<th><em>B. cepacia</em></th>
<th><em>Haemophilus species</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Amikacin</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefepime</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftazidime</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftolozane/Tazobactam</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colistin</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Gentamicin</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meropenem</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ticarcillin/Clavulanate</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Trimethoprim/Sulfa</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Tobramycin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Base on beta-lactamase result and KB Ampicillin
2 Report if I/R OR if I/R to 3 of the 4 antimicrobial agents: amikacin, ciprofloxacin, 3rd Generation Cephalosporins, Piperacillin/tazobactam OR if requested
3 Report if both Gentamicin and Tobramycin are R.
4 Report with comment if I/R to all other drugs
5 Report if I/R to All other antimicrobial agents OR if only aminoglycoside is S.
6 Report with comment if I/R to all other drugs base on PHL MIC result
7 Report if I/R to all routinely tested antimicrobials including colistin (excluding aminoglycosides)
8 Report if I/R to Ceftriaxone

Note: For *Pseudomonas species* (other than *P. aeruginosa*), fastidious Gram-negative bacteria, non-fermenters and *N. meningitidis* - DO NOT report susceptibility result. Report with ISOLATE comment "In vitro susceptibility testing for this organism is not routinely performed and/or is unreliable. If advice on antimicrobial therapy is required, please contact the Medical Microbiologist".

For *M. catarrhalis* - DO NOT report susceptibility result. Report with ISOLATE comment: "The majority of Moraxella catarrhalis are resistant to ampicillin. In vitro susceptibility testing for this organism is not routinely performed and/or is unreliable. If advice on antimicrobial therapy is required, please contact the Medical Microbiologist".

If all antimicrobial agents are resistant, inform the Microbiologist on-call.
Blood and other Sterile Sites - Gram Positive Susceptibility Reporting – 1 – *Staphylococcus aureus*, *Staphylococcus lugdunensis*, *Enterococcus*, Other CNST from sterile sites

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th><em>Staphylococcus aureus</em>, <em>Staphylococcus lugdunensis</em>, Other CNST (from sterile sites and bloods if requested)</th>
<th><em>Enterococcus species</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td></td>
<td>X⁰</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>X²</td>
<td></td>
</tr>
<tr>
<td>Ceftobiprole</td>
<td>X¹⁵</td>
<td></td>
</tr>
<tr>
<td>Cloxacillin</td>
<td>X⁴</td>
<td></td>
</tr>
<tr>
<td>Daptomycin</td>
<td>X¹⁰</td>
<td>X⁷</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>X¹³,¹⁴</td>
<td></td>
</tr>
<tr>
<td>HLGR²</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>HLSR²</td>
<td></td>
<td>X⁴</td>
</tr>
<tr>
<td>Linezolid</td>
<td>X¹⁰</td>
<td>X⁷</td>
</tr>
<tr>
<td>Moxifloxacin</td>
<td>X¹³</td>
<td></td>
</tr>
<tr>
<td>Piperacillin/Tazobactam</td>
<td></td>
<td>X⁴</td>
</tr>
<tr>
<td>Rifampin</td>
<td>X¹²</td>
<td></td>
</tr>
<tr>
<td>Tigecycline</td>
<td>X¹⁰</td>
<td>X¹⁰</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>X⁸,⁵</td>
<td>X⁶</td>
</tr>
</tbody>
</table>

² Base on Oxacillin/cefoxitin result; for *Staphylococcus pseudointermedius* base on Oxacillin result
³ HLGR = High Level Gentamicin Resistant; HLSR = High Level Streptomycin Resistant
Report based on HLGR using canned message (See Blood and Sterile Sites HLGR Results Reporting).
⁴ Report only if requested.
⁵ For *S. aureus* or MRSA, vancomycin MIC=2.0 mg/L, result with ISOLATE comment: “This isolate has a vancomycin MIC of 2 mg/L which is associated with an increased risk of treatment failures. Consultation with infectious diseases or medical microbiology is advised.”
⁶ *E. gallinarum* and *E. casseliflavus* report as R with the statement “This organism always has intrinsic non-transmissible resistance to vancomycin. The patient does not require isolation.”
⁷ Report if Vancomycin and Ampicillin are R OR if the isolate is *E. gallinarum* or *E. casseliflavus*.
⁸ Only if Oxacillin=R.
⁹ Report as R if beta-lactamase is positive.
¹⁰ Report if I/R to all other antimicrobial agents OR if requested.
¹¹ Report if requested with comments: “This organism is susceptible to rifampin. Rifampin should NOT be used as monotherapy given the risk of resistance. If rifampin combination therapy is being considered, consultation with infectious diseases or medical microbiology is advised.” “This organism is intermediate to rifampin.” OR “This organism is resistant to rifampin.”
¹² Report on Bone or Joint and sterile site specimens. DO NOT report on blood culture.
¹³ If doxycycline is I/R, include comment “Doxycycline results are based on testing tetracycline which may overcall doxycycline resistance. If you wish this isolate to be tested with doxycycline directly, please contact the microbiology laboratory.” Do not report on blood.
15 For MRSA only; report with comment:
   There are no CLSI standards for this drug. EUCAST suggests MICs \( \leq 2 \) mg/L correlate with susceptibility. Please consult the microbiologist-on-call with any questions. For research use only.
   There are no CLSI standards for this drug. EUCAST suggests MICs > 2 mg/L correlate with resistance. Please consult the microbiologist-on-call with any questions. For research use only.

Note: If all antimicrobial agents are resistant, inform the Microbiologist on-call.

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th><em>S. pneumoniae</em></th>
<th><em>viridans Strep. Strep. bovis group</em></th>
<th><em>S. anginosus</em> group</th>
<th>Group A, B, C, G <em>Streptococcus</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceftriaxone</td>
<td></td>
<td>X²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftriaxone-meningitis</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftriaxone-non-meningitis</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clindamycin⁶</td>
<td></td>
<td></td>
<td>X³</td>
<td></td>
</tr>
<tr>
<td>Erythromycin</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Levofloxacine</td>
<td>X¹, X³</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moxifloxacine</td>
<td>X¹, X³</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penicillin-IV meningitis</td>
<td></td>
<td>X</td>
<td>X⁴</td>
<td>X⁴</td>
</tr>
<tr>
<td>Penicillin-IV non-meningitis</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penicillin-oral</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vancomycin</td>
<td>X¹</td>
<td>X³</td>
<td>X⁵</td>
<td>X⁵</td>
</tr>
</tbody>
</table>

¹ Adults only (>18 y)
² Report as R if D-zone is present.
³ For viridans *Streptococcus*, *S. bovis* and *S. anginosus*, report MIC value as Isolate Comment only when from a Blood Culture or heart tissue specimen (e.g. Heart valve, vegetation, pericardial fluid).
⁴ Report only if Pen I or R
⁵ Report with isolate comment "If clindamycin susceptibility testing is required, please contact the microbiology laboratory within 48 hours."
⁶ Report on MSH and UHN patients only.
⁷ DO NOT report on MSH and UHN patients.
⁸ DO NOT report on MSH and UHN patients.

Note: *Listeria species* – DO NOT report susceptibility result. Report with ISOLATE comment — “Routine in vitro susceptibility testing of this organism is unreliable. *Listeria* spp. should be considered resistant to all cephalosporins. The recommended regimen for therapy is ampicillin. If additional advice on antimicrobial therapy is required, please contact the Medical Microbiologist.”

*Corynebacterium species, Bacillus species.* - DO NOT report susceptibility result. Report with ISOLATE comment "In vitro susceptibility testing for this organism is not routinely performed and/or is unreliable. If advice on antimicrobial therapy is required, please contact the Medical Microbiologist". If all antimicrobial agents are resistant, inform the Microbiologist on-call.
### Blood and other Sterile Sites - Gram Negative Susceptibility Reporting -1 - Enterobacteriaceae and Acinetobacter spp., Salmonella species including S. typhi, Shigella species

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th>Enterobacteriaceae</th>
<th>Acinetobacter spp.</th>
<th>Salmonella spp. including S. typhi</th>
<th>Shigella species</th>
<th>Aeromonas species[^1]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td>X[^3], I[^4], I[^1]</td>
<td></td>
<td>X</td>
<td>X[^1]</td>
<td></td>
</tr>
<tr>
<td>Amoxicillin/Clavulanate</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aztreonam</td>
<td></td>
<td>X[^2]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefazolin</td>
<td>X[^2], I[^4], I[^1], I[^6]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefepime</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftazidime</td>
<td></td>
<td></td>
<td>X[^2], I[^3], I[^1]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftolozane/Tazobactam</td>
<td></td>
<td>X[^2]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>X[^4], I[^1], I[^2]</td>
<td></td>
<td>X[^1]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td>X[^2]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colistin</td>
<td>X[^2]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doxycycline</td>
<td>X[^2]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ertapenem</td>
<td>X[^4]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gentamicin</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meropenem</td>
<td>X[^2]</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minocycline</td>
<td>X[^2]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piperacillin/Tazobactam</td>
<td></td>
<td>X[^4], I[^1], I[^2]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tetracycline</td>
<td>X[^2], I[^4]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ticarcillin/Clavulanate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tigecycline</td>
<td>X[^2]</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trimethoprim/Sulfa</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Tobramycin</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


[^3] Adults only (>13 y)

[^4] Adults only (>18 y)

[^5] Report only if I or R

[^6] Report if I/R to All ciprofloxacin, amoxicillin/clavulanic acid and trimethoprim/sulphamethoxazole

[^7] Report if I/R OR if I/R to 3 of the 4 antimicrobial agents: amikacin, ciprofloxacin, 3rd Generation Cephalosporins, Septra OR if requested

[^8] Always report for PMH

[^9] Report with comment if I/R to All other Antimicrobial Agents OR if only aminoglycoside is S.
10. For *E. coli*, *Klebsiella* species and *Proteus* species that are confirmed to have an ESBL of any class, report all penicillins and first, second and third generation cephalosporins and piperacillin/tazobactam as R.

11. For *Acinetobacter* sp. and *Enterobacteriaceae* other than *E. coli*, *Klebsiella* species and *Proteus* species where ESBL testing is not done, if any one of cefotaxime/ceftriaxone or ceftazidime=R, report all penicillins and first, second and third generation cephalosporins as R.

12. For *Citrobacter* spp., *Enterobacter* spp., *Hafnia* spp., *Morganella morganii*, *Proteus vulgaris*, *Providencia* species, *Serratia* species report all penicillins and first, second and third generation cephalosporins and piperacillin/tazobactam as R; report with comment “Resistance to extended-spectrum penicillins, beta-lactam/beta-lactamase inhibitor combinations (e.g. piperacillin-tazobactam), and cephalosporins may develop during therapy. These agents should be avoided and will be reported as resistant regardless of their in vitro susceptibility results. If you have questions, please contact the medical microbiologist on call.”

13. Report if I/R to All other Antimicrobial Agents

14. Report if both Gentamicin and Tobramycin are I/R.

15. Report if I/R to All other antimicrobial agents OR if only aminoglycoside is S OR if requested.

16. Report from KB result ONLY. Do NOT report for *Proteus mirabilis*.

17. Report with “Resistance to non-carbapenem beta-lactam antimicrobials may develop in Aeromonas species during therapy. Choosing a non-beta-lactam antimicrobial should be considered for serious infections. Consultation with infectious diseases or medical microbiology is advised.”
### Blood and other Sterile Sites - Gram Negative Susceptibility Reporting - 2 - *Pseudomonas aeruginosa, Pseudomonas* spp. (other than *P. aeruginosa*), fastidious gram-negative bacteria, non-fermenters, *M. catarrhalis, N. meningitidis, Stenotrophomonas maltophilia, Burkholderia cepacia, Haemophilus* species.

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th><em>P. aeruginosa</em></th>
<th><em>S. maltophilia</em></th>
<th><em>B. cepacia</em></th>
<th><em>Haemophilus</em> species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amikacin</td>
<td>X²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td></td>
<td></td>
<td>X¹</td>
<td></td>
</tr>
<tr>
<td>Aztreonam</td>
<td>X²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefazolin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefepime</td>
<td>X²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftazidime</td>
<td>X</td>
<td>X²</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Ceftolozane/Tazobactam</td>
<td>X²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>X²</td>
<td>X²</td>
<td>X²</td>
<td></td>
</tr>
<tr>
<td>Colistin</td>
<td>X²</td>
<td>X²</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Gentamicin</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Levofloxacin</td>
<td></td>
<td></td>
<td>X²-³</td>
<td></td>
</tr>
<tr>
<td>Meropenem</td>
<td>X²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piperacillin/Tazobactam</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ticarcillin/Clavulanate</td>
<td>X²</td>
<td>X³</td>
<td>X²</td>
<td></td>
</tr>
<tr>
<td>Tigecycline</td>
<td>X²</td>
<td>X⁶</td>
<td>X⁶</td>
<td></td>
</tr>
<tr>
<td>Trimethoprim/Sulfa</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tobramycin</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Based on beta-lactamase result
2. Adults only (>18 y)
3. Report with comment if I/R to all other drugs base on PHL MIC result
4. Report if I/R OR if I/R to 3 of the 4 antimicrobial agents: amikacin, ciprofloxacin, 3rd Generation Cephalosporins, Piperacillin/tazobactam OR if requested
5. Report if both Gentamicin and Tobramycin are R.
6. Report with comment if I/R to all other drugs;
7. Report if I/R to All other antimicrobial agents OR if only aminoglycoside is S
8. Report with comment “NOTE: There are no standardized interpretive breakpoints for *Stenotrophomonas maltophilia* and moxifloxacin but in general, levofloxacin and moxifloxacin minimum inhibitory concentrations (MICs) correlate well with each other. Ref: J Chemother. 2008 Feb;20(1):38-42.”
9. Report if I/R to all routinely tested antimicrobials including colistin (excluding aminoglycosides)

**Note:** *Pseudomonas* species (other than *P. aeruginosa*), fastidious Gram-negative bacteria, non–fermenters report susceptibilities as per PHOL.

For *N. meningitidis* - DO NOT report susceptibility result. Report with ISOLATE comment "In vitro susceptibility testing for this organism is not routinely performed and/or is unreliable. If advice on antimicrobial therapy is required, please contact the Medical Microbiologist”.

For *M. catarrhalis* - DO NOT report susceptibility result. Report with ISOLATE comment: "The majority of *Moraxella catarrhalis* are resistant to ampicillin. In vitro susceptibility testing for this organism is not routinely performed and/or is unreliable. If advice on antimicrobial therapy is required, please contact the Medical Microbiologist”.

If all antimicrobial agents are resistant, inform the Microbiologist on-call.

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UNIVERSITY HEALTH NETWORK/MOUNT SINAI HOSPITAL, DEPARTMENT OF MICROBIOLOGY

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Antimicrobial Related LIS Canned Messages

I. Introduction

Antimicrobial related canned messages are built into the Laboratory Information System to provide uniform reporting phrases to be used when certain pre-described conditions are met.

II. Procedure

A. Automatic Canned Messages:

The lists below are automatic canned messages that will appear when set conditions are met. The message will appear in a warning box when entering or before exiting an order.

1. When the message code appears, press F12 to save.
2. Continue with another F12 to save the order.
3. View the report.
4. If the same message has been saved previously (i.e. appeared more than once), go to the Isolate Comment window and delete the duplicate comment using CTRL L.
5. Re-status as required.
6. Press F12 to save the order.

LIS messages are sort below by type:

<table>
<thead>
<tr>
<th>General</th>
<th>GPC</th>
<th>GPB</th>
<th>GNB</th>
</tr>
</thead>
</table>

General:

**Ear and Eye specimens with susceptibility results**
LIS Isolate Canned Message Code: &eye; attached to Organism classes A and B with procedures EYE and COR and with source EAR and drugs am, betalac, cc, peng, sxt.
“These susceptibility testing results are based on guidelines for systemic antimicrobial agents and may not accurately represent activity of topical agents.

For **MSH MRO’s**
LIS Isolate Canned Message Code: \MRES, attached to drug – tax “MULTIPLE ANTIBIOTIC RESISTANT ORGANISM. THIS PATIENT MUST BE ON "CONTACT PRECAUTIONS" UNTIL FURTHER NOTICE FROM INFECTION CONTROL.”

For isolates that **susceptibility testing is not routinely performed and/or is unreliable**:
LIS Isolate Canned Message Code: \NSEN; attached to organisms and Isolate Comment keypad. "In vitro susceptibility testing for this organism is not routinely performed and/or is unreliable. If advice on antimicrobial therapy is required, please contact the Medical Microbiologist".

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GPC:

For **MSH MRSA’s**

LIS Isolate Canned Message Code: \MRSI, attached to organism stamr “**THIS PATIENT MUST BE ON "MRSA PRECAUTIONS" UNTIL FURTHER NOTICE.**”

**MRSA isolated from MRSA Screen Susceptibility Result Comment**

LIS Isolate Canned Message Code: \MRSS; linked to organism stamr, Dox=R

“Susceptibility results are provided for infection control purposes only.”

- **MRSA DENKA/induced DENKA=negative, Oxacillin Screen=positive, Oxacillin =>4mcg/L,** isolate is a **BORSA:** report as **S. aureus** with LIS Isolate Canned Message Code: \BORS “**This organism is a borderline-oxacillin resistant Staphylococcus aureus (BORSA) which is resistant to cloxacillin and cefazolin by a mechanism different from that in typical MRSA. Consultation with a Microbiologist or Infectious Disease physician is advised.**”

**For S. aureus vancomycin MIC=2.0 mg/L**, result with ISOLATE comment: Vva=2.0 ~va2

“This isolate has a vancomycin MIC of 2 mg/L which is associated with an increased risk of treatment failures. Consultation with infectious diseases or medical microbiology is advised.”

LIS Isolate Canned Message Code: \MUPz; for KB zone size ≥19mm, linked to drug code – mup

“Mupirocin zone size = xx mm

There are no standards to interpret this result as susceptible or resistant. Published literatures suggest MICs <2 mg/L and zones of inhibition ≥19mm may correlate with susceptibility. For help with interpretation, please consult the microbiologist-on-call. (Refs: J Clin Micro 1990;28(3); 608-609; AMMI Canada 2006 abstract P2.27).”

LIS Isolate Canned Message Code: \MUP; for MIC result, linked to drug code – mup

“Mupirocin MIC = xx mg/L

There are no standards to interpret this result as susceptible or resistant. Published literatures suggest MICs <2 mg/L and zones of inhibition ≥19mm may correlate with susceptibility. For help with interpretation, please consult the microbiologist-on-call. (Refs: J Clin Micro 1990;28(3); 608-609; AMMI Canada 2006 abstract P2.27).”

LIS Isolate Canned Message Code: \FD; linked to drug code – fa

“Fusidic acid MIC = xx mg/L.

There are no standards to interpret this result as susceptible or resistant. Published literatures suggest MICs <2mg/L may correlate with susceptibility. For help with interpretation, please consult the microbiologist-on-call. (Refs: Int J Antimicrob Agents 1999;22:S45-S58; J Clin Micro 1995;33(7):1712-1715.”
LIS Isolate Canned Message Code: \icr-;
For MRSA isolated from non-sterile sites: ICR-neg/clindamycin=S/erythromycin=R.
Report with comment: "If clindamycin susceptibility testing is required, please contact the microbiology laboratory within 48 hours."

For *S. aureus* reporting Tigercycline – messages link to Organism classes D, code \TIGD
"Tigecycline MIC is xx mg/L.
There are no CLSI standards for this drug. EUCAST suggests MICs <=0.5 mg/L correlate with susceptibility. Result for tigecycline is based on Etest gradient strips (bioMérieux) which have been validated with well-characterized laboratory (ATCC) strains. Verification on clinical isolates against a gold standard method has been limited. Please take this into consideration when interpreting these results. Please consult the microbiologist-on-call with any questions."

Coagulase-negative staphylococci, not *S. lugdunensis* from Blood Cultures:
LIS Isolate Canned Message Code: \cnst; linked to organism code – staneg
“Coagulase-negative staphylococci may be blood culture contaminants; clinical correlation is needed to determine the significance of this result. The vast majority of coagulase-negative staphylococci are susceptible to vancomycin; susceptibility testing will only be completed if requested.”

*S. lugdunensis* from Blood Cultures:
LIS Isolate Canned Message Code: \slug; linked to organism code – stalug
“*S. lugdunensis* is a virulent coagulase-negative staphylococcus that is associated with abscesses, native valve endocarditis, and other serious infections. Consultation with infectious diseases is recommended.”

*Staphylococcus saprophyticus* and CNST from urine
LIS Isolate Canned Message Code: \ssap; attached to organism code stasap.
"Susceptibility testing of this organism is not routinely done because infections respond to concentrations achieved in urine of antimicrobial agents commonly used to treat acute, uncomplicated urinary tract infections e.g. nitrofurantoin, trimethoprim/sulfa or fluoroquinolones. Suggest repeat specimen with request for susceptibility testing if patient does not respond to empiric therapy."

*Staphylococcus aureus* or MRSA where doxycycline is reported as R
LIS Isolate Canned Message Code: \doxyR; attached to organism code staaurr and staamrr
“Doxycycline results are based on testing tetracycline which may overcall doxycycline resistance. If you wish this isolate to be tested with doxycycline directly, please contact the microbiology laboratory.”
For MRSA if Ceftobiprole is requested:
MIC \( \leq 2 \text{ mg/L} \) – code /BPRS
There are no CLSI standards for this drug. EUCAST suggests MICs \( \leq 2 \text{ mg/L} \) correlate with susceptibility. Please consult the microbiologist-on-call with any questions. For research use only.

MIC \( > 2 \text{ mg/L} \) – code /BPRR
There are no CLSI standards for this drug. EUCAST suggests MICs \( > 2 \text{ mg/L} \) correlate with resistance. Please consult the microbiologist-on-call with any questions. For research use only.

\section*{β-haemolytic Streptococcus Groups A, B, C and G}
LIS Isolate Canned Message Code: /GBS; attached to organism straga, strpyo, strgrc, strgrg.
“This organism is intrinsically susceptible to penicillin. If treatment is required AND this patient cannot be treated with penicillin, please contact the Microbiology Department within 48 hours to request sensitivity testing.”

\section*{Streptococcus anginosus group on Non-Sterile Sites excluding Urines}
LIS Isolate Canned Message Code: /Mill; attached to Organism Class u.
“\textit{Streptococcus anginosus} group are generally susceptible to penicillin, clindamycin, and levofloxacin. If susceptibility testing for this organism is required, please contact the microbiology laboratory within 48 hours.”

\section*{Streptococcus anginosus group on Urines}
LIS Isolate Canned Message Code: /MilU; attached to Organism Class u.
“\textit{Streptococcus anginosus} group are generally susceptible to penicillin and levofloxacin. If susceptibility testing for this organism is required, please contact the microbiology laboratory within 48 hours.”

\section*{For Enterocococcus reporting Tigecycline} – messages link to Organism classes E, code /TIGE
“Tigecycline MIC is xx mg/L.
There are no CLSI standards for this drug. EUCAST suggests MICs \( \leq 0.25 \text{ mg/L} \) correlate with susceptibility. Result for tigecycline is based on Etest gradient strips (bioMérieux) which have been validated with well-characterized laboratory (ATCC) strains. Verification on clinical isolates against a gold standard method has been limited. Please take this into consideration when interpreting these results. Please consult the microbiologist-on-call with any questions.”

\section*{For MSH VRE’s}
LIS Isolate Canned Message Code: /VREI, attached to organisms Trimethoprim/Sulfa “THIS PATIENT MUST BE ON "VRE PRECAUTIONS" UNTIL FURTHER NOTICE.”

Vancomycin for \textit{E. gallinarum, and E. casseliflavus} report as R with the statement
LIS Isolate Canned Message Code: /EntV; attached to organisms - entgal and entcas.

\section*{NOTE: This document is Uncontrolled When Printed.}
Any documents appearing in paper form that do not state “CONTROLLED COPY” in red print are not controlled and should be checked against the document (titled as above) on the server prior to use.
"This organism always has intrinsic non-transmissible resistance to vancomycin. The patient does not require isolation."

**VRE isolated from VRE Screen Susceptibility Result Comment**

LIS Isolate Canned Message Code: ICSN; linked to organism Trimethoprim/Sulfa, Dlinezo=S or R.

“Susceptibility results are provided for infection control purposes only.”

For *Listeria species*:

LIS Isolate Canned Message Code: LIST; attached to organism codes lismoc and lismon.

“In vitro susceptibility testing of this organism is not routinely performed. *Listeria* spp. should be considered resistant to all cephalosporins. The recommended regimen for therapy is ampicillin. If additional advice on antimicrobial therapy is required, please contact the Medical Microbiologist.”

**Enterococcus faecium vanA gene positive but vancomycin susceptible**

LIS Isolate code: “entva” linked to Canned Message Code: \vaAi

“This organism is positive for vanA gene by the Cepheid vanA/B GenXpert Assay (for research use only) but has a vancomycin susceptible phenotype. The effectiveness of vancomycin in this setting is uncertain and is not recommended. Please contact Infectious Diseases or Medical Microbiology for treatment advice.”

**GPBs:**

For *Corynebacterium spp., not C. jeikeium or Bacillus spp., not B. anthracis* isolated from Blood Cultures:

LIS Isolate Canned Message Code: \cors; linked to organism class – h

LIS Isolate Canned Message Code: \baac; linked to organism class – j

“*Corynebacterium spp.* OR *Bacillus spp.* are frequent blood culture contaminants. Clinical correlation is needed to determine the significance of this result. Susceptibility testing for this (these) organism(s) can be completed at a reference laboratory if requested.”

For *Propionibacterium spp., and Micrococcus spp. Isolated from Blood Cultures*:

LIS Isolate Canned Message Code: \pros; linked to organism class – i

LIS Isolate Canned Message Code: \micc; linked to organism class – k

“*Propionibacterium spp.* OR *Micrococcus spp.* are frequent blood culture contaminants. Clinical correlation is needed to determine the significance of this result. Susceptibility testing for this (these) organism(s) is (are) unreliable. If advice on antimicrobial therapy is required, please contact the Medical Microbiologist.”

For *Clostridium difficile* and *Clostridium difficile Detected*:

LIS Isolate Canned Message Code: \Cdif linked to organism clodif and clodip

**GNBs:**
For *Citrobacter spp.*, *Enterobacter spp.*, *Hafnia spp.*, *Morganella morganii*, *Proteus penneri*, *Proteus vulgaris*, *Providencia species*, *Serratia species*

LIS Isolate Canned Message Code: \&spc attached to Organisms cedav, cedlap, cedspp, prepen, provul, provp, Classes d, e, H, L and S.

“Resistance to extended-spectrum penicillins, beta-lactam/beta-lactamase inhibitor combinations (e.g. piperacillin-tazobactam), and cephalosporins may develop during therapy. These agents should be avoided and will be reported as resistant regardless of their in vitro susceptibility results. If you have questions, please contact the medical microbiologist on call.”

For *Aeromonas* spp

LIS Isolate Canned Message Code: \aero attached to organism “f”

“Resistance to non-carbapenem beta-lactam antimicrobials may develop in Aeromonas species during therapy.

Choosing a non-beta-lactam antimicrobial should be considered for serious infections. Consultation with infectious diseases or medical microbiology is advised.”

For *MSH E. coli, Klebsiella species, Proteus* Class A ESBL, Infection Control message:

Isolate canned message code \&taz linked to organisms *E. coli*, Class J and Class T:

“MULTIPLY ANTIBIOTIC RESISTANT ORGANISM. THIS PATIENT MUST BE ON "CONTACT PRECAUTIONS" UNTIL FURTHER NOTICE FROM INFECTION CONTROL.”

**ESBL Comments**

Attached to organisms esccol, Class J and Class T

Desbinh=Y Dfox=S \&cla “The susceptibility pattern suggests that this organism contains a class A extended spectrum beta-lactamase (ESBL).”

Dtaz=R Desbinh=N Dfox=R or I \&claC “The susceptibility pattern suggests that this organism contains a class C extended spectrum beta-lactamase (ESBL).”

Dtaz=R or I Desbinh=N Dfox=R or I Ddzone=Y \&clIC “The susceptibility pattern suggests that this organism contains an inducible class C extended spectrum beta-lactamase (ESBL).”

Desbinh=Y Dfox=R or I \&clAC “The susceptibility pattern suggests that this organism contains class A and C extended spectrum beta-lactamases (ESBL).”

Dtaz=R Desbinh=N Dfox=S \&esbl “The susceptibility pattern suggests that this organism contains an extended spectrum beta-lactamase (ESBL) other than class A or C.”

**ESBL or other Resistant Gram-Negative-Bacilli isolated from ESBL Screen, Resistant Pseudomonas Screen or Resistant Gram-Negative-Bacilli Screen - Susceptibility Result Comment**

LIS Isolate Canned Message Code: \ICSN; linked to organism Class B, Dctr=R. “Susceptibility results are provided for infection control purposes only.”

**Positive BLACTA test result**, link to organism Class 1 and drug blacta=Y (\BLTA):
---Presumptive resistance to extended-spectrum penicillins,
~beta-lactam/beta-lactamase inhibitor combinations
~(e.g. piperacillin-tazobactam), and cephalosporins
~has been detected.
~Confirmation and further susceptibilities to follow.”

**Previous Positive ESBL, LIS isolate comment code:** \ESBP

*Escherichia coli*” or “*Klebsiella species*” or “*Proteus mirabilis*” “isolated” with ISO**LATE**
COMMENT: “Phenotypic screening suggests this organism is ESBL POSITIVE
as previously confirmed on “yyyy.mm.dd”.”

For **MSH CRE’s**

LIS Isolate Canned Message Code: \CREI, attached to organism Class B “**THIS PATIENT MUST BE ON "CRE PRECAUTIONS" UNTIL FURTHER NOTICE."**

**Previous Positive CRE, isolate comment code:** \CREP

“Phenotypic testing suggests this organism is carbapenemase POSITIVE as previously confirmed on “yyyy.mm.dd”.”

For **Resistant Enterobacteriaceae Colistin MIC Reporting**

MIC <=2 mg/L, LIS code \CO<2

“Colistin MIC = xx mg/L.
There are no CLSI standards for this drug. EUCAST suggests MICs <=2 mg/L correlate with susceptibility. Please consult the microbiologist-on-call with any questions.”

MIC >2 mg/L, LIS code \CO>2

“Colistin MIC = xx mg/L.
There are no CLSI standards for this drug. EUCAST suggests MICs >2 mg/L correlate with resistance. Please consult the microbiologist-on-call with any questions.”

For **Enterobacteriaceae (other than Proteus spp. Providencia spp., Morganella spp.) and S. maltophilia reporting tigecycline** – pick from keypad:

**For Susceptible results** code \TIGS:

"Tigecycline MIC = mg/L
There are no CLSI standards for this drug. EUCAST suggests MICs <=1 mg/L correlate with susceptibility. Result for tigecycline is based on Etest gradient strips (bioMérieux) which have been validated with well-characterized laboratory (ATCC) strains. Verification on clinical isolates against a gold
standard method has been limited. Please take this into consideration when interpreting these results. Please consult the microbiologist-on-call with any questions.”

**For Intermediate results code \TIGI:**
"Tigecycline MIC = 2 mg/L
There are no CLSI standards for this drug. EUCAST suggests MICs = 2 mg/L correlate with intermediate susceptibility. Result for tigecycline is based on Etest gradient strips (bioMérieux) which have been validated with well-characterized laboratory (ATCC) strains. Verification on clinical isolates against a gold standard method has been limited. Please take this into consideration when interpreting these results. Please consult the microbiologist-on-call with any questions.”

**For Resistant results code \TIGR:**
"Tigecycline MIC = mg/L
There are no CLSI standards for this drug. EUCAST suggests MICs > 2 mg/L correlate with resistance. Result for tigecycline is based on Etest gradient strips (bioMérieux) which have been validated with well-characterized laboratory (ATCC) strains. Verification on clinical isolates against a gold standard method has been limited. Please take this into consideration when interpreting these results. Please consult the microbiologist-on-call with any questions.”

**For Morganella, Proteus, Providencia Resistant results code \TIGN:**
"Tigecycline MIC = mg/L
There are no Clinical and Laboratory Standards Institute (CLSI) interpretive standards for this drug. For help with interpretation, please consult the microbiologist-on-call. (Ref: Pfizer Canada Inc. Product Monograph Pr Tygacil® Tigecycline for Injection. Kirkland, PQ: Pfizer Canada Inc., November 11, 2010)"

For **Enterobacteriaceae carbapenemase reporting**

Preliminary Report based on ertapenem result, if ertapenem is I or R or =>1 mg/L code \MHT

“~Screening tests suggest this organism may produce a carbapenemase. Further report to follow. If you have any questions, please contact the Medical Microbiologist on call.”

For **Carbapenemase Comments on Enterobacteriaceae:**

Preliminary Report when Rosco disks and potentiation is available:

**Mero & DPA (MRDP) >= 5 mm compared with Rosco meropenem (MRP10), code \MRDP:**

“Additional testing suggests this organism produces a metallo-beta-lactamase carbapenemase (e.g. NDM-1). Confirmation by PCR to follow.”
Mero & Boronic Acid (MRBO) ≥5 mm compared to Rosco meropenem (MRP10), code \MRBO: “Additional testing suggests this organism produces a class A carbapenemase (e.g. KPC). Confirmation by PCR to follow.”

Both Mero & DPA and Mero & Boronic Acid < 5 mm compared with Rosco meropenem (MRP10):
If mero S, code \MR-S: “Additional testing indicates that this organism does NOT produce a carbapenemase.”

Final CRE Reports:

Final Report - NEGATIVE PCR results from NML:
For clinical specimens, code \KPCN - "The previous reported carbapenemase test for ...(isolate name)...was NOT confirmed. This organism is NEGATIVE by PCR for carbapenemase genes; as reported by the National Microbiology Laboratory 1015 Arlington St. Winnipeg, MB. Canada, R3E 3R2. If you have any questions, please contact the Medical Microbiologist on call.”

For Infection Control Screens:
If the isolate is to be reported as ESBL, code \KPCN - "The previous carbapenemase test for ...(isolate name).......was NOT confirmed. This organism is NEGATIVE by PCR for carbapenemase genes; as reported by the National Microbiology Laboratory 1015 Arlington St. Winnipeg, MB. Canada, R3E 3R2. If you have any questions, please contact the Medical Microbiologist on call.”

If the isolate is not generally reported (e.g. Enterobacter in ESBL screens),
- Change isolate to an alpha isolate.
- Report at the TEST Window with TEST COMMENT code \KPCN - " The previous carbapenemase test for ...(isolate name)........was NOT confirmed. This organism is NEGATIVE by PCR for carbapenemase genes; as reported by the National Microbiology Laboratory 1015 Arlington St. Winnipeg, MB. Canada, R3E 3R2. If you have any questions, please contact the Medical Microbiologist on call.”

Final Report - POSITIVE PCR results from NML:
Report with ISOLATE COMMENT code \KPCP - “This organism is POSITIVE for ___ carbapenemase (add specific carbapenemase that is confirmed) based on PCR; as reported by the National Microbiology Laboratory 1015 Arlington St. Winnipeg, MB. Canada, R3E 3R2. If you have any questions, please contact the Medical Microbiologist on call.”

For Haemophilus species from Respiratory and Miscellaneous Sites – LIS Isolate Canned Message Code, attached to organism Class X:
If beta-lactamase is negative, \textbf{BLa-} “beta-lactamase negative result suggests susceptible to ampicillin.”

If beta-lactamase is positive, \textbf{BLa+} “beta-lactamase positive result suggests resistance to ampicillin but generally susceptible to amoxicillin-clavulanic acid and cefuroxime.”

For \textit{M. catarrhalis} - LIS Isolate Canned Message Code: \texttt{ncat}; attached to Organism: "The majority of \textit{Moraxella catarrhalis} are resistant to ampicillin. In vitro susceptibility testing for this organism is not routinely performed and/or is unreliable. If advice on antimicrobial therapy is required, please contact the Medical Microbiologist”.

For \textit{Shigella spp} from Enteric sites with susceptibilities performed - LIS Isolate Canned Message Code \texttt{Shig}：“This isolate has a ciprofloxacin MIC of \textit{mg/L}. There is the risk of ciprofloxacin treatment failures in infections caused by ciprofloxacin-susceptible \textit{Shigella} with ciprofloxacin MICs between 0.125 and 1mg/L. Consultation with medical microbiology or infectious diseases is advised.”

For \textit{S. maltophilia} reporting levofloxacin – code \texttt{sten}: “NOTE: There are no CLSI interpretive standards for moxifloxacin and \textit{Stenotrophomonas maltophilia} but levofloxacin and moxifloxacin minimum inhibitory concentrations (MICs) generally correlate well with each other. Ref: J Chemother. 2008 Feb;20(1):38-42.”

For reporting \textit{Cetolozane-Tazobactam} – code \texttt{C/T}: “Result for ceftolozane/tazobactam is based on Liofilmchem gradient strips (Alere) which have been validated with well-characterized laboratory (ATCC) strains. Verification with clinical isolates against a gold standard method has been limited. Please take this into consideration when interpreting these results.”

B. \textbf{Canned Messages to be selected from the Isolate Comment keypad:}

The listed below are canned messages to be selected from the Isolate Comment keypad when needed.

1. At the LIS Isolate Comment Window, type the appropriate number on the keypad.
2. Press F12 to save.
3. Continue using F12 to save the order.
4. View the report.
5. Status the report as required.

For \textit{Isoniazid (INH)} reporting if 0.1 mg/L=R and 0.4mg/L=S: LIS Isolate Canned Message Code: \texttt{INHr}; select from keypad “This isolate has low-level resistance to isoniazid (INH). Patients infected with strains exhibiting this level of INH resistance may benefit from continuing therapy with INH. Consultation with a specialist experienced in the treatment of tuberculosis is recommended.”
BORSA (DENKA/mecA-negative S. aureus with oxacillin MIC>=4mg/L)
LIS Isolate Canned Message Code: \BORS: select from Isolate Keypad
This organism is a borderline-oxacillin resistant Staphylococcus aureus (BORSA) which is resistant to cloxacillin and cefazolin by a mechanism different from that in typical MRSA. Consultation with a Microbiologist or Infectious Disease physician is advised.

If susceptibility is done on request for β-haemolytic Streptococcus Groups A, B, C & G
Do not remove original canned message. Add message from Isolate Comment keypad code “Susceptibility\done” – “Susceptibility completed as requested.”

Enterococcus from Blood and Sterile Sites:
If high level gentamicin is susceptible (regardless of streptomycin result), select from Isolate Comment Keypad \EGMS: “Serious enterococcal infections may require an aminoglycoside for synergy. Please contact the Medical Microbiologist for treatment advice”.
If high level gentamicin is resistant (regardless of streptomycin result), select from Isolate Comment Keypad \EGMR: “This organism is high level aminoglycoside resistant. Please contact the Medical Microbiologist for treatment advice”.

Positive BLACTA test result and
If ESBL is confirmed, report with isolate comment (\ESBC):
“Resistance to extended-spectrum penicillins, beta-lactam, beta-lactamase inhibitor combinations (e.g. piperacillin-tazobactam), and cephalosporins has been confirmed.”
OR
If ESBL is NOT confirmed e.g. in K. oxytoca, report with isolate comment (\ESBN):
“The previously reported presumptive resistance to extended-spectrum penicillins, beta-lactam, beta-lactamase inhibitor combinations (e.g. piperacillin-tazobactam), and cephalosporins was NOT confirmed.”
APPENDICES

APPENDIX A. VERIFICATION OF UNUSUAL RESULTS

Verification of Antimicrobial Susceptibility Test Results and Confirmation of Organism Identification

I. Introduction

This section describes the occasions where the drugs tested against isolates showed phenotype that:
1. have never been documented
2. are uncommon, and/or
3. represent results that could easily occur from technical errors which may have significant clinical consequences.

II. Reagents/Materials/Media

Analytical Process - Bacteriology Reagents_Materials_Media List QPCMI10001

III. Procedure

When any of the listed results in the TABLE 1 below occurs, verify the result as follows:
1. Check purity plate.
2. Check previous reports on the patient.
3. Confirm the identification of the isolate from the original isolation medium.
4. Repeat susceptibility test to confirm result. Use an alternative method if applicable.
5. For isolates that show results other than susceptible for those antimicrobial agents for which only susceptible interpretive criteria are provided by CLSI guidelines M100-S23 (listed as “not S” above) and for staphylococci with vancomycin – I or R results:
   i. Confirm the organism identification
   ii. Confirm the antimicrobial susceptibility test results
   iii. Freeze the isolate
   iv. Send the isolate to PHL for confirmation.
6. If the result is confirmed, notify the Charge Technologist.
7. The Charge Technologist confirms the result and notifies the Microbiologist.
8. The Microbiologist further confirms the result and notifies the Infection Control Practitioner.

For results marked with *, LIS reflex rules will automatically report these as R; repeat susceptibility testing is not required if the purity and organism identification is confirmed.
<table>
<thead>
<tr>
<th>Organism or Group</th>
<th>Uncommon results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any organism</td>
<td>Resistant to all agents routinely tested</td>
</tr>
</tbody>
</table>

**Gram-negative organisms**

<table>
<thead>
<tr>
<th>Organism or Group</th>
<th>Uncommon results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any gram-negative organisms</td>
<td>Piperacillin – <strong>S and</strong> Piperacillin/tazobactam – R</td>
</tr>
<tr>
<td>Enterobacteriaceae</td>
<td>Imipenem, Meropenem – I or R</td>
</tr>
<tr>
<td>Carbapenem – I or R</td>
<td>Amikacin, gentamicin, and tobramycin – R</td>
</tr>
<tr>
<td>Enterobacteriaceae</td>
<td>Imipenem, Meropenem – I or R <strong>and</strong> Ertapenem = S</td>
</tr>
<tr>
<td><em>Citrobacter freundii</em></td>
<td>Ampicillin, Cefazolin – S</td>
</tr>
<tr>
<td><em>Enterobacter</em> species</td>
<td></td>
</tr>
<tr>
<td><em>Serratia marcescens</em></td>
<td></td>
</tr>
<tr>
<td><em>Klebsiella</em> species</td>
<td></td>
</tr>
<tr>
<td><em>Proteus vulgaris</em></td>
<td></td>
</tr>
<tr>
<td><em>Providencia species</em></td>
<td></td>
</tr>
<tr>
<td><em>Escherichia coli, Klebsiella</em> species, <em>Proteus</em> species</td>
<td>Cefpodoxime – Vitek=I or R; KB=S</td>
</tr>
<tr>
<td><em>Escherichia coli, Klebsiella</em> species, <em>Proteus mirabilis</em></td>
<td>Extended-spectrum cephalosporin (III or IV) – I or R</td>
</tr>
<tr>
<td><em>Escherichia coli, Klebsiella</em> species, <em>Proteus</em> species</td>
<td>KB-ESBL panel with reduction in zone of inhibition instead of potentiation or no change.</td>
</tr>
<tr>
<td><em>Salmonella</em> and <em>Shigella</em> spp.</td>
<td>Cephalosporin III – I or R</td>
</tr>
<tr>
<td><em>Fluoroquinolone</em> – I or R</td>
<td></td>
</tr>
<tr>
<td><em>Pseudomonas aeruginosa</em></td>
<td>Colistin/polymyxin – I or R</td>
</tr>
<tr>
<td>Amikacin, gentamicin, and tobramycin – R</td>
<td></td>
</tr>
<tr>
<td><em>Carbapenem</em> – I or R</td>
<td></td>
</tr>
<tr>
<td><em>Acinetobacter baumannii</em></td>
<td>Colistin/polymyxin – R</td>
</tr>
<tr>
<td><em>Carbapenem</em> – I or R</td>
<td></td>
</tr>
<tr>
<td><em>Stenotrophomonas maltophilia</em></td>
<td>Imipenem, Meropenem – S</td>
</tr>
<tr>
<td><em>Trimethoprim-sulfamethoxazole</em> – I or R</td>
<td></td>
</tr>
<tr>
<td><em>Haemophilus influenzae</em></td>
<td>Amoxicillin-clavulanate – R</td>
</tr>
<tr>
<td>Ampicillin – R and β-lactamase negative</td>
<td></td>
</tr>
<tr>
<td>Aztreonam – not S</td>
<td></td>
</tr>
<tr>
<td>Imipenem, Meropenem – not S</td>
<td></td>
</tr>
<tr>
<td>3rd generation cephalosporin – not S</td>
<td></td>
</tr>
<tr>
<td>Extended-spectrum cephalosporin (III or IV) – not S</td>
<td></td>
</tr>
<tr>
<td>Cefaroline – not S</td>
<td></td>
</tr>
<tr>
<td>Organism or Group</td>
<td>Uncommon results</td>
</tr>
<tr>
<td>---------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Carbapenem – not S</td>
</tr>
<tr>
<td></td>
<td>Fluoroquinolone – not S</td>
</tr>
<tr>
<td><em>Neisseria gonorrhoeae</em></td>
<td>3rd generation cephalosporin – R</td>
</tr>
<tr>
<td></td>
<td>Extended-spectrum cephalosporin (III or IV) – not S</td>
</tr>
<tr>
<td></td>
<td>Fluoroquinolone – I or R</td>
</tr>
<tr>
<td><em>Neisseria meningitides</em></td>
<td>Ampicillin or Penicillin – R</td>
</tr>
<tr>
<td></td>
<td>Extended-spectrum cephalosporin (III or IV) – not S</td>
</tr>
<tr>
<td></td>
<td>Meropenem – not S</td>
</tr>
<tr>
<td></td>
<td>Ampicillin or Penicillin – I</td>
</tr>
<tr>
<td></td>
<td>Azithromycin – not S</td>
</tr>
<tr>
<td></td>
<td>Chloramphenicol – I or R</td>
</tr>
<tr>
<td></td>
<td>Fluoroquinolone – I or R</td>
</tr>
<tr>
<td></td>
<td>Minocycline – not S</td>
</tr>
<tr>
<td></td>
<td>Rifampin – I or R</td>
</tr>
<tr>
<td><strong>Gram-positive organisms</strong></td>
<td></td>
</tr>
<tr>
<td><em>Enterococcus</em> spp.</td>
<td>Daptomycin – not S</td>
</tr>
<tr>
<td></td>
<td>Linezolid – R</td>
</tr>
<tr>
<td></td>
<td>Vancomycin – R</td>
</tr>
<tr>
<td></td>
<td>High-level aminoglycoside – R</td>
</tr>
<tr>
<td><em>Enterococcus faecalis</em></td>
<td>Ampicillin or Penicillin – R</td>
</tr>
<tr>
<td></td>
<td>Daptomycin – not S</td>
</tr>
<tr>
<td></td>
<td>Quinupristin-Dalfopristin – S</td>
</tr>
<tr>
<td></td>
<td>Linezolid – I or R</td>
</tr>
<tr>
<td><em>Enterococcus faecium</em></td>
<td>Daptomycin – not S</td>
</tr>
<tr>
<td></td>
<td>Linezolid – I or R</td>
</tr>
<tr>
<td><em>Staphylococcus</em> aureus</td>
<td>Daptomycin – not S</td>
</tr>
<tr>
<td></td>
<td>Linezolid – R</td>
</tr>
<tr>
<td></td>
<td>Quinupristin-Dalfopristin – I or R</td>
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<tr>
<td></td>
<td>Oxacillin – R</td>
</tr>
<tr>
<td></td>
<td>Vancomycin – I or R</td>
</tr>
<tr>
<td></td>
<td>Vancomycin MIC = 4 ug/mL</td>
</tr>
<tr>
<td></td>
<td>Vancomycin MIC $\geq$ 8 ug/mL</td>
</tr>
<tr>
<td></td>
<td>Clindamycin=R and Erythromycin=S</td>
</tr>
<tr>
<td></td>
<td>Ceftaroline – R</td>
</tr>
<tr>
<td>Coagulate-negative <em>Staphylococcus</em></td>
<td>Daptomycin – not S</td>
</tr>
<tr>
<td>Organism or Group</td>
<td>Uncommon results</td>
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<td>--------------------------</td>
<td>-------------------------------------------------------</td>
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<tr>
<td></td>
<td>Linezolid – R</td>
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<tr>
<td></td>
<td>Vancomycin – I or R</td>
</tr>
<tr>
<td></td>
<td>Clindamycin=R and Erythromycin=S</td>
</tr>
<tr>
<td></td>
<td>Quinupristin-Dalfopristin – I or R</td>
</tr>
</tbody>
</table>
### Organism or Group

<table>
<thead>
<tr>
<th>Gram-positive organisms (cont’d)</th>
<th>Uncommon results</th>
</tr>
</thead>
</table>
| *Streptococcus pneumoniae*      | 3rd generation cephalosporin – R  
Fluoroquinolone – I or R  
Linezolid – not S  
Vancomycin – not S  
Clindamycin= R and Erythromycin= S  
Ceftaroline – not S  
Imipenem or meropenem – I or R  
Quinupristin-dalfopristin – I or R  
Rifampin – I or R  
Using nonmeningitis breakpoints:  
Amoxicillin or penicillin – R  
Extended-spectrum cephalosporin (III or IV) – R  
Oxacillin= S & Penicillin etest R |
| beta-haemolytic *Streptococcus* | Ampicillin or Penicillin – not S  
3rd generation cephalosporin – not S  
Daptomycin – not S  
Linezolid – not S  
Vancomycin – not S  
Clindamycin= R and Erythromycin= S  
Quinupristin-dalfopristin – I or R  
Ceftaroline – not S  
Ertapenem or meropenem – not S  
Extended-spectrum cephalosporin (III or IV) – not S |
| *viridans Streptococcus*         | Daptomycin – not S  
Ertapenem or meropenem – not S  
Linezolid – not S  
Quinupristin-dalfopristin – I or R  
Vancomycin – not S  
Clindamycin= R and Erythromycin= S |

### IV. Reference

Suggestions for Verification of Antimicrobial susceptibility Test Results and Confirmation of Organism identification in Table 8 of Clinical and Laboratory Standards Institute (CLSI) Document - Performance Standards for Antimicrobial Susceptibility Testing M100-S25 appendix A.

UNIVERSITY HEALTH NETWORK/MOUNT SINAI HOSPITAL, DEPARTMENT OF MICROBIOLOGY

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APPENDIX B. AGENTS NEVER TO BE REPORTED BY SITE

The antimicrobial agents listed in the table below should never be used for any isolate reported from the specified site.

<table>
<thead>
<tr>
<th>URINE SPECIMENS</th>
<th>CSF/VP SHUNT &amp; BRAIN SPECIMENS</th>
<th>RESPIRATORY SPECIMENS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Clindamycin</td>
<td>• Agents given orally</td>
<td>• Daptomycin</td>
</tr>
<tr>
<td>• Macrolides:</td>
<td>• 1&lt;sup&gt;st&lt;/sup&gt; &amp; 2&lt;sup&gt;nd&lt;/sup&gt; generation cephalosporins and cephemycins</td>
<td></td>
</tr>
<tr>
<td>• Erythromycin</td>
<td>• Clindamycin</td>
<td></td>
</tr>
<tr>
<td>• Clarithromycin</td>
<td>• Macrolides</td>
<td></td>
</tr>
<tr>
<td>• Azithromycin</td>
<td>• Tetracyclines</td>
<td></td>
</tr>
<tr>
<td>• Minocycline</td>
<td>• Fluoroquinolones</td>
<td></td>
</tr>
<tr>
<td>• Tigecycline</td>
<td>• Aminoglycosides</td>
<td></td>
</tr>
<tr>
<td>• Chloramphenicol</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

References:


APPENDIX C. DETECTION OF ANTIMICROBIAL RESISTANT ORGANISMS

Antibiotic Resistant Organisms Detection

I. How to Detect MRSA/BORSA:

Routine Bench

**Screening tests:**
- Oxacillin screen positive (and/or)
- Vitek cefoxitin screen positive (and/or)
- Vitek oxacillin MIC =>4 mg/L

**Confirmatory testing (to be done sequentially if any of the screening tests are positive)**
- [Denka](#)
- [Induced Denka](#) with cefoxitin KB (if Denka negative)
- If Denka and Induced Denka test negative, Send to PHL for PCR *(mecA and mecC)* & Oxacillin MIC

**Previously positive tests:**
Report as MRSA based on:
- <3days: Oxacillin screen only
- 3days-3months: Oxacillin screen with vitek susceptibilities (no Denka)
- >3months: Oxacillin screen with vitek susceptibilities plus Denka

**Reporting:**
- If Denka or Induced Denka test positive, then **finalize** as methicillin-resistant *Staphylococcus aureus* (MRSA).
- If Denka and Induced Denka test negative, while waiting for mecA and mecC PCR / Oxacillin MIC:
  - Send **prelim** report of *Staphylococcus aureus* with susceptibilities. Supress beta-lactams with the following comment added in the isolate comment:
    - "Screening tests suggest this isolate may be resistant to cloxacillin and cefazolin. Confirmation to follow. If you have any questions, please contact the microbiologist-on-call."

When **mecA and mecC** PCR / Oxacillin MIC results are available:
- If all confirmatory tests are negative but oxacillin <4 mg/L, then finalize as oxacillin susceptible *Staphylococcus aureus*.
- If **mecA or mecC** are positive then finalize as methicillin-resistant *Staphylococcus aureus* (MRSA).
**Screening Bench**

**Screen:**
- Denim blue colonies

**Initial Confirmatory test:**
- **Denka**
  - If Denka tests positive, then prelim as methicillin-resistant Staphylococcus aureus (MRSA) and continue with workup.

**Additional Confirmatory testing if Denka negative:**
- **Induced Denka** with cefoxitin KB
- Oxacillin screen positive
- Vitek cefoxitin screen positive
- Vitek oxacillin MIC =>4 mg/L

**Previously positive tests:**
- <3months: Report as MRSA based on denim blue colonies on screen plate and MALDI confirms S. aureus ID.
- ≥3months: Full work-up as above

**Reporting:**

- If all additional confirmatory tests are positive, then **finalize** as methicillin-resistant Staphylococcus aureus (MRSA).

- When conflicting results arise, please consult senior/charge technologist for further advice. Results should be held back (no isolate reported) but calls made to infection control as per senior/charge technologist’s advice.
II. How to Detect VISA/hVISA/VRSA:

Routine Bench

Screen:
- Vanco screen plate positive
- Vanco vitek MIC > 1 mg/L

Confirmatory testing:
- Vanco Etest to confirm MIC
- Macro Etest to detect hVISA

Previously positive tests:
Report as VISA/hVISA/VRSA based on:
- <3days: Vancomycin screen only
- 3days-3months: Vancomycin screen with vitek susceptibilities
- >3months: Vancomycin screen with vitek susceptibilities and Vanco Etest & Macro Etest.

Report:

If vanco vitek MIC =2 mg/L:
- If vanco Etest (rounded up to 2 fold dilution vanco) is <2 mg/L and macro Etest is negative, then report isolate as MSSA or MRSA as appropriate.
- If vanco Etest = 2mg/L and macro Etest is negative, then report as MSSA or MRSA as appropriate with MIC and with the following comment: “This isolate has a vancomycin MIC of 2 mg/L which is associated with an increased risk of treatment failures. Consultation with infectious diseases or medical microbiology is advised.”
- If vanco Etest <4mg/L and macro Etest is POSITIVE, then report as MSSA or MRSA as appropriate with the hVISA comment as follows: “Presumptive vancomycin hetero-intermediate S. aureus (hVISA). Confirmation to follow”.
- If vanco vitek &/or Etest MIC 4-8 mg/L, regardless of the macro Etest result:
  - Then report as MSSA or MRSA as appropriate with the VISA comment as follows: “Presumptive vancomycin-intermediate S. aureus (VISA). Confirmation to follow”.

If vanco vitek &/or Etest MIC >8 mg/L, regardless of the macro Etest result:
- Then report as MSSA or MRSA as appropriate with the VRSA comment as follows: “Presumptive vancomycin-resistant S. aureus (VRSA). Confirmation to follow”.
III. How to detect VRE:

**Routine Bench**

**Screen:**
- Vancomycin screen pos

**Confirmatory testing:**
- Vancomycin and teicoplanin macro Etests (all benches)
- Cepheid PCR (van “S” *E. faecium* from blood culture)

**Previously positive tests:**
Report as VRE based on:
- <3 days: Vancomycin screen
- 3 days-3 months: Vancomycin screen plus Etests (no Cepheid PCR)
- >3 months: Vancomycin screen, Etests plus Cepheid PCR

**Report:**
- If macro Etests are positive, then VRE
- If Cepheid is positive, then VRE or VanS VRE
- Otherwise, no VRE

**Screening Bench**

**Screen:**
- Purple/blue colonies on Brilliance agar

**Confirmatory testing:**
- Cepheid PCR
- Vancomycin and teicoplanin macro Etests
- Vancomycin screen

**Previously positive tests:**
Report as VRE based on:
- <3 months: ID and Vancomycin screen
- >3 months: ID, Vancomycin screen, Etests plus Cepheid PCR

**Report:**
- If macro Etests are positive, then VRE
- If Cepheid is positive, then VRE or VanS VRE
- Otherwise, no VRE
IV. How to detect ESBL:

**Routine Bench**

**Screen:**
Cefpodoxime (Vitek) I/R (MIC > 1 mg/L) – for *E coli*, *Klebsiella pneumonia*, *K. oxytoca* and *Proteus mirabilis*

**Confirmatory testing:**
ESBL Double disk
1. Routine Figure 1. KB-ESBL Template

**Previously positive tests:**
Report as ESBL based on:
- <3days: Reported ID with referral to previous isolate
- >3days: Reported ID with vitek and ESBL Double disk

**Report:**
Report with susceptibilities based on vitek
Confirm with ESBL double disk and record result on back of card only – issue a corrected report if discrepancy found

**Screening Bench**

**Screen:**
MCPOD plate – oxidase negative LF / NLF are considered screen positive

**Confirmatory testing:**
ESBL Double disk
A. Infection Control Figure 2. Infection Control KB-ESBL Template
   (only for Mother/Infant ward and special requests)

**Previously positive tests:**
Report as ESBL based on:
- <3months: growth on McPOD, ID with referral to previous isolate
- ≥3months: growth on McPOD, ID with ESBL Double disk

**Report:**
Report positive ESBL Double disks to Mother/Infant wards only

**NOTE:** An isolate with cefpodoxime S and ceftriaxone or ceftazidime I/R is an UNUSUAL RESULT. Check for purity and redo the susceptibility.
V. How to detect CRE:

Routine Bench

Screen:
- Erta=I/R and Mero mic ≤0.25
- Mero=I/R or Mero=S mic ≥0.5
- KB Mero Screen Test = R

Confirmatory testing:
- βCARBA
- CARB-R Cepheid PCR

Additional Confirmatory testing:
- ROSCO with Temocillin (if βCARBA= negative OR βCARBA = positive & CARB-R Cepheid PCR neg)
- PCR - send to NML (if CARB-R Cepheid PCR neg OR ROSCO with Temocillin=R/potentiation)

Notify as per Isolate Notification and Freezing Table QPCMI15003

Previously positive tests:
Report as CRE based on:
- <3days: ID with meropenem screen results
- 3days-6 months: ID with Vitek, βCARBA
- >6 months: ID with Vitek, βCARBA, CARB-R Cepheid PCR, ROSCO with Temocillin (if βCARBA =neg) NML PCR(if CARB-R Cepheid PCR neg OR ROSCO with Temocillin=R/potentiation)

Report:
- See Carbapenemase Testing Reporting

Screening Bench

Screen:
- KB MERO Screen=R

Confirmatory testing:
- βCARBA
- CARB-R Cepheid PCR
Additional Confirmatory testing:
- ROSCO with Temocillin (if βCARBA= negative OR βCARBA = positive & CARB-R Cepheid PCR neg)
- PCR - send to NML (if CARB-R Cepheid PCR neg OR if Rosco with Temocillin=R/potentiation)
- Notify as per Isolate Notification and Freezing Table QPCMI15003

Previously positive tests:
Report as CRE based on:
- <6 months: βCARBA test
- ≥6 months: βCARBA, CARBR Cepheid PCR, (ROSCO with Temocillin (if βCARBA =neg) PCR NML (if CARB-R Cepheid PCR =neg or ROSCO with Temocillin=R/potentiation)

Report:
- See Carbapenemase Testing Reporting

NOTE: An isolate with erta S and mero I/R is an UNUSUAL RESULT. Check for purity and repeat the susceptibility.
CARBAPENEMASE TESTING FLOWCHART
Infection Control CRE Screen Flowchart
No growth or Oxidase positive

**MCPOD**

Growth and Oxidase negative

Set up Mero Screen (Panel kbmems)

No CRE

**S >25mm**

**R ≤25mm**

Set up Vitek MS

Non-Enterobacteriaceae

**Acinetobacter**

- add result to kb mem

**kb mem = S**

Entrerobacteriaceae

**Kb mem = I/R**

- Send Report \*ANML
- Notify ICP

**BCARB**

Previous Positive

- Send report \*CREP
- Notify ICP

New Positive

- Send report \*PCRB
- Notify ICP

Cepheid CARBR

Positive

Set up ROSCO with Temocillin for epidemiology purposes; record & suppress results.

- Send report \*CPC+
- Notify ICP

Negative

**Positive:**

Temocillin=R or Potentiation to MRDP or MRBO

- Send report \*CNML
- Notify ICP

**Negative:**

Temocillin=S and NO potentiation

- Send report \*CNML
- Notify ICP

**CNML**

**JCRE**

Send to NML ASAP

Set up ROSCO with Temocillin for epidemiology purposes; record & suppress results.

- Send report \*CREP
- Notify ICP

**No CRE**
Identification of Carbapenemase Producing isolates from Clinical Samples Flowchart

Oxidase- negative GNB

Vitek MS and Sensi

Acinetobacter spp.  

Enterobacteriaceae

MERO mic >2

Set up kb mem

Ert=I/R and Mero mic ≤0.25

Mero=I/R or Mero=S mic ≥0.5

Set up Mero Screen (Panel kbmems)

I/R <18mm  
S >17mm  
S >25mm  
R ≤25mm

Not CRE  

BCARB

Previous Positive  

New Positive  

Negative

- Send report \ANML  
- Notify ICP

- Send report \CREP  
- Notify ICP

- Send report \PCRB  
- Notify ICP

Cepheid CARBR

Positive

Negative

Set up ROSCO with Temocillin

Set up ROSCO with Temocillin for epidemiology purposes; record & suppress results.

- Send report \CPC+  
- Notify ICP

- Send report \pCRB  
- Notify ICP

- Send report \CNML  
- Notify ICP

- Send report \nCRE

Send to NML ASAP

NOTE: This document is Uncontrolled When Printed.
### Carbapenemase Testing Reporting

#### Direct Specimen PCR Reporting

<table>
<thead>
<tr>
<th>LIS Code</th>
<th>Test Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>)CAR-</td>
<td>“Negative - No carbapenemase genes detected by Cepheid Xpert CARBA-R Assay (for research use only). This assay is able to detect NDM, KPC, OXA48, OXA181, OXA232, OXA244, IMP-1, and VIM carbapenemase genes.”</td>
</tr>
<tr>
<td>)CAR+</td>
<td>“______ gene DETECTED by Cepheid Xpert CARBA-R Assay (for research use only). This assay is able to detect NDM, KPC, OXA48, OXA181, OXA232, OXA244, IMP-1, and VIM carbapenemase genes.”</td>
</tr>
</tbody>
</table>

#### For IC Screen & Clinical Culture Reporting – *Acinetobacter* spp

<table>
<thead>
<tr>
<th>Test Comment</th>
<th>Isolate Comment</th>
<th>Report Status</th>
<th>Notification to ICP/Ward</th>
<th>Other Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>KB mem I/R</td>
<td>For IC Screen:</td>
<td>For Clinical</td>
<td>Prelim</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>\ANML</td>
<td>Cultures: \ANML</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative NML</td>
<td>For IC Screen:</td>
<td>For Clinical</td>
<td>Final</td>
<td>Yes</td>
</tr>
<tr>
<td>Report</td>
<td>“UPDATED REPORT”</td>
<td>Cultures: \ACCN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive NML</td>
<td>For IC Screen:</td>
<td>For IC &amp; Clinical</td>
<td>Final</td>
<td>Yes</td>
</tr>
<tr>
<td>Report</td>
<td>“UPDATED REPORT”</td>
<td>Cultures: \ACCP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### For IC Screen & Clinical Culture Reporting

<table>
<thead>
<tr>
<th>Test Comment</th>
<th>Isolate Comment</th>
<th>Report Status</th>
<th>Notification to ICP/Ward</th>
<th>Other Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative βCARBA/ Negative ROSCO</td>
<td>For IC Screen: “UPDATED REPORT” JNCRE</td>
<td>For Clinical Cultures: report susceptibility results as per</td>
<td>Final</td>
<td>Yes</td>
</tr>
<tr>
<td>Test Comment</td>
<td>Isolate Comment</td>
<td>Report Status</td>
<td>Notification to ICP/Ward</td>
<td>Other Instructions</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------</td>
<td>---------------</td>
<td>--------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td><strong>Negative βCARBA/Positive ROSCO</strong></td>
<td>For IC Screen: “UPDATED REPORT” “POSITIVE Carbapenemase Screen”</td>
<td>For Clinical Cultures: \CNML</td>
<td>Final</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Positive βCARBA**

<p>| Previous positives ≤6 months | For IC Screen: “POSITIVE Carbapenemase Screen.” | For IC &amp; Clinical Cultures: CREP | Final | Yes |
| New positive | For IC Screen: “POSITIVE Carbapenemase Screen” | For IC &amp; Clinical Cultures: PCR | Prelim | Yes |
| Positive βCARBA and Negative Cepheid CARBA-R PCR (CARBR) | For IC Screen: “UPDATED REPORT” “POSITIVE Carbapenemase Screen” | For IC &amp; Clinical Cultures: pCRB | Prelim | Yes | Remove the original Isolate comment and replace with new Isolate comment. |
| Positive βCARBA and Positive Cepheid CARBA-R PCR (CARBR) | For IC Screen: “UPDATED REPORT” “POSITIVE Carbapenemase Screen” | For IC &amp; Clinical Cultures: CPC+ | Final | Yes |</p>
<table>
<thead>
<tr>
<th>Test Comment</th>
<th>Isolate Comment</th>
<th>Report Status</th>
<th>Notification to ICP/Ward</th>
<th>Other Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>For Clinical Cultures: “UPDATED REPORT”</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Negative NML Report</strong></td>
<td>UPDATED REPORT</td>
<td>Final</td>
<td>Yes</td>
<td>For IC Screen: Suppress previously reported Isolate</td>
</tr>
<tr>
<td></td>
<td>(\text{KPCN})</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Positive NML Report</strong></td>
<td>For IC Screen: “UPDATED REPORT” “POSITIVE Carbapenemase Screen”</td>
<td>For IC &amp; Clinical Cultures: (\text{KPCP})</td>
<td>Final</td>
<td>Yes</td>
</tr>
</tbody>
</table>
CPO Reporting Canned Messages

A. *Acinetobacter spp.* Reporting Messages

<table>
<thead>
<tr>
<th>LIS Code</th>
<th>Canned Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>}NCRE</td>
<td>Negative – No carbapenemase-producing organism (CRE) isolated</td>
</tr>
<tr>
<td>\ANML</td>
<td>~This organism is meropenem non-susceptible.</td>
</tr>
<tr>
<td></td>
<td>~Further characterization from the National Microbiology Laboratory to follow.</td>
</tr>
<tr>
<td>\ACCN</td>
<td>This organism is NEGATIVE for carbapenemase genes by PCR; as reported by the National Microbiology Laboratory (NML) 1015 Arlington St. Winnipeg, MB. Canada, R3E 3R2. NML Specimen No.</td>
</tr>
<tr>
<td>\ACCP</td>
<td>This organism is POSITIVE for ___ carbapenemase (add specific carbapenemase that is confirmed) based on PCR; as reported by the National Microbiology Laboratory (NML) 1015 Arlington St. Winnipeg, MB. Canada, R3E 3R2. NML Specimen No. The NML assay is able to detect NDM, KPC, OXA-48, OXA-181, OXA-232, OXA-244, IMP-1, VIM, NMC, and IMI as well as OXA-58, OXA-51, OXA-23, OXA-24, OXA-235, and OXA-143 carbapenemases. If you have any questions, please contact the Medical Microbiologist on call.</td>
</tr>
</tbody>
</table>

B. *Enterobacteriaceae* Reporting Messages

<table>
<thead>
<tr>
<th>LIS Code</th>
<th>Canned Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>}NCRE</td>
<td>Negative – No carbapenemase-producing organism (CRE) isolated</td>
</tr>
<tr>
<td>}KPCN</td>
<td>The previously reported positive carbapenemase result for was NOT confirmed. This organism is NEGATIVE for carbapenemase genes by PCR; as reported by the National Microbiology Laboratory (NML) 1015 Arlington St. Winnipeg, MB. Canada, R3E 3R2. The NML assay is able to detect NDM, KPC, OXA48, OXA181, OXA232, OXA244, IMP-1, VIM, NMC, IMI, and SME carbapenemases.</td>
</tr>
</tbody>
</table>
**ISOLATE COMMENTS**

<table>
<thead>
<tr>
<th>LIS Code</th>
<th>Canned Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>\nCRE</td>
<td>Additional testing indicates that this organism does NOT produce a carbapenemase</td>
</tr>
<tr>
<td>CNML</td>
<td>~This organism is negative by the βCARBA test (Bio-Rad)</td>
</tr>
<tr>
<td></td>
<td>~but phenotypic testing based on the KPC+MBL+OXA48</td>
</tr>
<tr>
<td></td>
<td>~Confirm Kit inhibitor tablets (ROSCO) cannot rule out</td>
</tr>
<tr>
<td></td>
<td>~carbapenemase production.</td>
</tr>
<tr>
<td></td>
<td>~Genotypic confirmation from the National Microbiology</td>
</tr>
<tr>
<td></td>
<td>~Laboratory to follow.</td>
</tr>
<tr>
<td>CREP</td>
<td>Phenotypic testing suggests this organism is</td>
</tr>
<tr>
<td></td>
<td>carbapenemase POSITIVE as previously confirmed on</td>
</tr>
<tr>
<td></td>
<td>yyyy.mm.dd.</td>
</tr>
<tr>
<td>PCRB</td>
<td>~This organism is phenotypically carbapenemase POSITIVE</td>
</tr>
<tr>
<td></td>
<td>~by the βCARBA test (Bio-Rad).</td>
</tr>
<tr>
<td></td>
<td>~Genotypic confirmation to follow.</td>
</tr>
<tr>
<td>pCRB</td>
<td>~This organism is phenotypically carbapenemase POSITIVE</td>
</tr>
<tr>
<td></td>
<td>~by the βCARBA test (Bio-Rad). No carbapenemase genes</td>
</tr>
<tr>
<td></td>
<td>~were detected by the Cepheid Xpert CARBA-R Assay</td>
</tr>
<tr>
<td></td>
<td>~(for research use only).</td>
</tr>
<tr>
<td></td>
<td>~This assay is able to detect NDM, KPC, OXA48, OXA181,</td>
</tr>
<tr>
<td></td>
<td>~OXA232, OXA244, IMP-1, and VIM carbapenemase genes.</td>
</tr>
<tr>
<td></td>
<td>~Additional genotypic testing from the National</td>
</tr>
<tr>
<td></td>
<td>~Microbiology Laboratory to follow.</td>
</tr>
<tr>
<td>CPC+</td>
<td>____ carbapenemase gene DETECTED by Cepheid Xpert</td>
</tr>
<tr>
<td></td>
<td>CARBA-R Assay (for research use only). This assay</td>
</tr>
<tr>
<td></td>
<td>is able to detect NDM, KPC, OXA48, OXA181, OXA232,</td>
</tr>
<tr>
<td></td>
<td>IMP-1, and VIM carbapenemase genes.</td>
</tr>
<tr>
<td>KPCP</td>
<td>This organism is POSITIVE for ____ carbapenemase (add specific carbapenemase that is</td>
</tr>
<tr>
<td></td>
<td>confirmed) based on PCR; as reported by the National Microbiology Laboratory (NML) 1015</td>
</tr>
<tr>
<td></td>
<td>Arlington St. Winnipeg, MB, Canada, R3E 3R2.</td>
</tr>
<tr>
<td></td>
<td>The NML assay is able to detect NDM, KPC, OXA48, OXA181, OXA232, OXA244, IMP-1,</td>
</tr>
<tr>
<td></td>
<td>VIM, NMC, IMI, and SME</td>
</tr>
<tr>
<td></td>
<td>carbapenemases. If you have any questions, please contact the Medical Microbiologist on call</td>
</tr>
</tbody>
</table>
APPENDIX D. SUSCEPTIBILITY TESTING METHODOLOGIES:

I - Disk Diffusion

I. Introduction

The disk diffusion method of susceptibility testing (also known as the Kirby-Bauer (KB) method) has been standardized primarily for testing of rapidly growing bacteria. To perform the test, filter paper disks impregnated with a specific amount of antimicrobial agent are applied to the surface of an agar medium that has been inoculated with a known amount of the test organism. The drug in the disk diffuses through the agar. As the distance from the disk increases, the concentration of the antimicrobial agent decreases creating a gradient of drug concentrations in the agar medium. Concomitant with diffusion of the drug, the bacteria that were inoculated and that are not inhibited by the concentration of the antimicrobial agent continue to multiply until a lawn of growth is visible. In areas where the concentration of drug is inhibitory, no growth occurs, forming a zone of inhibition around each disk. Criteria currently recommended for interpreting zone diameters and MIC results for commonly used antimicrobial agents are published by CLSI. Results are reported categorically as Susceptible (S), Intermediate (I), or Resistant (R).

For *E. coli*, *Klebsiella* species and *Proteus* species, instead of using standard cutoffs to determine S, I or R, screening test cutoffs are used and interpretations as R and S are reported if zone size is < or > of these screening breakpoints.

II. Materials

- Antimicrobial disks (store frozen with a desiccant)
- Mueller Hinton Agar (MH)
- Mueller Hinton Blood Agar (MHB)
- Haemophilus Test Media (HTM)
- Trypticase Soy Broth (TSB) (3 mL)
- VITEK colorimeter
- Sterile saline
- Sterile swabs

III. Procedure

1. Allow disks to come to room temperature before opening the container.
2. Using the Vitek colorimeter, prepare a suspension of the test organism in sterile saline equivalent to a 0.5 McFarland standard using isolated colonies. If there is not enough growth, inoculate the organism into TSB, and incubate at 35°C for 2-4 hours or until it reaches the turbidity of a 0.5 McFarland standard (with the colorimeter adjusted for TSB).
3. Using a sterile cotton swab, inoculate the organism onto an appropriate agar plate, streaking in 3 directions over the entire agar surface. For organisms that grow rapidly use MH agar. For *Haemophilus* species use HTM and for *S. pneumoniae*, beta-haemolytic streptococcus and viridans streptococcus use MHB. For other organisms that do not grow on MH, use MHB.

4. Using forceps or a disk dispenser, apply the appropriate Antimicrobial disks onto the agar. Place the disks with an equal distance apart from each other and put no more than 6 disks on a 100mm diameter plate.

5. Incubate plates as follows:
   - *Campylobacter* species - microaerophilically at 35°C x 18 hours
   - *Haemophilus* species - CO₂, 35°C x 18 hours
   - *S. pneumoniae* - CO₂, 35°C x 20 to 24 hours
   - Beta-haemolytic streptococcus - CO₂, 35°C x 20 to 24 hours
   - Viridans streptococcus - CO₂, 35°C x 20 to 24 hours
   - *S. aureus* and *Enterococcus* species for Methicillin and Vancomycin - O₂, 35°C x 24 hours
   - Others - O₂, 35°C x 18 hours

IV. Interpretation

After incubation, measure the diameters of the zone of complete inhibition (as judged by the unaided eye) with callipers.

For MH and HTM agar (except for *Staphylococcus* spp. – linezolid, oxacillin, vancomycin OR *Enterococcus* spp. – vancomycin):

1. Measure from the back of the plate.
2. Hold the petri dish a few inches above a black, nonreflecting background illuminated with reflected light.
3. The zone margin should be considered the area showing no obvious, visible growth that can be detected with the unaided eye. Ignore faint growth of tiny colonies that can be detected only with a magnifying lens at the edge of the zone of inhibited growth.
4. Strains of *Proteus* spp. may swarm into areas of inhibited growth around certain antimicrobial agents. With *Proteus* spp., ignore the thin veil of swarming growth in an otherwise obvious zone of growth inhibition.
5. With trimethoprim and the sulfonamides, antagonists in the medium may allow some slight growth; therefore, disregard slight growth (20% or less of the lawn of growth) and measure the more obvious margin to determine the zone diameter.

For *Staphylococcus* spp. – linezolid, oxacillin, vancomycin OR *Enterococcus* spp. – vancomycin):

1. Measure from the back of the plate.
2. Use transmitted light (plate held up to light source).
3. The zone margin should be considered the area showing no obvious, visible growth that can be detected with the unaided eye.
4. Any discernable growth within the zone of inhibition is indicative of resistant.

**For MHB agar:**

1. Measure the zones from the upper surface of the agar illuminated with reflected light and with the cover removed.
2. The zone margin should be considered the area showing no obvious, visible growth that can be detected with the unaided eye. Ignore faint growth of tiny colonies that can be detected only with a magnifying lens at the edge of the zone of inhibited growth.

Refer to CLSI Document M100-S23 for the zone size interpretations. Report susceptible, resistant and intermediate as appropriate.

**V. Quality Control**

Check for pure culture before recording test results. Retest if disk diffusion plate appears to be of mixed culture.

Test the following organisms each time a new batch of MH agar is prepared and once weekly. Subculture the organisms from the BHI slant (stored refrigerated) to BA the day before setting up the QC.

For weekly QC on MH:
- *S. aureus* ATCC 25923
- *E. coli* ATCC 25922
- *P. aeruginosa* ATCC 27853

For weekly QC on HTM:
- *Haemophilus influenzae* ATCC 49247
- *Haemophilus influenzae* ATCC 10211 (test for growth)

For weekly QC on MHB:
- *Streptococcus pneumoniae* ATCC 49619

For each new batch of MH:
- *S. aureus* ATCC 25923
- *E. coli* ATCC 25922
- *P. aeruginosa* ATCC 27853
- *S. faecalis* ATCC 29212
For each new batch of HTM:

*Haemophilus influenzae* ATCC 49247
*Haemophilus influenzae* ATCC 10211 (test for growth)

See CLSI Document M100-S26 Table 3 for acceptable QC results.

For troubleshooting out-of-range QC results, see CLSI Document M100-S26 Table 3C.
VI. Reference


Finelay, J.E., Miller, A., Poupard, J.A. Interpretive Criteria for Testing Susceptibility of Staphylococci to Mupirocin J Clin Microbiol 1997; 41:1137-1139

II – Double Disk Diffusion for Erythromycin and Clindamycin on *Staphylococcus* species, β-haemolytic *Streptococci* Groups A, B, C, G and *Streptococcus pneumoniae*

I. **Introduction**

Macrolide (erythromycin) resistant *Staphylococcus* species, β-haemolytic *Streptococci* and *Streptococcus pneumoniae* isolates may have constitutive or inducible resistance to lincosamides (clindamycin). The mechanisms of resistance include:

- Ribosomal modification encoded by an *erm* gene; also refer to as MLS\(_B\) (macrolide, lincosamide and type B streptogramin) resistance.
- Efflux of the antibiotic encoded by a *mef* gene; resistant only to macrolide
- Drug inactivation

Inducible clindamycin resistance can be detected using a disk approximation test with a clindamycin disk placed 12 mm from an erythromycin disk as part of the normal disk diffusion test.

II. **Materials**

Antimicrobial disks – clindamycin (DA, 2 μg) and erythromycin (E, 15 μg)
Mueller Hinton Agar (MH) – for *Staphylococcus* species
Mueller Hinton Blood Agar (MHB) – for *Streptococcus* species
VITEK colorimeter
Sterile saline
Sterile swabs

III. **Procedure**

1. Allow disks to come to room temperature before opening the container.

2. Using the Vitek colorimeter, prepare a suspension of the test organism in sterile saline equivalent to a 0.5 McFarland standard using isolated colonies.

3. Using a sterile cotton swab, inoculate the standardized organism onto a MH or MHB agar plate, streak in three directions over the entire agar surface.

4. Place plate on disk template (Figure 1.)

5. Using forceps or a disk dispenser, apply the clindamycin and erythromycin disks onto the agar, 15 mm to 26 mm away for staphylococci or 12 mm away for streptococci, from edge to edge using template below (Figure 1). Other antimicrobial disks can be placed on the same agar plate if needed.
IV. **Interpretation**

1. After incubation, measure the diameters of the zone of complete inhibition with callipers/ruler. Measure at the narrowest side of the zone. Refer to Clinical and Laboratory Standards Institute (CLSI) Document - M100 for the zone size interpretations.
2. Enter zone size measurements into the LIS.
3. Organisms that show flattening of the clindamycin zone adjacent to the erythromycin disk in the shape of the letter D (referred to as a “D” zone) have inducible clindamycin resistance. Enter into the LIS under LIS drug “D zone” the presence or absence of “D” zone as “Y” or “N”. Isolates that
show the presence of D zone will be automatically reflexed in the LIS to report as “clindamycin resistant”.
Examples of Zone of Inhibition Patterns and their Interpretation:

- **Both E and DA are Susceptible.** Report both E and DA as S

- **Both E and DA (measured at the narrowest side) are I or R; “D” zone is positive – Inducible MLSB; presumed genotype: *erm***
  - Report both E and DA as R

- **Both E and DA I or R – Inducible or constitutive MLSB; presumed genotype: *erm***
  - Report both E and DA as R
E is I or R and DA is S – M phenotype; presumed genotype: mef. Report E as I or R and DA as S.
V. Quality Control

See Clinical and Laboratory Standards Institute (CLSI) Document - M100-S23 Table 3 for acceptable QC results.

VI. References


*Streptococci* and *Staphylococcus* (overview of macrolides and lincosamide resistance)
Leclercq CID 2002; 34:482-92

*Streptococcus pneumoniae*
Descheemaeker et al JAC 2000 45:167-173

Beta-haemolytic streptococcus (Groups A, B, C, G)
GAS Descheemaeker et al. JAC 2000 45:167-173
GBS de Azavedo et al. AAC 1001;45:3504-3508
GCS & GGS Kataja et al. AAC 1998;42:1493-1494
III - Double Disk Test for ESBL Confirmation

I. Introduction

Cefpodoxime*, third generation cephalosporins, and aztreonam are all extremely susceptible to ESBLs and can be used as screening agents to test for the presence of ESBLs. CLSI suggests using screening MIC and disk diffusion zones breakpoints for these antibacterials that are distinct from treatment breakpoints to screen for ESBLs.

When *E. coli*, *Klebsiella* species or *Proteus* species are cefpodoxime resistant by Vitek OR either cefpodoxime or any 3rd generation cephalosporin or aztreonam are tested “resistant” by disk diffusion and screening breakpoints are used, confirmation of the presence of ESBL can be determined by the double disk test.

*Cefpodoxime alone can be used to screen for the presence of ESBL. UHN/MSH data from isolates in 2000 to 2006 did not reveal any *E. coli*, *Klebsiella* species or *Proteus* species that are cefpodoxime susceptible but 3rd generation cephalosporin or aztreonam resistant.

II. Materials

Mueller-Hinton (MH) agar (150) mm
20/10 mg amoxicillin-clavulanate disk
30 mg ceftazidime disk
30 mg ceftriaxone or cefotaxime disk
30 mg aztreonam disk
10 mg cefpodoxime disk (optional)
30 mg cefoxitin disk
30 mg ceftepime disk
5 mg ciprofloxacin disk (for Infection Control Screen orders)
10 mg ertapenem disk (for Infection Control Screen orders or if Vitek susceptibility has not been done)
10 mg gentamicin disk (for Infection Control Screen orders)
10 mg meropenem disk (for Infection Control Screen orders)
110 mg piperacillin/tazobactam disk
Quality control strain: *E. coli* ATCC 35218

III. Procedure

1. Prepare a bacterial suspension of the organism to be tested that has a turbidity equivalent to a 0.5 McFarland standard.

2. Inoculate a Mueller-Hinton agar plate with this suspension in accordance with CLSI M100-S23 guidelines for disk diffusion testing.
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3. Place the amoxicillin-clavulanic acid disk on the plate so that ceftriazone, ceftazidime, aztreoman and cefpodoxime disks may be placed around it with 15 mm between disk edges (See Figure 1. KB-ESBL Template). Add cefoxitin, cefepime and piperacillin/tazobactem disks on other parts of the plate. If Vitek susceptibility has not been done, add ertapenem disk.

4. For Infection Control screen orders, add ciprofloxacin, ertapenem and gentamicin disks. (See Figure 2. Infection Control KB-ESBL Template)

5. Incubate 35°C, in O₂ x 18-24 hours and record the zone diameters for the all cephalosporins as per CLSI guidelines.

6. For *E. coli*, *Klebsiella* species and *Proteus* species, instead of using standard cutoffs to determine S, I or R, ESBL screening test cutoffs are used and interpretations as R and S are reported if zone size is < or > of these screening breakpoints.
Figure 1. KB-ESBL Template

To be used for ESBL Screen isolates where Vitek card has been set up.
Figure 2. Infection Control KB-ESBL Template

To be used for Infection Control ESBL Screen isolates where Vitek card has NOT been set up.
IV. Interpretation

Note: The following applies to cefpodoxime-nonsusceptible *E. coli*, *Klebsiella* species and *Proteus* species only.

1. After incubation, measure the diameters of the zone of complete inhibition with callipers/ruler. Measure at the narrowest side of the zone.
2. Document zone size for all antibiotics into the LIS.
3. Observe for **potentiation** of the inhibition zone (i.e. *increase* in the inhibition zone) of any one of cefpodoxime, ceftazidime, ceftriaxone or aztreonam when combined with clavulanic acid (enter **Yes** or **No** to the “drug” named “Potentiation” in the LIS).
4. If a **reduction** of zone of inhibition of any one of cefpodoxime, ceftazidime, ceftriaxone or aztreonam when combined with clavulanic acid is observed (i.e. a D zone formation), enter **Yes** or **No** to the “drug” named “D zone” in the LIS. Recheck the identification of the isolate and repeat testing if the identification is questionable.

**Class A ESBL present:**
   i) Potentiation of the inhibition zone of any one of cefpodoxime, ceftazidime, ceftriaxone or aztreonam when combined with clavulanic acid (see below for examples of different patterns of potentiation that can be seen with organisms that contain Class A ESBLs)
   ii) Susceptible to cefoxitin.
   iii) Susceptible, Intermediate or Resistant to any one of ceftazidime, ceftriaxone or aztreonam

**Class A and Class C ESBL present:**
   i) Potentiation of the inhibition zone of any one of cefpodoxime, ceftazidime, ceftriaxone or aztreonam when combined with clavulanic acid
   ii) Resistant or Intermediate to cefoxitin.
   iii) Susceptible, Intermediate or resistant to any one of ceftazidime, ceftriaxone or aztreonam

**Class C-ESBL present:**
   i) No potentiation with clavulanic acid
ii) Resistant or Intermediate to cefoxitin

iii) Resistant to any one of ceftazidime, ceftriaxone or aztreonam.
Inducible Class C-ESBL present:
- i) No potentiation with clavulanic acid
- ii) Resistant or Intermediate to cefoxitin
- iii) Susceptible, Intermediate or Resistant to any one of ceftazidime, ceftriaxone or aztreonam.
- iv) D zone with clavulanic acid

ESBL not Class A or Class C present:
- i) No potentiation with clavulanic acid
- ii) Susceptible to cefoxitin
- iii) Resistant to any one of ceftazidime, ceftriaxone or aztreonam

ESBL absent:
- i) No potentiation with clavulanic acid
- ii) Susceptible, Intermediate or resistant to cefoxitin
- iii) Susceptible to all of ceftazidime, ceftriaxone or aztreonam

V. Reporting

<table>
<thead>
<tr>
<th>Reporting Comment</th>
<th>Potentiation of the inhibition zone of any one of cefpodoxime, ceftazidime, ceftriaxone or aztreonam when combined with clavulanic acid (enter Y or N to the “drug” “Potentiation” in the LIS)</th>
<th>Cefoxitin</th>
<th>Ceftazidime, ceftriaxone or aztreonam</th>
<th>D zone (enter Y or N to the “drug” “D zone” in the LIS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The susceptibility pattern suggests that this organism contains a class A extended spectrum beta-lactamase (ESBL).</td>
<td>Yes</td>
<td>S</td>
<td>S/I/R</td>
<td>N</td>
</tr>
<tr>
<td>The susceptibility pattern suggests that this organism contains class A and C extended spectrum beta-lactamases (ESBL).</td>
<td>Yes</td>
<td>I/R</td>
<td>S/I/R</td>
<td>N</td>
</tr>
<tr>
<td>The susceptibility pattern suggests that this organism contains class A and an inducible class C extended spectrum beta-lactamases (ESBL).</td>
<td>Yes</td>
<td>I/R</td>
<td>S/I/R</td>
<td>Y</td>
</tr>
</tbody>
</table>
**Reporting Comment** | **Potentiation of the inhibition zone** | **Cefoxitin**, **Ceftazidime, ceftriaxone or aztreonam** | **D zone**
---|---|---|---
The susceptibility pattern suggests that this organism contains a class C extended spectrum beta-lactamase (ESBL). | No | I/R | R | N
The susceptibility pattern suggests that this organism contains an inducible class C extended spectrum beta-lactamase (ESBL). | No | I/R | S/I/R | Y
The susceptibility pattern suggests that this organism contains an extended spectrum beta-lactamase (ESBL) other than class A or C. | No | S | R | N
Not ESBL – no reporting comment | No | S/R | S | N

For *E. coli*, *Klebsiella* species and *Proteus* species that are confirmed to have an ESBL of any class, report all pencillins and first, second and third generation cephalosporins as R; for Class A, also report fourth generation cephalosporins (i.e. cefepime) as R.

For carbapenemase reporting, see [Carbapenemase Reporting](#) section.
VII. References


6. CLSI. Performance standards for antimicrobial susceptibility testing; Eighth informational supplement. CLSI document M100-S23 [ISBN 1-26238-337-X]. CLSI, 940 West Valley Road, Suite 1400, Wayne, Pennsylvania 19087-1898 USA, 2013)


IV - Beta-Lactamase Testing

I. Introduction

Cefinase disks are intended for use in rapid testing of isolated colonies of Neisseria gonorrhoeae, M. catarrhalis, Staphylococcus species, Enterococcus species, Haemophilus influenzae and anaerobic bacteria for the production of beta-lactamase. Refer to CRITERIA FOR SUSCEPTIBILITY TESTING for appropriate beta-lactamase testing.

The Cefinase disk is impregnated with the chromogenic cephalosporin, Nitrocefin. This compound exhibits a very rapid colour change from yellow to red as the amide bond in the beta-lactam ring is hydrolyzed by beta-lactamase. When a bacterium produces this enzyme in significant quantities, the yellow-coloured disk turns red in the area where the isolate is smeared.

Although other penicillins and cephalosporins may be used as substrates for specific enzymes, Nitrocefin has the wide spectrum of susceptibility and sensitivity of the commercially available beta lactams. It is not known to react with other microbial enzymes.

II. Materials

Cefinase disks (BBL) (store refrigerated)
Sterile distilled water
Microscope slides
Sterile Pasteur pipettes

III. Procedure

1. Using forceps remove the required number of disks from the dispenser and place on a microscope slide. Use 1 disk per organism.

2. Using a sterile Pasteur pipette, moisten each disk with a drop of sterile water.

3. With a sterile loop or applicator stick, pick several similar colonies from the agar plate and smear onto the surface of the disk.

4. Observe the disk for up to 5 minutes for a colour change. For staphylococci, observe the disks for up to 60 minutes.
### IV. Interpretation

Positive: yellow to red colour change on the area where the culture was applied. Note: colour change does not usually develop over the entire disk. A negative result will show no colour change on the disk.

Negative: no colour change

For most bacterial strains a positive result will develop within 5 minutes. However, positive reactions for some staphylococci may take up to 1 hour to develop.

<table>
<thead>
<tr>
<th>Organisms</th>
<th>Result</th>
<th>Approx. Reaction Time</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>Positive</td>
<td>1 hr</td>
<td>Resistant to penicillin, ampicillin, carbenicillin. Probably susceptible to cephalothin, methicillin, oxacillin, nafcillin and other penicillinase-resistant penicillins.</td>
</tr>
<tr>
<td><em>Enterococcus faecalis</em></td>
<td>Positive</td>
<td>5 min</td>
<td>Resistant to penicillin and ampicillin.</td>
</tr>
<tr>
<td><em>Haemophilus influenzae</em></td>
<td>Positive</td>
<td>1 min</td>
<td>Resistant to ampicillin Susceptible to cephalosporins.</td>
</tr>
<tr>
<td><em>Neisseria gonorrhoeae</em> and <em>Branhamella catarrhalis</em></td>
<td>Positive</td>
<td>1 min</td>
<td>Resistant to penicillin. Probable identification is <em>Bacteroides</em> species. Probably resistant to penicillin and may be resistant to cephalosporins including cefotaxime and rarely cefoxitin.</td>
</tr>
<tr>
<td>Anaerobic bacteria</td>
<td>Positive</td>
<td>30 mins</td>
<td></td>
</tr>
</tbody>
</table>

### V. Quality Controls

Set up positive and negative controls whenever a test is performed.

- *Haemophilus influenzae* ATCC 35056: Positive
- *Haemophilus influenzae* ATCC 10211: Negative

### VI. Reference

- BBL paper Disks for the Detection of β-Lactamase Enzymes, Cefinase Disks, package insert 2004/06.
V - Oxacillin Screen Plate

I. Introduction

This is an agar dilution method using a single concentration of oxacillin incorporated into Mueller Hinton (MH) agar to screen for resistant strains of *S. aureus*.

II. Materials

- Control plate (MH with 4% NaCl)
- Screen plate (MH with 4% NaCl and 6 μg/mL Oxacillin)
- VITEK colourimeter
- Sterile saline
- Sterile swabs

III. Procedure

1. Using the VITEK colourimeter, prepare a suspension with isolated colonies of the test organism (from solid medium after overnight culture) in sterile saline equivalent to a 0.5 McFarland standard (inoculum prepared for VITEK can be used).

2. Retrieve OXA, NACL, BHI with casein and VISA plates from fridge and their corresponding registration label (Lot number and expiry date). Affix the appropriate label to the reverse side of the worksheet **OXACILLIN AND VANCOMYCIN SCREEN RECORDING SHEET FOR S. aureus**. Write the date of testing on the sheet

3. Using a sterile swab, spot inoculate the suspension onto the screen and control plates. Numerous organisms can be tested on one plate (use grid TEMPLATE).

4. After the inocula have dried, incubate the plate at 35°C, O₂ for a total of 24 hours.

5. All resistant isolates on the screen plate must be checked for purity (e.g. Gram stain, *S. aureus* tube coagulase or slide agglutination and sub-culture). The resistance must be confirmed by Denka MRSA Screen (Refer to Denka MRSA Screen). Send a preliminary report as ISOLATE: Methicillin-resistant *S. aureus* and report to infection control.

IV. Interpretation

Growth on the screen plate indicates that the organism is methicillin resistant and therefore is considered resistant to all beta-lactam Antimicrobials (eg. penicillin, oxacillin, cephalosporins). Note: test is valid only for organisms which grow on the control plate.
V. Quality Control

Controls must be tested each day. The organisms are to be sub-cultured from the TSA slant (in refrigerator) to Blood Agar each day.

Sensitive: *S. aureus* ATCC 29213

Sensitive/ Haze : *S. aureus* ATCC 43387

Resistant: *S. aureus* LPTP 8610-1
*S. aureus* ATCC 43300

VI. Reference

Oxacillin and Vancomycin Screen Plate Template FOR *S. aureus*

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### Antimicrobial Susceptibility Manual - OXACILLIN AND VANCOMYCIN SCREEN RECORDING SHEET FOR S. aureus page 1

Enter Lot number of OXA, NACL, VISA, BHI+casein on the back of this worksheet.

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<th>Set up by:</th>
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<tr>
<th>No. / Bench</th>
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<th>OXA 18h</th>
<th>24h</th>
<th>VISA 18h</th>
<th>24h</th>
<th>48h</th>
<th>NACL Gr/NG</th>
<th>BHIA+ Casein Gr/NG</th>
<th>No. / Bench</th>
<th>Lab No.</th>
<th>OXA 18h</th>
<th>24h</th>
<th>VISA 18h</th>
<th>24h</th>
<th>48h</th>
<th>NACL Gr/NG</th>
<th>BHIA+ Casein Gr/NG</th>
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<td>S. aureus LPTP 8610</td>
<td>R</td>
<td>S</td>
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<td></td>
</tr>
</tbody>
</table>

18h OXA + VISA read by:  
24h OXA + VISA read by:  
48h VISA read by:
OXACILLIN AND VANCOMYCIN SCREEN RECORDING SHEET FOR S. aureus page 2
Policy #MI\ANTIR04\05bv05

Lot number and expiry date labels:

OXA____________________

NACL___________________

VISA___________________

BHIC___________________
VI – PBP2 MRSA Screen

**Principle**

To be used as a screening test for the detection of Methicillin Resistant *S. aureus* (MRSA) from isolated colonies.

**Reagents**

- PBP2a SA Culture Colony Test Kit (Alere)
- Oxoid Needle
- Vortex

**Safety Precautions**

Wear eye protection, protective clothing, protective gloves.

**Method**

1. Holding the dropper bottle vertically, add two drops of Reagent 1 to an assay tube.
2. Take 3 well-grown-isolated colonies on the culture plate, place into the tube and thoroughly mix.
3. Holding the dropper bottle vertically, add two drops of Reagent 2 to the tube.
4. Vortex briefly. The blue solution must turn a clear color (if the color does not change, add one more drop of Reagent 2 and mix until the sample turns clear).
5. Insert the test strip into the tube with arrow pointed downward.
6. At five minutes, withdraw the strip from the tube and read the result.
   - The control area is read at the top half of the strip
   - The test area is read at the bottom half of the test strip
**Interpretation**

A positive result is interpreted by a pink/purple control line on any intensity (faint or strong appearance).

<table>
<thead>
<tr>
<th>Test Area</th>
<th>Control Area</th>
<th>Example</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>+</td>
<td><img src="image" alt="Control Sample" /></td>
<td>Negative – Not MRSA</td>
</tr>
<tr>
<td>+</td>
<td>+</td>
<td><img src="image" alt="Control Sample" /></td>
<td>Positive – MRSA</td>
</tr>
<tr>
<td>- or +</td>
<td>-</td>
<td><img src="image" alt="Control Sample" /></td>
<td>Invalid</td>
</tr>
</tbody>
</table>

Repeat any invalid test results with a new strip

**Induced PBP2 MRSA Screen**

For discrepant *S.aureus* results perform an **Induced** PBP2 MRSA Screen:

1. Prepare a 0.5 mcFarland standard using isolated colonies.
2. Using a sterile cotton swab, inoculate the organism onto MH agar with a cefoxitin disk. Incubate in O2 at 35°C overnight.
3. Measure and document the zone size around the cefoxitin disk.
4. Repeat PBP2 MRSA Screen using growth closest to the cefoxitin disk.
5. If Induced PBP2 MRSA Screen is positive, it is a confirmed *S. aureus* report as MRSA.

If cefoxitin-induced DENKA is negative, check the Vitek Oxacillin MIC and Cefoxitin screen and Oxacillin screen result. Refer to [How to Detect MRSA/BORSA](#) section for further testing and reporting.
Quality Control

Positive and negative controls must be set up once per week.

1. Positive: S.aureus ATCC 43300
2. Negative: S.aureus ATCC 29213

Reference

Alere Scarborough, Inc., Maine, USA, PBP2a SA Culture Colony Test insert 2017
VII - Serum Bacteriostatic and Bactericidal Titres

I. Introduction

In the treatment of bacterial endocarditis or osteomyelitis, it may be important to know whether the prescribed dosage of antimicrobials are achieving blood levels sufficiently high enough to kill the causative organism.

The bacteriostatic level is the dilution of serum that inhibits visible bacterial growth; the bactericidal level is the serum dilution that kills 99.9% of the initial inoculum.

NOTE: This test is to be performed only with the approval of a microbiologist.

II. Specimen Collection

The dose, the time the dose was given, and the time of collection must be recorded on the requisition. Pre- and post-dose blood specimens are obtained in serum separator tubes. The pre-dose blood specimen is drawn immediately before administering the next dose of antimicrobial in order to evaluate the pre (trough) level. Blood for the post-dose (peak) level should be drawn 1 hour after an intravenous infusion has been started, 1 hour after an intramuscular dose and 1 to 2 hours after an oral dose.

III. Reagents/Materials/Media

- Mueller Hinton Broth (MHB) (100 mL)
- Blood Agar (BA)
- Sterile 13 x 100 mm glass tubes
- Sterile 1.0 mL pipettes
- Sterile yellow pipette tips
- Test tube racks
- Pipetter
- Precision pipette to deliver 20 μL

IV. Procedure

A. Processing of Specimens

Upon arrival in the laboratory, centrifuge the blood and aseptically transfer the serum into a sterile tube.
**B. Preparation of bacterial suspension:**

Inoculate several colonies of a pure culture of the patient's organism (overnight sub-culture) into 5 mL MHB. Incubate on a shaker at 36°C for a minimum of 3 hours or until it achieves turbidity greater than the 0.5 McFarland standard (approximately $1.3 \times 10^8$ CFU/mL).

**C. Serum dilution:**

a. Place 12 sterile test tubes in a rack for each serum sample to be diluted.

b. Number the tubes 1 to 12.

c. Aseptically pipette 1.0 mL of patient's serum into tubes 1 and 2.

d. Aseptically pipette 1.0 mL of MHB into tubes 2-12.

e. With a new 1.0 mL sterile pipette transfer 1.0 mL of serum from tube 2 to tube 3. Mix well.

f. Serially dilute the serum by sequentially transferring 1.0 mL of the mixture through to tube 10. Discard 1.0 mL of the mixture from tube 10. No serum is to be added to tube 11 (positive inoculum control) or to tube 12 (broth sterility control). The final dilution of serum in tube 10 is 1:512 and final volume in all tubes should be 1.0 mL.

**D. Inoculating Broth**

a. Using the Vitek colourimeter, dilute the bacterial suspension to the turbidity of a 0.5 McFarland standard using MHB.

b. Prepare a 1:4 dilution of the standardized inoculum by adding 1.0 mL of inoculum to 3.0 mL MHB. Mix well.

c. Using a precision pipette, dispense 20 μL (0.02 mL) of diluted inoculum into tubes 1 through 11. Inserting the pipette tip well under the surface of the antimicrobial containing serum broth mixture. AVOID ANY CONTACT BETWEEN THE TIP AND THE WALLS OF THE TUBE - to prevent transfer of organisms to the inside of tube above the meniscus. Mix by flushing 2 or 3 times without creating air bubbles or splashing. Use a new tip for each tube.

d. Incubate all tubes at 37°C for 20 hours in a CO₂-free incubator.

e. From the 1:4 dilution of the standardized inoculum, dilute 1:250 in MHB (0.1 mL in 24.9 mL MHB) to achieve an inoculum of $10^5$ CFU/mL.

f. Perform a colony count to confirm the bacterial count in the final inoculum. Transfer 0.001 mL of diluted inoculum to BA using a urine loop and distribute evenly on the surface of a BA plate.

g. Incubate the BA plate overnight at 35°C.

**Determination of serum bacteriostatic titres**

1. After incubation, tube 12 (broth sterility control) should be clear while tube 11 (positive inoculum control) should be turbid.

2. Record the colony count. The colony count plate should have 75-150 colonies. If the colony count is <75 or >150 consult the charge technologist before reading the tubes.
3. The highest dilution of serum that completely inhibits visible growth represents the bacteriostatic titre.

Determination of serum bactericidal titre

1. Vortex all tubes without visible growth for 15 seconds.

2. Use a urine loop to subculture all of the clear tubes onto 1/4 BA. Incubate at 37°C for 18 hours.

3. After incubation, read the plates and record the colony count.

4. The first dilution showing 99.9% killing activity (ie. no growth on sub-culture) is reported as the serum bactericidal titre.

V. Reporting Results

Telephone all results when available. Report as follows and give a copy of the report to the microbiologist:

Pre-dose serum bacteriostatic titre -
Pre-dose serum bactericidal titre -

Post-dose serum bacteriostatic titre -
Post-dose serum bactericidal titre -

VI. Reference

VIII - Broth Macrodilution and Agar Dilution

I. Introduction

These tests are not routinely done and will only be performed following consultation with a microbiologist. Refer to the CLSI standard M7-A9, 2012 for methodology.
IX - Broth Microdilution MIC

I. Introduction

Dilution susceptibility testing methods are used to determine the minimal concentration of an antimicrobial agent required to inhibit or kill a microorganism. Antimicrobial agents are usually tested at log₂ (twofold) serial dilutions, and the lowest concentration that inhibits visible growth of an organism is regarded as the MIC. The concentration range used may vary with the drug, the organism tested, and the site of infection. The method and principles of the microdilution method is essentially the same as the macrodilution method except that the antimicrobial dilutions are in 0.1 mL volumes contained in wells of a microdilution tray (usually 96 well trays). Results obtained may be reported as the actual MIC or categorically as Susceptible (S), Intermediate (I), or Resistant (R). Interpretive categories are published and up-dated regularly by CLSI.

II. Materials

Sterile saline
Transfer pipettes
Sterile distilled water
Vitek colorimeter
MIC microtitre panel
Inoculator (tray and lid)

III. Procedure

1. Remove the desired MIC panel from the –70°C freezer. Place a cover over the panel and place into the O₂ incubator to thaw.

2. When thawed, label the panel and a blood agar plate with the order number.

3. Prepare a suspension of the test organism in sterile saline equivalent to a 0.5 McFarland standard using isolated colonies.

4. Transfer 1.5 mL of the suspension into the inoculation tray and add approximately 30 mL of sterile distilled water.

5. Aseptically replace the transfer lid into the inoculating tray making sure no bubbles are under the prongs.
6. Lift the transfer lid and center it over the previously thawed MIC panel.

7. Align the left side (lettered) of the panel with the left side (lettered) of the inoculator.

8. Lower the transfer lid into the panel so the prongs enter all wells.

9. Remove transfer lid and cover the panel with a dummy MIC panel.

10. Record the date and time of panel set-up on the lid of the panel.

11. Using a transfer pipette, transfer 1 drop of suspension from the inoculation tray to a blood agar plate and streak for isolated colonies.

12. Pour the suspension into a sharps container containing hypochloride and discard the inoculator into a sharps disposal box.

13. Incubate for in O₂ at 35°C. For Staphylococcus and Enterococcus, read panel after 16-20 hours incubation. Reincubate the panel and read the oxacillin and vancomycin at 24 hours.

IV. Interpretation

The highest dilution of the antimicrobial that completely inhibits visible growth represents the minimum inhibitory concentration (MIC).

V. Quality Control

Panels are Quality Controlled with the appropriate ATCC control organisms.

For troubleshooting out-of-range QC results, see CLSI Document M100-S23 Table 3F (page 158).

VI. Reference

X - Etest

I. Introduction

The Etest (also known as the Gradient Diffusion Method) is based on the same principle as the disk diffusion method. It is an in vitro method for quantitative antimicrobial susceptibility testing whereby a preformed antimicrobial gradient from a plastic-coated strip diffuses into an agar medium inoculated with the test organism. The MIC values are read directly from the scale on the top of the strip, typically at the point where the ellipse of organism growth inhibition intercepts the strip, but this may vary slightly between drug and organism types and should be checked.

II. Materials

Etest strips (AB BIODISK, bioMerieux, store at -20°C and with desiccant when opened)
Brain Heart Infusion Agar with Casein (BBL BHIA or Oxoid BHIA plus Casein)
Mueller-Hinton Agar (MHA)
BBL-Mueller-Hinton Agar (BD BBL-MHA)
Mueller-Hinton Blood Agar (MHBA)
BBL-Mueller-Hinton Blood Agar (BD BBL-MHBA)
Haemophilus Test Media (HTM)
RPMI 1460 (contains L-glutamine) + 2% Glucose + MOPS + 1.5% Bacto Agar (Oxoid)
Trypticase Soy Broth (TSB) (3 mL)
Mueller-Hinton Broth (MHB) (3mL)
Sterile saline (3-5mL)
VITEK colourimeter
Sterile wooden sticks
Sterile swabs

III. Procedures

1. Allow Etest strips to come to room temperature before opening the container.

2. Use the Vitek colourimeter to prepare a suspension of the test organism in sterile saline unless otherwise specified. If there is not enough growth, inoculate the organism into TSB, and incubate at 35°C for 2-4h or until it reaches sufficient turbidity to prepare the required McFarland standard. Use pure culture for testing ONLY

   a) For testing non-fastidious organisms to most antibiotic combinations, prepare a bacterial suspension equivalent to a 0.5 McFarland standard using isolated colonies.

   b) For very mucoid organisms, adjust the suspension to a 1.0 McFarland standard.
c) For detecting reduced susceptibility to glycopeptides in *Staphylococcus aureus* (VISA or hVISA) or acquired glycopeptide resistance in *Enterococcus* species (VRE) using the MacroEtest Method, prepare a bacterial suspension equivalent to a 2.0 McFarland standard using isolated colonies and inoculate to a BBL BHIA or Oxoid’s BHI plus Casein Agar for testing both teicoplanin and vancomycin (For Etest Macromethod procedure for *S. aureus*, see EAS-003 Staphylococci, and for enterococci, see EAS 006 Enterococci from [http://www.abbiodisk.com/bd_litt_eas.html](http://www.abbiodisk.com/bd_litt_eas.html)).

d) For determining standard glycopeptide MIC by Etest in coagulase-negative staphylococci, use a 0.5 MacFarland equivalent suspension prepared in saline, plate to MHA and test vancomycin only (See EAS 003 Staphylococci from [http://www.abbiodisk.com/bd_litt_eas.html](http://www.abbiodisk.com/bd_litt_eas.html)).

e) For determining MIC by Etest to *Streptococcus pneumoniae* or *Haemophilus influenzae*, prepare in Mueller-Hinton broth a 0.5 MacFarland equivalent bacterial suspension (if non-mucoid) or a 1.0 MacFarland (if mucoid) using a blank tube of MHB to adjust the Vitek colourimeter instead of a blank saline. (See EAS 010 and CIS 004 for *Streptococcus pneumoniae*, and EAS 005 for *Heamophilus* spp. from or [http://www.abbiodisk.com/bd_litt_eas.html](http://www.abbiodisk.com/bd_litt_eas.html)). Plate suspension to the appropriate agar without delay to prevent loss of cell viability within the suspensions as this will negatively affect interpretation of results.

f) For determining MIC for yeasts by Etest (i.e. caspofungin) prepare organism suspensions in saline equivalent to a 0.5 MacFarland for *Candida* spp. and to a 1.0 MacFarland for *Cryptococcus* spp. For these organisms, ensure to “double dip” the swab when inoculating the RPMI: i.e. after inoculating the plate the first time, soak the swab again and repeat the process a second time (See EAS 006 and CIS 005 Media for Antifungal testing from [http://www.abbiodisk.com/bd_litt_eas.html](http://www.abbiodisk.com/bd_litt_eas.html)).

3. Use a sterile cotton swab to inoculate the organism onto an appropriate agar plate, streaking in 3 directions over the entire agar surface.

   a) For non-fastidious, rapid-growing organisms (excluding those below) use MHA.

   b) For VRE detection in *Enterococcus* and VISA/hVISA detection in *Staphylococcus aureus*, test both vancomycin AND teicoplanin, evenly applying the heavy suspension to BBL BHIA or Oxoid “BHIA with Casein” (See EAS 009 from [http://www.abbiodisk.com/bd_litt_eas.html](http://www.abbiodisk.com/bd_litt_eas.html)).

   c) For testing daptomycin in *Staphylococcus aureus*, coagulase-negative staphylococci or enterococci, use BD BBL MHA (or confirm Ca++ concentration in another brand is between 25-40mg/L) (See CIS 014 from [http://www.abbiodisk.com/bd_litt_eas.html](http://www.abbiodisk.com/bd_litt_eas.html)).
d) For MIC to agents other than glycopeptides in *S. aureus* and enterococci, use MHA inoculated with 0.5 MacFarland equivalent bacterial suspensions.

e) For *Haemophilus* spp. use HTM (See EAS 005 from [http://www.abbiodisk.com/bd_litt_eas.html](http://www.abbiodisk.com/bd_litt_eas.html))

f) For *S. pneumoniae* or viridans streptococci use BD BBL-MHBA (See CIS 004 from [http://www.abbiodisk.com/bd_litt_eas.html](http://www.abbiodisk.com/bd_litt_eas.html)).

g) For organisms that do not grow on MHA without blood, use MHBA.

4. Use sterile forceps to apply the appropriate Etest strip, MIC scale facing upwards, onto the appropriate agar making sure no bubbles remain trapped under the strip.

   a) Apply the strip ONLY AFTER the suspension has been allowed to dry thoroughly for at least 15 minutes. If strips are applied when plates are still wet, a ridge of growth running up the base of the strip will occur that will make interpretation difficult – if this happens, this growth should always be ignored.

   b) A maximum of two Etest strips may be placed on a small plate and a maximum of six strips may be placed on a large plate. When placing multiple strips on one plate, always ensure that the expected elliptical diffusion zones of adjacent drugs are not close enough to overlap.

5. Incubate plates as follows:

   a) Non-fastidious organisms (except those specified below) - O₂, 35°C x 18h

   b) *Haemophilus* species - CO₂, 35°C x 18h

   c) *Streptococcus pneumoniae* or viridans streptococci - CO₂, 35°C x 20-24h

   d) For MacroEtest with vancomycin and teicoplanin against *Staphylococcus aureus* and *Enterococcus* spp. - O₂, 35°C x 24h and 48h

   f) For *Candida* spp. (plates in plastic bag) O₂, 35°C x 24-48h (when testing *C. glabrata* and *C. tropicalis*, MIC must always be confirmed at 48h)

   g) For *Cryptococcus* spp. (plates in plastic bag) O₂, 35°C x 48-72h
ETEST Procedure Summary:

**Staphylococcus aureus** set up all of the following if Vitek MIC =>2 mg/L OR Growth on Vancomycin Screen:

<table>
<thead>
<tr>
<th>Antimicrobial</th>
<th>Inoculum</th>
<th>Media</th>
<th>Incubation</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancomycin-macro + Teicoplanin-macro</td>
<td>2.0 McFarland Std.</td>
<td>BHI with Casein Agar (OXOID)</td>
<td>35°C in O₂</td>
<td>At 24 hours and 48 hours</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>0.5 McFarland Std.</td>
<td>Mueller Hinton Agar (OXOID)</td>
<td>35°C in O₂</td>
<td>At 24 hours</td>
</tr>
</tbody>
</table>

**Coagulase-negative-Staphylococcus** or **Enterococcus set up if Vitek vancomycin = I or R OR Growth on Vancomycin Screen**:

<table>
<thead>
<tr>
<th>Organism</th>
<th>Antimicrobial</th>
<th>Inoculum</th>
<th>Media</th>
<th>Incubation</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coagulase-negative-</td>
<td>Vancomycin</td>
<td>0.5 McFarland Std.</td>
<td>Mueller Hinton Agar (OXOID)</td>
<td>35°C in O₂</td>
<td>At 24 hours</td>
</tr>
<tr>
<td>Staphylococcus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Enterococcus species</strong></td>
<td>Vancomycin +</td>
<td>2.0 McFarland Std.</td>
<td>BHI with Casein Agar (OXOID)</td>
<td>35°C in O₂</td>
<td>At 24 hours and 48 hours</td>
</tr>
<tr>
<td>Teicoplanin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Other organisms:**

<table>
<thead>
<tr>
<th>Organism</th>
<th>Inoculum</th>
<th>Media</th>
<th>Incubation</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-fastidious organisms</td>
<td>0.5 McFarland Std.</td>
<td>Mueller Hinton Agar (OXOID) (Mueller Hinton with Blood if organism fails to grow)</td>
<td>35°C in O₂</td>
<td>At 18 hours</td>
</tr>
<tr>
<td>Mucoid Organisms</td>
<td>1.0 McFarland Std.</td>
<td>Media appropriate for the organism</td>
<td>35°C in O₂</td>
<td>At 18 hours</td>
</tr>
<tr>
<td><em>Haemophilus</em> species</td>
<td>0.5 McFarland Std.</td>
<td>Hemophilus Test Medium (HTM)</td>
<td>35°C in CO₂</td>
<td>At 18 hours</td>
</tr>
<tr>
<td><em>Streptococcus pneumoniae</em> or viridans streptococci</td>
<td>0.5 McFarland Std.</td>
<td>BD BBL-MHBA</td>
<td>35°C in CO₂</td>
<td>At 20 to 24 hours</td>
</tr>
<tr>
<td><em>Candida</em> species</td>
<td>0.5 McFarland Std.</td>
<td>RPMI 1460 using “double dip” yeast inoculation technique</td>
<td>35°C in O₂</td>
<td>At 24 to 48 hours</td>
</tr>
<tr>
<td><em>Cryptococcus</em> species</td>
<td>1.0 McFarland Std.</td>
<td>RPMI 1460 using “double dip” yeast inoculation technique</td>
<td>35°C in O₂</td>
<td>At 48 to 72 hours</td>
</tr>
</tbody>
</table>
Interpretation

After the appropriate incubation, read the MIC value as per AB BIODISK instructions. Note: reading and interpretations are often drug-organism specific. Therefore check specific instructions first for each drug-organism combination.

ETEST Reading Guide
Antimicrobial effect: Cidal or Static
Etest Use - Reading powerpoint.pdf

1. For bactericidal drugs, the MIC is typically read at the point of complete inhibition where the zone edge intersects the Etest strip, whereas for bacteriostatic agents, the MIC is read at 80% inhibition when trailing is seen (See CIS 006 from ETEST Reading Guide for mode of antibiotic action to determine which are read at complete versus 80% inhibition).

2. Since Etest comprises a continuous gradient, MIC values in between two-fold dilutions may be obtained. In most cases, these values may be rounded up to the next two-fold dilution before interpretation but DO NOT round up for ALL organism types without checking as exceptions exist (i.e. for vancomycin and teicoplanin with possible VISA) (See EAS 003 Staphylococci and CIS 002 Endpoints for Glycopeptides from ETEST Reading Guide).

3. Polymyxin B is prone to hazy endpoints, so to avoid these, stay on the lighter side of the 0.5MacFarland standard when preparing the bacterial suspension, and inoculate the MHA using a swab that has been squeezed of all excess fluid. Do not exceed the recommended 18h incubation time. When reading the MIC, read at the point of complete inhibition, and if there is a dip, read at the base of the dip. (See Etest Polymyxin B Reading CIS 007 and CIS 012 from ETEST Reading Guide).

4. For testing vancomycin and teicoplanin against Staphylococcus aureus use the Etest macromethod procedure to detect VISA or hVISA (See EAS 003 Staphylococci and CIS 002 Endpoints for Glycopeptides from ETEST Reading Guide):
   a) A VISA is defined as a S. aureus (MRSA or MSSA) with MIC to vancomycin AND teicoplanin of 8mg/L or greater, OR a teicoplanin MIC of 12mg/L or greater with a vancomycin MIC of <8mg/L (hence BOTH drugs MUST be tested simultaneously)
   b) To determine endpoints, it may be necessary to use a magnifying glass, oblique light and to tilt the plate
   c) Read at complete inhibition, looking for hazes, micro-colonies and isolated colonies within the zone of inhibition
d) DO NOT ROUND UP the MIC to the next two-fold value as with other organisms, especially if the *S. aureus* zone ellipse intersects the strip at 6mg/L, as this may result in a major error. Results of <8mg/L are interpreted as susceptible for vancomycin unless teicoplanin is 12mg/L or greater.
5. For **daptomycin** testing (See CIS 014 from ETEST Reading Guide, and Etest Daptomycin communiqué), it is necessary to:
   a) only use media that has a Ca++ concentration of 25-40mg/L (BD BBL MHA for staphylococci or enterococci, BD BBL MHBA for *S. pneumoniae*; awaiting information regarding the Ca++ concentration of Oxoid MHA and MHBA – apparently they corrected the CA++ a couple of years ago to comply with dapto testing requirements)
   b) only use bacterial suspensions that do not exceed the mid-range mark on the VITEK turbidometer for the 0.5 MacFarland Standard, as heavier suspensions may result in falsely elevated MIC
   c) squeeze out any excess liquid from the swab prior to inoculating the plate
   d) ensure that the plate dries for ~10-15min before applying the daptomycin Etest strip, as wet plates may result in growth up the side of the Etest strip, making results difficult to interpret
   e) confirm any daptomycin-resistant isolate by broth microdilution MIC testing

IV. Reporting

Report MIC values rounded up to the next two-fold dilution where indicated. DO NOT round up when reporting of macro-etest vancomycin and teicoplanin for *S. aureus*.

**Reporting vancomycin and teicoplanin for Staphylococcus aureus:**

<table>
<thead>
<tr>
<th></th>
<th>Vancomycin</th>
<th>Teicoplanin</th>
<th>Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macro-etest</td>
<td>&lt;8 mg/L</td>
<td>&lt;12 mg/L</td>
<td>Negative</td>
</tr>
<tr>
<td>Macro-etest</td>
<td>≥8 mg/L</td>
<td>≥8 mg/L</td>
<td>Positive</td>
</tr>
<tr>
<td>Macro-etest</td>
<td>&lt;8 mg/L</td>
<td>≥12 mg/L</td>
<td>Positive</td>
</tr>
</tbody>
</table>

**Reporting vancomycin and teicoplanin for Enterococcus:**

<table>
<thead>
<tr>
<th></th>
<th>Vancomycin</th>
<th>Teicoplanin</th>
<th>Phenotype</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macro-etest</td>
<td>≥32 mg/L (R)</td>
<td>≥16 mg/L (1 - R)</td>
<td>vanA</td>
<td><em>E. faecalis, E. faecium</em></td>
</tr>
<tr>
<td>Macro-etest</td>
<td>≥8 - 256 mg/L (I - R)</td>
<td>≤4 mg/L (1 - R)</td>
<td>vanB</td>
<td><em>E. faecalis, E. faecium</em></td>
</tr>
<tr>
<td>Macro-etest</td>
<td>4 – 16 mg/L (S - I)</td>
<td>≤4 mg/L (S)</td>
<td>vanC1</td>
<td><em>E. gallinarum</em></td>
</tr>
<tr>
<td>Macro-etest</td>
<td>4 – 16 mg/L (S - I)</td>
<td>≤4 mg/L (S)</td>
<td>vanC2</td>
<td><em>E. casseliflavus, E.flavescens</em></td>
</tr>
<tr>
<td>Macro-etest</td>
<td>64 mg/L (R)</td>
<td>≤4 mg/L (S)</td>
<td>vanD</td>
<td><em>E. faecium</em></td>
</tr>
<tr>
<td>Macro-etest</td>
<td>16 mg/L (I)</td>
<td>≤4 mg/L (S)</td>
<td>vanE</td>
<td><em>E. faecalis</em></td>
</tr>
</tbody>
</table>
V. **Quality Control**

1. The following four e-test strips (penicillin, ceftazidime, ceftriaxone and cefotaxime) are tested weekly with *S. aureus* ATCC 29213. The organism is sub-cultured from the TSA slant to BA the day before setting up the QC.

Expected Results*:

<table>
<thead>
<tr>
<th>MIC</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillin</td>
<td>0.25-2.0 mg/L</td>
</tr>
<tr>
<td>Ceftazidime</td>
<td>4.0-16.0 mg/L</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>1.0-8.0 mg/L</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>1.0-4.0 mg/L</td>
</tr>
</tbody>
</table>

* As per CLSI document M100-S23, 2013, Table 3.

VI. **Reference**

AB BIODISK, Sohna, Sweden, Etest package insert.


[https://kaldur.landspitali.is/gaeda/gnhsykla.nsf/5e27f2e5a88e898e00256500003c98c2/2030bf44cbec6e0e00256f23003f2169/SFILE/Fine-tuning%20Etest%20Use%20-%20Reading.pdf](https://kaldur.landspitali.is/gaeda/gnhsykla.nsf/5e27f2e5a88e898e00256500003c98c2/2030bf44cbec6e0e00256f23003f2169/SFILE/Fine-tuning%20Etest%20Use%20-%20Reading.pdf)
XI - Vancomycin & High Level Aminoglycoside Testing for *Enterococcus*

I. **Introduction**

Synergy between ampicillin, pencillin or vancomycin and an aminoglycoside for *Enterococcus* species can be predicted by high level aminoglycoside (HLA - gentamicin and streptomycin) screening test. Vancomycin resistance of *Enterococcus* species can be detected by BHI vancomycin agar screen plate containing 6mg/L of vancomycin.

II. **Materials**

Control plate (Brain Heart Infusion Agar)
Entero HLA and Vancomycin Screen plates
VITEK colorimeter
Sterile saline
Sterile swab

III. **Procedure**

1. Using the VITEK colourimeter, prepare a 0.5 McFarland suspension in sterile saline (inoculum from VITEK can be used).

2. Retrieve BHI, Vanco, and Hi-level Gent/Strept plates from fridge and their corresponding registration label (Lot number and expiry date) Affix the appropriate label to the reverse side of the worksheet. Write the date of testing on the sheet QUAD Screen Recording Sheet for *Enterococcus*

3. Using a sterile swab, spot inoculate the suspension onto each of the test and control plates (use grid TEMPLATE).

4. After the inocula have dried, incubate the plate at 35°C for up to 48 hours.

IV. **Interpretation**

Check the control plate for adequate growth. Then check the drug plates for absence or presence of growth; any growth is considered significant. Read plates at 24 hours and record results. If there is no growth on the streptomycin plate, re-incubate plate for an additional 24 hours.

Growth on Vancomycin Screen plate must be confirmed by checking the purity of the control plate, vancomysin E-test and repeat vancomycin screen testing.
V. **Quality Control**

Control strains are tested with each plate.

<table>
<thead>
<tr>
<th>Control Strains</th>
<th>Expected results of each quadrant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
</tr>
<tr>
<td><em>E. faecalis</em> (ATCC 49532)</td>
<td>+</td>
</tr>
<tr>
<td><em>E. gallinarum</em> (ATCC 49573)</td>
<td>+</td>
</tr>
<tr>
<td><em>E. faecalis</em> (ATCC 49533)</td>
<td>+</td>
</tr>
</tbody>
</table>

C = Growth Control; G = Gentamicin; S = Streptomycin; V = Vancomycin

VI. **Reporting Results**

Blood cultures and sterile sites and vancomycin is susceptible:

- If high level gentamicin is **susceptible** (regardless of streptomycin result) report as: 
  “Serious enterococcal infections may require an aminoglycoside for synergy. Please contact the Medical Microbiologist for treatment advice”.

- If high level gentamicin is **resistant** (regardless of streptomycin result) report as: 
  “This organism is high level aminoglycoside resistant. Please contact the Medical Microbiologist for treatment advice”.

- Record the streptomycin result in the LIS. Report result only upon request.

Urines and other sites:

- Do not report HLA.
- Report Vancomycin result as per specimen type specific reporting tables.

VII. **Reference**

### QUAD Screen Recording Sheet for *Enterococcus* Page 1

Enter Lot numbers for BHI, HLA, VA on back page of this worksheet.

<table>
<thead>
<tr>
<th>Date:</th>
<th>Set up by:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>No. / Bench</th>
<th>ATCC Control Or Lab No.</th>
<th>VANC 18 h</th>
<th>BHI 24h</th>
<th>GENTA 24h</th>
<th>STREPTO 24h 48h</th>
<th>No. / Bench</th>
<th>Lab No.</th>
<th>VANC 18 h</th>
<th>BHI 24h</th>
<th>GENTA 24h</th>
<th>STREPTO 24h 48h</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>E. faecalis</em> ATCC 49532</td>
<td>S</td>
<td>R</td>
<td>S</td>
<td></td>
<td>13</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td><em>E. gallinarum</em> ATCC 49573</td>
<td>R</td>
<td>S</td>
<td>S</td>
<td></td>
<td>14</td>
<td></td>
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<tr>
<td>3</td>
<td><em>E. faecalis</em> ATCC 49533</td>
<td>S</td>
<td>S</td>
<td>R</td>
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<td>15</td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>22</td>
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</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
QUAD Screen Recording Sheet for Enterococcus Page 2

Lot number and expiry date labels:

BHI____________________

HLA____________________

VA____________________
XII - Vancomycin-Intermediate Staphylococcus aureus Screen

I. Introduction

This spot agar dilution method uses a single concentration of vancomycin at 4mg/L incorporated into BBL Brain Heart Infusion agar (BBL BHI) to screen for *Staphylococcus aureus* with reduced susceptibility to glycopeptides. Strains capable of growing on this medium are known as VISA or hVISA as their vancomycin and/or teicoplanin MIC are typically intermediate. This type of low-level resistance may be heterogeneously present and so is difficult to detect, but it is important to notice as such subpopulations are implicated in vancomycin treatment failures. BBL BHI-vancomycin screen agar is commercially available from Oxoid as VISA ISOLATION AGAR (MP0243), while the control agar without vancomycin is available from Oxoid as BHIA with Casein. BBL BHIA (MP0244) is far more enriched than other formulations due to additional casein, and because of this, it is important not to prepare this screen agar with any other classic BHIA brand.

II. Materials

Screen plate (BD BBL BHI with 4 mg/L vancomycin or Oxoid’s VISA ISOLATION AGAR)
Control plate (BD BBL BHIA or Oxoid’s BHIA with Casein)
VITEK colourimeter
24-position acetate grid for spot plate
Sterile saline
Sterile cotton swabs

III. Procedure

1. Using the VITEK colourimeter, prepare a suspension equivalent to a 0.5 McFarland standard in sterile saline (use the VITEK inoculum if already made).

2. Prepare worksheet as per **OXACILLIN AND VANCOMYCIN SCREEN RECORDING SHEET FOR *S. aureus***

3. Using a sterile swab, spot inoculate the suspension onto the predetermined position on each of the screen and control agar, noting that no more than 24 isolates including controls should be spotted to each plate (use grid **TEMPLATE**).

4. Similarly, spot inoculate the following quality control strains, in order, to the first four positions on each agar: *E. gallinarum* ATCC 49573, *S. aureus* ATCC 43300 (MRSA), *S. aureus* LPTP 8610 (MRSA), and *S. aureus* ATCC 29213 (MSSA)
5. After the inocula have dried, incubate the plate at 35°C in O₂.

6. Perform a preliminary read for any growth after 18 hours incubation, and read again after both 24 hours and 48 hours incubation.

7. All resistant isolates on the screen plate must be checked for purity (e.g. Gram stain, tube coagulase or slide agglutination and sub-culture).

8. If the growth is:

   i. Confluent and pure, Pastorex-positive, Gram positive cocci in clusters, set up a confirmatory MacroEtest by preparing the suspension equivalent to a 2 MacFarland standard directly from the VISA spot plate. Inoculate to Oxoid’s BHIA with Casein (BBL BHIA), allow plate to dry for 15min, apply both vancomycin and teicoplanin Etest strips, and read after both 24h and 48h incubation at 35°C for reduced susceptibility (Refer to APPENDIX X – Etest).

   ii. If the growth is spotty but pure, attempt to prepare suspension for a macroEtest and repeat screen plates directly from the VISA spot plate. If insufficient, use the growth on the control agar to supplement the inoculum.

   iii. If there is only a single or few colonies, subculture to a 5% sheep blood agar and perform confirmatory testing the following day. (Refer to APPENDIX X – Etest).

IV. Interpretation

1. Plates may be read initially at 18h but MUST BE REINCUBATED and read again at 24h and again at 48h, or the results are invalid.

2. At the first reading time (18h), check the control plate for adequate growth on each inoculated spot, and record these on the sheet documenting both growth and purity. Note: There must be confluent growth on the control plate for the test to be valid.

3. Then check the VISA ISOLATION plates to ensure the controls grew and/or were inhibited as appropriate (see QC table below).

4. Then check for absence or presence of growth for all test isolates; while any growth is considered significant, document confluent versus single colony growth on worksheet (see master copy below) and on the back of the specimen worksheet in the LIS.
5. Record 18h, 24h and 48h results on the worksheet. Final interpretations are made according to confirmatory testing (see above).

6. Report preliminary findings to infection control as a possible VISA if the growth on the spot plate is confluent and pure (even if colony sizes vary or growth is poor), and if the isolate is derived from blood or sterile sites.

7. However, if only a few colonies grow on the VISA screen agar, before reporting to Infection Control or Physicians, complete all confirmatory testing as there is an approximate breakthrough rate of single colonies using this method of 3%.

V. Quality Control

Control strains are tested on every plate.

<table>
<thead>
<tr>
<th>Control Strains</th>
<th>BHIA+Casein Control plate</th>
<th>VISA ISOLATION AGAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. gallinarum ATCC 49573</td>
<td>Growth</td>
<td>Growth</td>
</tr>
<tr>
<td>S. aureus (MRSA) ATCC 43300</td>
<td>Growth</td>
<td>No growth</td>
</tr>
<tr>
<td>S. aureus (MRSA) LPTP 8610</td>
<td>Growth</td>
<td>No growth</td>
</tr>
<tr>
<td>S. aureus (MSSA) ATCC 29213</td>
<td>Growth</td>
<td>No growth</td>
</tr>
</tbody>
</table>

VI. Reference


### XIII – Antimicrobial Abbreviations

#### Antimicrobial Disks

<table>
<thead>
<tr>
<th>ANTIMICROBIAL</th>
<th>DISK (Manufacturer)</th>
<th>Concentration (µg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amikacin</td>
<td>AK (Oxoid)</td>
<td>30</td>
</tr>
<tr>
<td>Amoxicillin/Clavulanic Acid</td>
<td>AMC</td>
<td>30</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>AMP (Oxoid)</td>
<td>10</td>
</tr>
<tr>
<td>Ampicillin/Sulbactam</td>
<td>AMS</td>
<td>20</td>
</tr>
<tr>
<td>Azithromycin</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>ATM</td>
<td>30</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>KZ (Oxoid)</td>
<td>30</td>
</tr>
<tr>
<td>Cefepime</td>
<td>FEP</td>
<td>30</td>
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<tr>
<td>Cefixime</td>
<td>CFM</td>
<td>5</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>CTX</td>
<td>30</td>
</tr>
<tr>
<td>Cefotetan</td>
<td>CTT (Gen. Diag.)</td>
<td>30</td>
</tr>
<tr>
<td>Cefoxitin</td>
<td>FOX (Oxoid)</td>
<td>30</td>
</tr>
<tr>
<td>Ceftriaxime</td>
<td>CRO (Oxoid)</td>
<td>30</td>
</tr>
<tr>
<td>Cefuroxime</td>
<td>CXM</td>
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</tr>
<tr>
<td>Cephalothin</td>
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<td>Cefpodoxime</td>
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<tr>
<td>Chloramphenicol</td>
<td>C</td>
<td>30</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>CIP (Oxoid)</td>
<td>5</td>
</tr>
<tr>
<td>Clarithromycin</td>
<td>CLR</td>
<td>15</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>DA (Oxoid)</td>
<td>2</td>
</tr>
<tr>
<td>Colistin</td>
<td>CT</td>
<td>10</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>DO</td>
<td>30</td>
</tr>
<tr>
<td>Ertapenem</td>
<td>ETP (Oxoid)</td>
<td>10</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>E (Oxoid)</td>
<td>15</td>
</tr>
<tr>
<td>Fosfomycin</td>
<td>FOT (Oxoid)</td>
<td>200</td>
</tr>
<tr>
<td>Fusidic Acid</td>
<td>FD</td>
<td>10</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>CN (Oxoid)</td>
<td>10</td>
</tr>
<tr>
<td>Imipenem</td>
<td>IPM (Difco)</td>
<td>10</td>
</tr>
<tr>
<td>Levofloxacin</td>
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<td>5</td>
</tr>
<tr>
<td>Linezolid</td>
<td>LZD</td>
<td>30</td>
</tr>
<tr>
<td>ANTIMICROBIAL</td>
<td>DISK (Manufacturer)</td>
<td>Concentration (µg)</td>
</tr>
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<td>---------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Meropenem</td>
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<td>10</td>
</tr>
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<td>5</td>
</tr>
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</tr>
<tr>
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<td>5</td>
</tr>
<tr>
<td>Nalidixic Acid</td>
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<td>30</td>
</tr>
<tr>
<td>Nitrofurantoin</td>
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</tr>
<tr>
<td>Norfloxacin</td>
<td>NOR (BBL or Difco)</td>
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</tr>
<tr>
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<td>NV</td>
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<td>Piperacillin</td>
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<td>100</td>
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<td>TZP</td>
<td>110</td>
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<tr>
<td>Polymyxin B</td>
<td>PB</td>
<td></td>
</tr>
<tr>
<td>Quinupristin-Dalfopristin (Synercid)</td>
<td>QD</td>
<td></td>
</tr>
<tr>
<td>Rifampin</td>
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<td>5</td>
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<tr>
<td>Teicoplanin</td>
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<td>30</td>
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<tr>
<td>Tetracycline</td>
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<td>Ticarcillin/Clavulanate (Timentin)</td>
<td>TIM (Oxoid)</td>
<td>85</td>
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<td>Trimethoprim/Sulfamethoxazole</td>
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<td>25</td>
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### e-test Strips

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<th>ANTIMICROBIAL</th>
<th>ABBREVIATION</th>
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</tr>
<tr>
<td>Amikacin</td>
<td>AK</td>
</tr>
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<td>Ampicillin</td>
<td>AM</td>
</tr>
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<td>AZ</td>
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<td>Cefotetan</td>
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<td>Cefoxitin</td>
<td>FX</td>
</tr>
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<td>TZ</td>
</tr>
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<td>C/T</td>
</tr>
<tr>
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<tr>
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### ANTIMICROBIAL | ABBREVIATION
--- | ---
Piperacillin | PP
Piperacillin/Tazobactam | PTC
Polymyxin B | PO
Quinupristin-Dalfopristin (Synercid) | QDA
Rifampin | RI
Streptomycin (High Level) | SM
Teicoplanin | TP
Tetracycline | TC
Ticarcillin/Clavulanate | TLc
Tigecycline | TGC
Tobramycin | TM
Trimethoprim/sulfamethoxazole | TS
Vancomycin | VA
### LIS (Soft Computer Corporation)

<table>
<thead>
<tr>
<th>ANTIMICROBIAL</th>
<th>ABBREVIATION</th>
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<tbody>
<tr>
<td>Amikacin</td>
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<tr>
<td>Amoxicillin</td>
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<tr>
<td>Amoxicillin / Clavalanic Acid</td>
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<td>Cefpodoxime (Kirby-Bauer panel)</td>
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<td>Cefpodoxime / Clavulanic Acid</td>
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<td>Sulfisoxazole</td>
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<td>Synercid</td>
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<td>Teicoplanin</td>
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<td>Temocillin (ROSCO Disk)</td>
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<td>Ticarcillin</td>
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<tr>
<td>Ticarcillin/Clavulanic Acid</td>
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<td>Tobramycin</td>
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<td>Trimethoprim</td>
<td>tmp</td>
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<tr>
<td>Trimethoprim/sulfamethoxazole</td>
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<tr>
<td>Vancomycin</td>
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</table>
XV – Carbapenemase Testing with ROSCO Diagnostica Tablets

I. Materials

Vitek gram negative susceptibility card with ertapenem
Mueller-Hinton (MH) agar
10 mg meropenem disk (OXOID)
Rosco Diagnostica KPC + MBL Confirm ID kit tablets:
- Meropenem (MRP10)
- Meropenem+Dipicolonic acid (MR+DP)
- Meropenem+Boronic acid (MR+BO)
- Meropenem+Cloxacillin (MR+CL)
- Temocillin (TEM)

II. Procedure

For Meropenem Screen disk ≤25mm or Vitek Meropenem MIC ≥0.5mg/L & βCARBA (BCARB) = NEGATIVE
OR
For Meropenem Screen disk ≤25mm or Vitek Meropenem MIC ≥0.5mg/L & βCARBA (BCARB) = POSITIVE, CARB-R Cepheid PCR = NEGATIVE

1. Set up Rosco Diagnostica KPC + MBL with Temocillin test:
   - Using the Vitek colorimeter, prepare a suspension of the test organism in sterile saline equivalent to a 0.5 McFarland standard.
   - Using a sterile cotton swab, inoculate the organism onto a 150 mm (large) MH agar plate. Dispense tablets into a petri dish and use forceps to apply the 5 Rosco tablets (MRP10, MR+DP, MR+BO, MR+CX & TEM) onto the agar. Place the tablets at least 30 mm apart from each other.
   - Incubate plate in O₂ at 35°C x 18 hours.
   - In the LIS, order Breakpoint Panel "kpcros" for drugs "mrp10", "mrdp", "mrdpp", "mrbo", "mrbop", "mrcl", "mrclp" “tem”.
   - Set up routine Vitek susceptibility/kbesbl as appropriate.

2. Interpretation of Rosco KPC+MBL Confirm Kit tablets:

   Note: βCARBA=pos, CARB-R cases, record but do not report (for research purposes only)
   - Record the zone size of all the tablets after incubation.
   - Compare the zone size of the MRP10 tablet against the zone sizes of MRDP, MRBO and MRCL. If there is ≥5 mm difference in zone size, record “Y” for the potentiation of the drug. If there is <5 mm difference in zone size, record as “N” for the potentiation of the drug.
   - Mero & Cloxacillin (MRCL) to be reported and potentiation compared to MRP10 ≥=5 mm to be documented in LIS.
- Measure temocillin zone size
- Refer to the table below for interpretation
### Meropenem breakpoint:

<table>
<thead>
<tr>
<th>By Meropenem Screen Disk (MEMS)</th>
<th>By ROSCO Tablet (MRP10)</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;25 mm</td>
<td>&gt;26 mm</td>
<td>S</td>
</tr>
<tr>
<td>≤25 mm</td>
<td>≤26 mm</td>
<td>R</td>
</tr>
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</table>

### Temocillin breakpoint:

<table>
<thead>
<tr>
<th>By ROSCO Tablet (TEM)</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;11 mm</td>
<td>S</td>
</tr>
<tr>
<td>≤11 mm</td>
<td>R</td>
</tr>
</tbody>
</table>

### Rosco KPC+MBL Confirm Kit Interpretation:

<table>
<thead>
<tr>
<th>MRDP Potentiation</th>
<th>MRBO Potentiation</th>
<th>Temocillin-R</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRP10 vs MRDP ≥5mm</td>
<td>MRP10 vs MRBO ≥5mm and MRP10 vs. MRCL &lt;5mm</td>
<td>Temocillin-R (≤11 mm)</td>
<td>No potentiation ≥5mm and Temocillin-S (&gt;11 mm)</td>
</tr>
<tr>
<td>Interpretation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class B carbapenemase (metallo-ß-lactamase) (e.g. NDM, VIM, IMP1)</td>
<td>Class A carbapenemase (e.g. KPC, NMC, IMI, SME, GES)</td>
<td>Class D carbapenemase (e.g. OXA48, OXA181, OXA232, OXA244) or Class B carbapenemase (metallo-ß-lactamase) (e.g. NDM, VIM, IMP1)</td>
<td>No carbapenemase</td>
</tr>
<tr>
<td>Reporting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>send to NML for PCR confirmation; order “kpcrcon” panel; see Reporting section for reporting phrase</td>
<td></td>
<td></td>
<td>No CRE</td>
</tr>
</tbody>
</table>

**NOTE:** This document is Uncontrolled When Printed.

Any documents appearing in paper form that do not state "CONTROLLED COPY" in red print are not controlled and should be checked against the document (titled as above) on the server prior to use.

Management System\UHN_Mount Sinai Hospital Microbiology\Standard Operating Procedures\Bacteriology Procedures\
3. When PCR results are returned from NML, enter as drug kpcr=Y (if positive) or kpcr=N (if negative) with the appropriate result comments (see Reporting section) and call the Infection Control Practitioner with the results.

**Notes:**
- All screen positive isolates to be frozen.
- All screen positive to be called to infection control
- All interim and final updated results to be called to infection control.

### III. Reporting

See [Carbapenemase Testing Reporting](#)

If the isolate is to be reported as ESBL, report with ISOLATE COMMENT code \KPCN\: see [Carbapenemase Testing Reporting](#)
- Notify Infection Control Practitioner

If the isolate is not generally reported (e.g. *Enterobacter* in ESBL screens),
  a. Suppress the isolate.
  b. Report at the TEST Window with TEST COMMENT code \KPCN\ - see [Carbapenemase Testing Reporting](#)
  c. Notify Infection Control Practitioner

### IV. Reference

Rosco Diagnostica KPC + MBL Confirm Kit package insert. [applicationsheet - KPC and MBL.pdf](#)
XVII - BCARBA Test

I. Introduction

Any species within the family Enterobacteriaceae may acquire genes encoding enzymes that hydrolyze carbapenem antimicrobial agents such as ertapenem, imipenem, meropenem and doripenem, and these enzymes are referred to as carbapenemases. The Bio-Rad /BCARBA test provides a rapid, qualitative colorimetric procedure for detecting production of carbapenemases. It has been shown to be highly sensitive and specific, detecting all common genotypes (i.e. IMI1, KPC, NDM, OXA48-like, VIM, SME). It is performed in a micro-tube directly from colonies grown on Chromogenic agar, 5% Sheep Blood or Mueller-Hinton agar, preferably taken from around a resistant meropenem disc screen test. The test detects carbapenemase hydrolytic activity as the chromogenic carbapenem substrate changes colour from yellow (negative) to orange or red or purple (positive) within 30 minutes.

II. Reagents

Bio-Rad /BCARBA Kit contains 3 reagent vials: R1 (diluent), R2 (dehydrated chromogenic substrate) and R3 (solvent for R2). The entire contents of R3 (1.1mL) is transferred to reconstitute R2 when a new kit is opened.

III. Materials

Required but not provided
Sterile 1µL green plastic loops
Extra sterile micro-tubes to supplement those provided
Rack with appropriate sized holes
Water bath set at 37°C with thermometer
Timer

IV. Procedure

1. The /BCARBA test is to be done only on isolates grown preferably on Mueller-Hinton agar with meropenem disc screen resistant (inhibition zone ≤25mm) or on 5% Sheep Blood agar or Brilliance UTI agar according to CRE testing flowcharts.

2. In both screen and clinical cases, the isolate to be tested must already have been identified by VITEK MS PLUS as to belong to the family Enterobacteriaceae.

3. When opening a new kit, homogenize reagent R1 and R3 by vortexing briefly. Ensure the lyophilized reagent is in the bottom of vial R2 prior to reconstitution. Reconstitute lyophilized R2
with full contents of R3 (1.1mL) and discard the empty R3 vial. Do not use reconstituted R2 if the colour turns red.

4. To perform one test, add 30µl each of reagents R1 and R2 into a labeled 1.5ml micro-tube.

5. Inoculate the tube using a heavy 1µL loop full of bacteria from a 5% sheep blood agar plate (clinical specimens) or from a Mueller-Hinton Plus agar plate from the inner zone of a resistant meropenem disc screen. (Note: DO NOT test from MacConkey-based agars).

6. Using the loop, mix the tube thoroughly to ensure the organisms are smoothly suspended in the reagents (if possible, do not vortex as the volume may be reduced).

7. Place tube in an appropriate rack into a 37°C water bath and set timer for 30 minutes.

8. A positive result may be recorded as soon as a colour-change to red occurs (as early as 2 min), but a negative test (yellow) should be observed for a full 30 minutes to ensure no delayed orange (weak) positive reactions are overlooked.

9. Do not incubate longer than 30 minutes, as by 45 minutes, it is possible for a rare false-positive reaction to occur.

V. Interpretation of results:

<table>
<thead>
<tr>
<th>Result</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour change from Yellow to Orange or Red or Purple</td>
<td>Positive Presence of carbapenemase</td>
</tr>
<tr>
<td>No colour change from Yellow</td>
<td>Negative Absence of carbapenemase</td>
</tr>
</tbody>
</table>

VI. Reporting

See Carbapenemase Testing Reporting.

VII. Quality Control

Quality control testing will be done on receipt for each new shipment by the QC bench and by the bench on opening each new kit.

Positive controls: Klebsiella pneumoniae ATCC 1705

Negative controls: Klebsiella pneumoniae ATCC 1706 or E. coli ATCC 25922

VIII. References

ECCMID and AMMI-CACMID abstract references.
XVIII - BLACTA Test

I. Introduction:

The BioRad BLACTA provides a simple, rapid qualitative procedure for detecting 3rd generation cephalosporin resistance in Enterobacteriaceae without intrinsic resistance (i.e. Escherichia coli, any Klebsiella spp. or Proteus mirabilis). In these species, a colour-change from yellow to red or orange indicates the enzymatic hydrolysis of a chromogenic cephalosporin due the presence of acquired cephalosporinases (i.e. ESBL or plasmidic ampC β-lactamases). The test is designed to enable earlier reporting of resistance, if present, to all cephalosporins, and may be done as soon as MALDI-TOF identification from short-incubation (3-6h) blood or sterile fluid cultures of the above organisms has been completed.

II. Reagents:

1. Reagent 1 and 2

III. Materials:

Provided:

1. Micro-tubes

Required but not provided:

1. Sterile 1uL plastic loops
2. Rack
3. Timer

IV. Procedure:

1. The BLACT test is to be done only on isolates from early subcultures from blood or sterile fluid specimens that are already identified by VITEK MS as E. coli, Klebsiella spp, or P. mirabilis.

2. On the back of the LIS work-card, pick media “BLACT” from the test keypad menu when the test is to be set up.

3. Only proceed to the KB menu after the test has been completed.

4. To perform one test, add one drop each of reagents R1 and R2 into a labeled micro-tube.

5. Inoculate the tube using a heavy loop full of bacteria isolated on 5% sheep blood agar (Note: DO NOT inoculate test from MacConkey agar).

6. Vortex the tube thoroughly to ensure the organisms are well mixed (i.e. a smooth suspension).

7. Disregard test time and colour interpretations on the insert on inner lid of box
8. Place the tube into a rack at room temperature and set timer for 30 min

9. While the result may be recorded as soon as a colour-change to red occurs (as early as 2 min), the test should be observed for red or orange by 30 min to ensure no delayed positive reactions are overlooked

10. In the LIS at the back of the workcard adjacent to “BLACT”, document the time and colour of the reaction by picking from the keypad (i.e. **Red within 15min, Red between 15 - 30 min, Orange at 30 min, or Yellow at 30 min**)

   **POSITIVE** = Red within 15min, Red between 15 - 30 min, Orange at 30 min
   **NEGATIVE** = Yellow at 30 min

11. If the BLACTA is **POSITIVE** proceed to the KB menu on isolate field and select the BLACTA POSITIVE panel “**kbBLAC+**”. This selection will:

   (a) Enable recording of the POSITIVE BLACTA test result (enter “2” for positive)
   (b) For MSH newborn:D1-M13 or MSH Female 12-50yrs, generate a “**kbESBL**” panel that must be set up right away along with the VITEK 2 AST-N213 card
   (c) reflex “R” for all to extended-spectrum penicillins, beta-lactam/beta-lactamase inhibitor combinations (e.g. piperacillin-tazobactam), and cephalosporin
   (d) attach a comment in the isolate window as per reporting section

12. Do not call when we have MALDI or BLACTA results

13. Enable recording of the NEGATIVE BLACTA test result (enter “1” for negative)

   If the BLACTA is **NEGATIVE** this result **must NOT be reported** if calling the organism identification. Rather set up VITEK 2 AST-N213 card as per manual and proceed to the isolate field to select the BLACTA negative panel from the KB menu “**kbBLAC-**”

   This selection WILL record the BLACTA negative result but it will NOT generate any other tests or comments.

**V. Interpretation of results:**

<table>
<thead>
<tr>
<th>Color</th>
<th>Interpretation of results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow (includes pale yellow-orange)</td>
<td>Negative</td>
</tr>
<tr>
<td>Red (at any time within 30 minutes)</td>
<td>Positive</td>
</tr>
<tr>
<td>Orange (at 30 minutes ONLY)</td>
<td>Positive</td>
</tr>
</tbody>
</table>
IX. Report:

Positive BLACTA, report with isolate comment (\BLTA):

“~Presumptive resistance to extended-spectrum penicillins, ~beta-lactam/beta-lactamase inhibitor combinations ~\textit{e.g.} piperacillin-tazobactam, and cephalosporins ~has been detected. ~Confirmation and further susceptibilities to follow.”

If ESBL is confirmed, report with isolate comment (\ESBC):
“Resistance to extended-spectrum penicillins, beta-lactam, beta-lactamase inhibitor combinations \textit{(e.g.} piperacillin-tazobactam), and cephalosporins has been confirmed.”

If ESBL is NOT confirmed \textit{e.g.} in \textit{K. oxytoca}, report with isolate comment (\ESBN):
“The previously reported presumptive resistance to extended-spectrum penicillins, beta-lactam, beta- lactamase inhibitor combinations \textit{(e.g.} piperacillin-tazobactam), and cephalosporins was NOT confirmed.”

Negative BLACTA – DO NOT REPORT

VII. Quality Control:

Quality control testing will be done on receipt for each new shipment and weekly by the QC bench.

1. Positive control:
   \textit{Escherichia coli} ATCC 51446

2. Negative control:
   \textit{Escherichia coli} ATCC 35218 (type TEM-1 \textit{B}-lactamase producing strain)

VIII. References:

For Vitek instructions, see:

Vitek Manual

2014.07.09 Vitek AES breakpoint changes:
..\..\Audits\Vitek_AES Breakpoint Manual Changes\2014.09.0 2014 CLSI.pdf

For TREK Sensititre instructions see:

Trek Sensititre Manual
### Record of Edited Revisions

**Manual Section Name:** ANTIMICROBIAL SUSCEPTIBILITY TESTING MANUAL

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Management System| UHN_Mount Sinai Hospital Microbiology\Standard Operating Procedures\Bacteriology Procedures\
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| Page 3 – change *N. gonorrhoeae* and *M. catarrhalis* – not tested | November 21, 2005 | Dr. T. Mazzulli |
| Page 3 – add if isolate is resistant to all drugs – add polymyxin and colistin e-test. | November 21, 2005 | Dr. T. Mazzulli |
| Page 4 - add MRSA Screen - MUP e-test | November 21, 2005 | Dr. T. Mazzulli |
| Page 4 - add - if VA-R *E. faecalis* and *E. faecium* add VRE MIC panel | November 21, 2005 | Dr. T. Mazzulli |
| Page 4 - *S. pneumoniae* - Blood and sterile sites add KB e and cc; other sites add KB e and cc | November 21, 2005 | Dr. T. Mazzulli |
| Page 5 – Group A, B, C, G *Streptococcus* - Blood and sterile sites - KB e, cc; p and va if e and cc are R; other sites change to KB e, cc, lvx,va; Add Vaginal/GBS screen – KB e,cc,va. Double disk for e, cc. | November 21, 2005 | Dr. T. Mazzulli |
| Page 5 - Add *S. bovis* - blood and sterile sites - Vitek; mixed and other sites - not tested. | November 21, 2005 | Dr. T. Mazzulli |
| Page 5 - Add *S. milleri* - blood and sterile sites - e-test CRO, P, VA; other sites - KB cc, e, p, lvx; urine - KB p, lvx | November 21, 2005 | Dr. T. Mazzulli |
| Oxacillin Screen - add DENKA and induced DENKA to confirm diskreant results | November 21, 2005 | Dr. T. Mazzulli |
| Add *S. aureus* ATCC 29213 for QUAD and Vancomycin Screen Plates QC and recording charts | November 21, 2005 | Dr. T. Mazzulli |
| Re-grouped all reporting pages | November 21, 2005 | Dr. T. Mazzulli |
| Urine - report nitro to all sites for *Staph.* and *Enterotox.* | November 21, 2005 | Dr. T. Mazzulli |
| Urine – CNST not tested | November 21, 2005 | Dr. T. Mazzulli |
| Urine - add linezolid, synergicid to enterococcus if van-R and am-R except E. *gal* and E. *cass.* | November 21, 2005 | Dr. T. Mazzulli |
| MRSA screen - report sxt, mup, doxy, rafampin with message for re-eradication purpose; fusidic acid if mup=R | November 21, 2005 | Dr. T. Mazzulli |
| Urine – beta strep – add report cc, e | November 21, 2005 | Dr. T. Mazzulli |
| Urine - *S. milleri* - p, lvx | November 21, 2005 | Dr. T. Mazzulli |
| all reporting pages, add call microbiologist if R to all drugs | November 21, 2005 | Dr. T. Mazzulli |
| Reporting tables (Urine, Resp and other sites and blood culture) changes for *S. maltophilia* sxt and levo | November 21, 2005 | Dr. T. Mazzulli |
| Reporting tables (Urine, Resp and other sites and blood culture) changes for *B. cepacia* for sxt, taz, mero | November 21, 2005 | Dr. T. Mazzulli |
| Urine - imipenem - add report if R or R to all other drugs or if only aminoglycoside is S | November 21, 2005 | Dr. T. Mazzulli |
| Resp& Misc - add cc to *S. pneumoniae* | November 21, 2005 | Dr. T. Mazzulli |
| Resp & Misc - change GBS - delete am, kz,p, tet; add va with foot note-do not report for GBS screen or vag swab; uniform reporting for all beta-strep | November 21, 2005 | Dr. T. Mazzulli |
| All beta strep from non-sterile sites - report sensi with "Susceptibility completed as requested" | November 21, 2005 | Dr. T. Mazzulli |
| Resp - *S. milleri* - add report p, e, cc | November 21, 2005 | Dr. T. Mazzulli |
| Resp and Misc – SPICE group - add comment if ceftriaxone is S | November 21, 2005 | Dr. T. Mazzulli |
| Resp - add linezolid, synergicid to enterococcus if van-R and am-R except E. *gal* and E. *cass.* | November 21, 2005 | Dr. T. Mazzulli |
| Statement for reporting sensi on eye and ear sources | November 21, 2005 | Dr. T. Mazzulli |

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<td>“or I” added to SPICE message: Citrobacter spp., Enterobacter spp., Hafnia spp., Morganella morgantii, Proteus vulgaris, Providencia species, Serratia species, if S or I, report with comment “Resistance to extended-spectrum penicillins, beta-lactam/beta-lactamase inhibitor combinations, and cephalosporins may develop during therapy with these agents. For serious infections, these agents should be avoided and consultation with a medical microbiologist or infectious disease physician is strongly recommended.”</td>
<td>January 05, 2009</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Modify appearance of Table of Contents</td>
<td>May 10, 2009</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Annual Review</td>
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<td>Dr. T. Mazzulli</td>
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<tr>
<td>Added double disk CC/E for Staphylococcus testing</td>
<td>May 10, 2009</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Remove reflex rules for CC/E on Staphylococcus</td>
<td>May 10, 2009</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>VISA screen added</td>
<td>May 10, 2009</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Remove CNST from vancomycin screen plate</td>
<td>May 10, 2009</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Modified etest procedure</td>
<td>May 10, 2009</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Modified medium for S. aureus on screen plate and etest</td>
<td>May 10, 2009</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Added Modified Hodge Test</td>
<td>May 10, 2009</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Modified MHT resulting phrases</td>
<td>March 15, 2010</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Modified S. anginosus reporting phrases if susceptibility is not tested</td>
<td>March 15, 2010</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Report moxifloxacin on S. pneumo for UHN patients instead of levo</td>
<td>March 15, 2010</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Modified ESBL template</td>
<td>May 26, 2010</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Added reporting phrase for ESBL D zone=Y, Potentiation=Y</td>
<td>May 26, 2010</td>
<td>Dr. T. Mazzulli</td>
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<td>Dr. T. Mazzulli</td>
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<tr>
<td>Modified GBS from urine panel and reporting</td>
<td>June 04, 2010</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Revised Modified Hodge Test “Interpretation” section</td>
<td>September 15, 2010</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>E coli and Kleb species, if VT is S to Ceftriaxone and I/R to pip/tazo, set up KB pip/tazo to confirm</td>
<td>September 15, 2010</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Stool Transplant Study comment added to C. diff isolates</td>
<td>October 08, 2010</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Report meropenem for Gram negatives if I added to statement of report if R.</td>
<td>October 16, 2010</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Cipro in urines reporting for RVHS corrected (it was omitted in error in the last revision)</td>
<td>October 16, 2010</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Added picture of NDM-1 in Modified Hodge Test section</td>
<td>October 22, 2010</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Removed Modified Hodge Test section</td>
<td>November 11, 2010</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Send all erta I or R enterobacteriaceae to PHL for KPC PCR</td>
<td>November 11, 2010</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Carbapenemase reporting with ESBL screen added</td>
<td>November 11, 2010</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Added meropenem disk to IC ESBL screen plate</td>
<td>November 11, 2010</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Removed pip/tazo from routine reporting in Enterobacteriaceae. If requested, set up KB and report using KB results.</td>
<td>November 11, 2010</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Added Carbapenemase Screening Section</td>
<td>November 17, 2010</td>
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<tr>
<td>Modified Steno resulting phrase</td>
<td>November 17, 2010</td>
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<tr>
<td>Added Tigecycline reporting phrases</td>
<td>November 17, 2010</td>
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<tr>
<td>Updated Carbapenemase send out procedure</td>
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<td>Updated Carbapenemase testing to Rosco KPC MBL Confirm Kit disks</td>
<td>January 20, 2011</td>
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<tr>
<td>Rosco disk added to Antimicrobial table</td>
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<td>Updated criteria for susceptibility table</td>
<td>January 20, 2011</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Page 4, added KB for cefazolin if requested or from sterile sites</td>
<td>February 23, 2011</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Page 18 changed cefazolin reporting to – report from KB only if requested</td>
<td>February 23, 2011</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Page 25 changed cefazolin reporting to – report from KB only</td>
<td>February 23, 2011</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Added TREP sensititre for S. pneumoniae – procedure and modified reporting sections</td>
<td>March 14, 2011</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>For E. gallinarum or E. casseliflavus and VA=R, E. faecalis or E. faecium from Blood &amp; Sterile sites updated to include set up linezolid and synergic</td>
<td>June 15, 2011</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>“Susceptibility tested on pure cultures ONLY” – added to Criteria for testing for clarity.</td>
<td>June 15, 2011</td>
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<td>Cephalexin added to Urine gram negative reporting</td>
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<tr>
<td>Added Colistin etest to resistant Enterobacteriaceae + colistin reporting canned messages</td>
<td>July 18, 2011</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Added not to report Erythromycin on GBS for GBS screen</td>
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<td>Added Tigecycline to reporting tables</td>
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<td>Dr. T. Mazzulli</td>
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<td>Added ertapenem reporting if ertapenem=I/R or MDR</td>
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<td>Zone size interpretation change for ROSCO meropenem 10</td>
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<td>Blood Culture Yeast sensiti refer back up to 7 days</td>
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<tr>
<td>Revised OXA, VANC workflow instructions</td>
<td>August 2, 2012</td>
<td>Dr. T. Mazzulli</td>
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<td>Remove Teico etest with 0.5 McFarland for S. aureus</td>
<td>August 2, 2012</td>
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<tr>
<td>Removed routine KB tzp testing for Ps aeruginosa and Enterobacteriaceae</td>
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<tr>
<td>Added line for IC isolates refer back 3 months on page 4 – criteria for testing</td>
<td>December 12, 2012</td>
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<tr>
<td>Acinetobacter, test for KB Amikacin if Gent and Tob are R</td>
<td>December 12, 2012</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Interpretations for reporting changed as per CSLI M100-S22 (zone size and mic changes)</td>
<td>December 12, 2012</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Revised resulting messages for Colistin and Tigercycline</td>
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<tr>
<td>Reflexed tzp to be I/R if any 3rd gen cephalosporin is I or R</td>
<td>January 25, 2013</td>
<td>Dr. T. Mazzulli</td>
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<td>Revised table format of “set up criteria”</td>
<td>July 17, 2013</td>
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<tr>
<td>Removed all polymyxin testing and reporting</td>
<td>July 17, 2013</td>
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<tr>
<td>Added sent to PHL for MIC for S.maltophilia and B. cepacia</td>
<td>July 17, 2013</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Updated canned message section</td>
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<tr>
<td>Remove RVHS from all reporting tables</td>
<td>July 17, 2013</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Interpretations for reporting changed as per CSLI M100-S23</td>
<td>July 17, 2013</td>
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**UNIVERSITY HEALTH NETWORK/MOUNT SINAI HOSPITAL, DEPARTMENT OF MICROBIOLOGY**

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<td>Merged MSH and UHN columns on all reporting tables</td>
<td>October 10, 2013</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Added set up and reporting for Aeromonas species</td>
<td>October 10, 2013</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Added meropenem screen to replace ertapenem screen for infection control CRE screens</td>
<td>October 10, 2013</td>
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<tr>
<td>Report Amox/clavu for Enterobacteriaceae; set up kb for amox clav</td>
<td>October 10, 2013</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Remove reporting am, cf, nitro, sxt for all sites in Pseudomonas aeruginosa</td>
<td>October 10, 2013</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Vitrek interpretation change for cepodoxime – from ≤2= R to ≤0.5=R; 4= I removed, from &gt;8=R to &gt;4=R</td>
<td>October 10, 2013</td>
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<td>cc=R e=S for Staph and Strep - repeat and confirm id; freeze, added to page 12</td>
<td>October 10, 2013</td>
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<tr>
<td>Remove cefurozime from Resp Enterobacteriaceae</td>
<td>October 10, 2013</td>
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<td>Report HLGR results on enterococcus from blood and sterile sites only when vancomycin is susceptible</td>
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<td>Dr. T. Mazzulli</td>
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<tr>
<td>Remove cloxacillin from reporting on Staph in spinal fluid</td>
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<td>Staphylococcus from Blood Culture – remove e, cc and sxt from reporting</td>
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<tr>
<td>Remove ciprofloxacin from reporting for enterococci to TRI urine</td>
<td>October 10, 2013</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Salmonella – remove nalidic acid testing, set up kb and etest for cipro and suppress cip from reporting from Vitrek (Vitrek has older breakpoints)</td>
<td>October 10, 2013</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Report Doxycycline on Staphs from all tissues. wounds (not from respiratory sites) and urine</td>
<td>October 10, 2013</td>
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<tr>
<td>Report moxifloxacin on staphs from bone/joint</td>
<td>October 10, 2013</td>
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<tr>
<td>Modified positive Carbapenemase reporting phrase</td>
<td>October 10, 2013</td>
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<tr>
<td>No sensi set up for CNST other than S. lugdenensis isolated from all blood cultures, report with new message</td>
<td>November 13, 2013</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Report erta and mero when it is I/R for all gram negatives</td>
<td>November 13, 2013</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>For Enterobacteriaceae, report erta and mero when it is I/R OR I/R to 2 of the 3 antimicrobial agents: amikacin, ciprofloxacin, 3rd Generation Cephalosporins</td>
<td>November 19, 2013</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>For P. aeruginosa, report mero when it is I/R OR I/R to 2 of the 3 antimicrobial agents: amikacin, ciprofloxacin, 3rd Generation Cephalosporins AND Piperacillin/tazobactam</td>
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<tr>
<td>Report Doxycycline on S. aureus from all tissues. wounds (not from respiratory sites) and urine (change from all Staphylococcus)</td>
<td>November 19, 2013</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Modified KB panel set up for Enterobacteriaceae to</td>
<td>November 19, 2013</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Modified Aeromonas set up panel</td>
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<tr>
<td>Added secondary reporting drugs to all Aeromonas</td>
<td>November 19, 2013</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Page 73 macro etest table second category 2, modified teicoplanin from “&lt; or &gt; 12 mg/L” to “&gt;8 mg/L”</td>
<td>November 19, 2013</td>
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<tr>
<td>Neisseria gonorrhoeae all sites – send to PHL for susceptibility</td>
<td>November 19, 2013</td>
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<tr>
<td>Enterobacteriaceae - Report meropenem and ertapenem if I/R OR if I/R to 3 of the 4 antimicrobial agents: amikacin, ciprofloxacin, 3rd Generation Cephalosporins, Septra OR if requested</td>
<td>December 24, 2013</td>
<td>Dr. T. Mazzulli</td>
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Management System\UHN_Mount Sinai Hospital Microbiology\Standard Operating Procedures\Bacteriology Procedures\
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<td>P. aeruginosa - Report meropenem if I/R OR if I/R to 3 of the 4 antimicrobial agents: amikacin, ciprofloxacin, 3rd Generation Cephalosporins, Piperacillin/tazobactam OR if requested</td>
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<td>Doxycycline R comment added</td>
<td>December 24, 2013</td>
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<tr>
<td>B. cepacia to PHL – change request to levo aand tcc</td>
<td>December 24, 2013</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Report all SPICE bugs R to all beta-lactam and beta-lactem/inhibitors drugs</td>
<td>December 24, 2013</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Added ceftriaxone etest to S. anginosis isolated from non-sterile sites. To be reported when Pen is I/R</td>
<td>December 24, 2013</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Report if I/R to All other Antimicrobial Agents OR if only aminoglycoside is S OR if requested</td>
<td>January 25, 2014</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Report if I/R to All oral Antimicrobial Agents (i.e. amoxicillin, amoxicillin-clavulanic acid, cephalaxin, TMP-SMX, ciprofloxacin, doxycycline, tetracycline, nitrofurantoin) OR if requested.</td>
<td>January 25, 2014</td>
<td>Dr. T. Mazzulli</td>
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<td>Added instructions for set up if Vitek card is terminated under “Criteria for Susceptibility Testing”</td>
<td>February 10, 2014</td>
<td>Dr. T. Mazzulli</td>
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<td>Updated S. maltophilia and B. cepacia etest</td>
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<td>Stenotrophomonas maltophilia</td>
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<td>Send to PHL for MIC for TCC and Minocycline</td>
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<tr>
<td>Acinetobacter set up meropenem by KB; send to NML for PCR id mero=I/R</td>
<td>May 25, 2014</td>
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<tr>
<td>Updated zone size and etest breakpoint for Acinetobacter to 2014 CLSI guidelines</td>
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<td>Added KB panel for resistant gnb (kbxdr panel)</td>
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<td>Added KB for sxt for MSSA and MRSA</td>
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<td>BLACTA Test added</td>
<td>June 27, 2014</td>
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<td>Base on Cefoxitin to rule out MRSA</td>
<td>June 27, 2014</td>
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<td>CRE reporting changes</td>
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<td>Confirmed by KB if Vitek SXT = R</td>
<td>June 27, 2014</td>
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<td>Revised Salmonella set up and reporting, removed Vitek</td>
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<td>Vitek AES breakpoint changes</td>
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<td>Changed rule out MRSA “Cefoxitin” to “Cefoxitin Screen”</td>
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<td>Modified Hemophilus beta-lactamase reporting phrase for non-sterile sites</td>
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<td>Updated BLACTA reporting phrases</td>
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<td>Update UHN/MSH logo</td>
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<tr>
<td>Changed B cepacia to etest for SXT</td>
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<td>Change Enterococcus from KB to etest for linezolid</td>
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<tr>
<td>Revised addition of Linezolid, daptomycin, tigecillin for BORSA/MRSA</td>
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</tr>
<tr>
<td>Pseudomonas aeruginosa - Changed from “If resistant to all routinely tested antimicrobials (including aminoglycosides). KB (kbxdrpa).”</td>
<td>October 25, 2014</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Page Number / Item</td>
<td>Date of Revision</td>
<td>Signature of Approval</td>
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</tr>
<tr>
<td>ATM, FEP, TIM” to: “If resistant to all routinely tested antimicrobials and colistin <em>(excluding</em> aminoglycosides). KB (kbxdrpa). ATM, FEP, TIM”</td>
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</tr>
<tr>
<td>Enterococcus change panel to astgp67</td>
<td>October 25, 2014</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Perform susceptibilities on CNST in BC if isolated from patients with endocarditis</td>
<td>October 25, 2014</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Added link to bactericidal vs static drug table for Etest reading</td>
<td>December 30, 2014</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Remove Piperacillin/Tazobactam on Enterococcus</td>
<td>December 30, 2014</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Report levo and add linezolid to enterococci from urine if no other oral options</td>
<td>February 9, 2015</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>BORSA detection update</td>
<td>February 9, 2015</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Annual Review</td>
<td>February 9, 2015</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>p.28 viridans note#4: added “only if in BC or heart tissue specimen”</td>
<td>April 30, 2015</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Urine p. 13, clarified clinda/levo comments, added #17</td>
<td>April 30, 2015</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Urine GPC - chart change: s. aurues to s. species</td>
<td>April 30, 2015</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Aeromonas: Added tetracycline to all sites for <em>Aeromonas</em> spp. With comment &gt;13yrs Aeromonas panel added for Enterics with reporting results.</td>
<td>May 27, 2015</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Fosfomycin KB from FOS to FOT, change concentration to 200ul Fixed typo: all sites enterococcus Screen added “va”</td>
<td>July 21, 2015</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Removed setting up double disk KB for all Staphylococcus when vitek is ICR-/cc=S/e=R. For MRSA suppress clindamycin and release with comment.</td>
<td>July 29, 2015</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Removed b-lacatamase testing for blood/sterile sites enterococci</td>
<td>July 29, 2015</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Added Previous positive CRE and ESBL LIS comments to canned message section.</td>
<td>August 20, 2015</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Added previous positive refer back criteria and reporting for clinical and IC screen on ARO detection.</td>
<td></td>
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<tr>
<td>Under “When to test” at end of page added reference to link to folder with CLSI guidelines.</td>
<td>August 27, 2015</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Added hyperlinks to CRE How To Detect Section for reporting.</td>
<td>October 6, 2015</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Under “What to Test” for Enterobacteriaceae for : E. coli, K. pneumonia, K. oxytoca or P. mirabilis: If CPD=I or R or BLACTA+ Added: <strong>ONLY on specimens</strong> : MSH newborn:D1-M13 &amp; MSH Female 12-50yrs</td>
<td>October 28, 2015</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>p.10 Removed in section for Enterococcus spp; if Nitro I/R from Vitek: set up KB FD</td>
<td>November 25, 2015</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>p.94 Enterococcus QUAD screen log: added BHI 24h column and added “bench” with No. column.</td>
<td></td>
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<tr>
<td>Staph Ox screen, added “bench” with No. column</td>
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<tr>
<td>Update “How to detect” section for CRE: Routine and Screening” Added CRE Clinical/IC screen flowcharts Added CRE reporting tables</td>
<td>December 21, 2015</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
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<tr>
<td>Updated What to test table for enterobacteriaceae</td>
<td>December 30, 2015</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Updated ROSCO with procedure and reporting</td>
<td></td>
<td></td>
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<tr>
<td>Added BCARBA procedure</td>
<td></td>
<td></td>
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<tr>
<td>Ceftazidime for Enterobacteriaceae suppressed from reporting for all sites</td>
<td>January 7, 2016</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>For fastidious and nonfermenting GNBs in What to test section,</td>
<td>January 19, 2016</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Added: Blood and Sterile sites send to PHOL and HACEK group to name.</td>
<td></td>
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<tr>
<td>For Blood cultures and Sterile sites “What to report” added footer note to report as per PHOL susceptibilities.</td>
<td></td>
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</tr>
<tr>
<td>“What to set up” section: Moraxella added for BC and Sterile sites send to PHL for sensi</td>
<td></td>
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</tr>
<tr>
<td>“What to report” for Aeromonas in each site, Tetracycline: Report if I/R to All ciprofloxacin, amoxicillin/clavulanic acid and trimethoprim/sulfamethoxazole</td>
<td></td>
<td></td>
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<tr>
<td>Remove link to TREK Manual</td>
<td>February 24, 2016</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Resp/non-sterile: Vancomycin Ceftriaxone: Report if Pen I or R or send to PHL.</td>
<td></td>
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</tr>
<tr>
<td>Report Ceftriaxone, Vancomycin for S.pneumo from sterile sites, no conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For <em>Staphylococcus species</em> Cloxacillin and Cefazolin reporting added note: &quot;for <em>Staphylococcus pseudintermedius</em> base on Oxacillin result.</td>
<td>April 4, 2016</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>BCARBA test: added Brilliance UTI agar to acceptable testing agars.</td>
<td></td>
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<tr>
<td>Added ETest Drug Ceftolozane-Tazobactam</td>
<td></td>
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<tr>
<td>Remove Amoxicillin Clavulanic acid from Aeromonas set up panel &amp; reporting tables</td>
<td></td>
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<tr>
<td>Remove Amoxicillin Clavulanic acid, Piperacillin/Tazobactam, Ertapenem, Tigecycline from reporting on gram negatives for Spinal Fluid specimens</td>
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<tr>
<td>Aminoglycosides and Septra suppressed unless Ceftriaxone is non-susceptible for CSF specimens.</td>
<td></td>
<td></td>
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<tr>
<td>Annual Review</td>
<td>May 9, 2016</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td><em>Aerococcus</em> species added to what to test table. Susceptibility comment added to reporting tables.</td>
<td></td>
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<tr>
<td>-Updated MSH logo in header</td>
<td>July 26, 2016</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>-Updated CRE comments \NCRB, \CNML, }NCRB, \pCRB, \pCRB</td>
<td></td>
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<tr>
<td>-Removed “CNSIP” send out in CRE flowcharts for IC / Clinical</td>
<td></td>
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<tr>
<td>-For <em>S. pneu</em> on all sites, add Oxacillin KB; report for sterile sites as:</td>
<td></td>
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<tr>
<td>If Oxacillin=S and Penicillin etest=S, report as S.</td>
<td></td>
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<tr>
<td>If Oxacillin=R and Penicillin etest=R, report as R.</td>
<td></td>
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<tr>
<td>If Oxacillin=S and Penicillin etest=R, unusual result, confirm.</td>
<td></td>
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<tr>
<td>If Oxacillin=R and Penicillin etest=S, report base on PHOL Penicillin MIC</td>
<td></td>
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<tr>
<td>Report on non-sterile sites:</td>
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<tr>
<td>Base on Oxacillin result if S. <strong>OR</strong></td>
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### Antimicrobial Susceptibility Manual

**Section:** Bacteriology Procedures

<table>
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</table>
| if Oxacillin is R, base on Penicillin etest if I or R OR if Oxacillin is R, and Penicillin etest is S, base on PHOL MIC Added to list of unusual results for *S. pneumoniae* Oxacillin=S & Penicillin etest R -Do NOT set CZ on proteus mirabilis -Enterobacteriaceae from urines: Report Fosfomycin if I/R to all of the following: amoxicillin/ampicillin, amox/clav, cephalexin, ciprofloxacin, nitrofurantoin and TMP/SMX, or if Requested. Report *E. coli* with interpretation. Report other *Enterobacteriaceae* with zone diameter and Isolate Message. For *E. coli* where fosfomycin is not reported, add Isolate Message “*E. coli* is generally susceptible to fosfomycin for treatment of acute uncomplicated cystitis.” -Enterococcus from urines: Report Fosfomycin for I/R to ampicillin and nitrofurantoin. For *E. faecalis* report interpretation. For *E. faecium* report with zone diameter and Isolate message. For *E. faecalis* where fosfomycin is not reported, add Isolate Message “*E. faecalis* is generally susceptible to fosfomycin for treatment of acute uncomplicated cystitis.” -Annual Review Changed *N. meningitidis* from No sensi to send to PHL as per IQMH 2016.07.06 practice recommendations for AST. Added *Vibrio* to “What to set up” table for enterics (not sensi) and sterile sites (send to PHL) as per IQMH 2016.12.14 Stool reporting Practice recommendations. Addition of Appendix “AGENTS NEVER TO BE REPORTED BY SITE” Added etest panel to Acinetobacter, Steno, Burkholderia for resistant etest (etresa) Addition of routine septra etest set up for *S. maltophilia* and send out to PHL if KB and etest disagree. Amoxicillin Etest added to Abbreviation list Aeromonas susceptibility removed from Enteric sites (on request only). Added susceptibility comment for Aeromonas spp. to report with “Resistance to non-carbapenem beta-lactam antimicrobials may develop in Aeromonas species during therapy. Choosing a non-beta-lactam antimicrobial should be considered for serious infections. Consultation with infectious diseases or medical microbiology is advised.” Added link to TREK manual in the TOC. Addition of susceptibility options for *Shigella* spp when requested on enteric sites. Reporting ciprofloxacin phrase for *Shigella* Etest added to reporting table for enteric sites. Under What to Test, temporary procedure change instructions for Vitek card recall added. Added to appendix XIX for temporary procedure change instructions for Vitek astn213 and

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<tbody>
<tr>
<td>Vitek astgp67 susceptibility results.</td>
<td>May 3, 2017</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Annual Review</td>
<td></td>
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<tr>
<td>Urine cephalixin reflexed from cefsolin vitek2 result. Reported only for E.coli,</td>
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<td>Klebsiella pneumonia and Proteus mirabilis.</td>
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<tr>
<td>Cephalixin =I/R will reflex Ampicillin =R for E.coli, Klebsiella</td>
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<td>pneumonia.</td>
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<tr>
<td>Added Staphylococcus pseudointermedius &amp; Staphylococcus intermedius in “What to</td>
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<tr>
<td>set up” table with Staphylococcus lagundensis.</td>
<td></td>
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<tr>
<td>Removed Amp/Sulbactam from set up and reporting for enterobacteriaceae and</td>
<td>May 17, 2017</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Acinetobacter spp.</td>
<td></td>
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<tr>
<td>Added set up etest Daptomycin for Enterococcus: All sites, if VA=R or vanA positive, E. faecalis or E. faecium</td>
<td>May 18, 2017</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Updated What to set up for Urine GBS and Urine Group A, C, F. Resp and non-sterile Beta strep reporting, removed duplicate</td>
<td>June 2, 2017</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>comment #20 (duplicate to comment #2)</td>
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<td>For Urine Beta strep comment with Clinda for insignificant amounts, updated</td>
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<td>comment to include “for intrapartum chemoprophylaxis”</td>
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<td>Urine Beta strep comment #12 removed “and erythromycin”.</td>
<td></td>
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<td>Removed:</td>
<td>July 22, 2017</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>Under What to Test, temporary procedure change instructions for Vitek card recall</td>
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<tr>
<td>added. Added to appendix XIX for temporary procedure change instructions for Vitek astn213 and Vitek astgp67 susceptibility results.</td>
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<tr>
<td>For P. aeruginosa what to set up.</td>
<td>July 28, 2017</td>
<td>Dr. T. Mazzulli</td>
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<tr>
<td>• removed KB disks ATM/FEP/TIM to set up “If resistant to all routinely tested</td>
<td></td>
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<tr>
<td>antimicrobials and colistin (excluding aminoglycosides)”</td>
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<tr>
<td>• Added ATM /FEP KB to “If resistant to all routinely tested antimicrobials</td>
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<td>(excluding aminoglycosides)”</td>
<td></td>
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<tr>
<td>Implementation of Acinetobacter for CPO screening:</td>
<td>August 2, 2017</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Added Acinetobacter to CPO flowcharts for both clinical and IC. The resulting</td>
<td></td>
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<tr>
<td>comment codes/notifications for Acinetobacter have been added.</td>
<td></td>
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<tr>
<td>Addition of results phrases/canned messages for Acinetobacter negative and</td>
<td>August 8, 2017</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>positive comments when returning from NML (\ACCN &amp; \ACCP)</td>
<td></td>
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<tr>
<td>Rifampicin and Amoxicillin etest abbreviations added.</td>
<td>August 18, 2017</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Modified Shigella “What to set up” from All sites Vitek to only non-enteric sites</td>
<td></td>
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<td>Vitek.</td>
<td></td>
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<tr>
<td>Added result of Haze as acceptable for OX screen plate with S.aureus ATCC43387.</td>
<td>September 25, 2017</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Added reporting of Ceftolozane/Tazobactam for Enterobacteriaceae comment and</td>
<td>October 27, 2017</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>P.aeruginosa when: I/R to All other Antimicrobial Agents OR if only aminoglycoside is S OR when requested.</td>
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<tr>
<td>Urine what to report for entero: linked comment 20 “if “S” for E.faecalis add</td>
<td>December 7, 2017</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Isolate Message “E. faecalis is generally susceptible”</td>
<td></td>
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<td>to fosfomycin for treatment of acute uncomplicated cystitis.” to reported drugs Amp, Tet, Nitro</td>
<td>May 20, 2018</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Added set up KB fos to Entrobacteriaceae “If resistant to all routinely tested antimicrobials(excluding aminoglycosides)” for Urines</td>
<td>August 29, 2018</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Added for Aeromonas isolated from enteric, no sensi to be set up unless requested.</td>
<td>Sept 14 2018</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Removed Chloramphenicol from Urine Enterobacteriaceae reporting. All other sites Non-Urine release Chloramphenicol if I/R to All other Antimicrobial Agents</td>
<td>November 18, 2018</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Annual Review</td>
<td>November 18, 2018</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Increased templates for screen plates. Replaced Etests and PHOL testing for S.pneumoniae and replaced with TREK set up. Modified reporting rules accordingly.</td>
<td>November 18, 2018</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Added CRE IC canned message</td>
<td>November 18, 2018</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>New etest Ceftobiprole added for MRSA on request only to all applicable sections.</td>
<td>November 18, 2018</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Added reporting phrase for tigecycline: “Results for tigecycline is based on Etest gradient strips (bioMérieux) which have been validated with well-characterized laboratory (ATCC) strains. Verification on clinical isolates against a gold standard method has been limited. Please take this into consideration when interpreting these results.”</td>
<td>November 18, 2018</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Added reporting phrase for Ceftolozane/tazobactam: “Results for ceftolozane/tazobactam is based on Liofilmchem gradient strips (Alere) which have been validated with well-characterized laboratory (ATCC) strains. Verification with clinical isolates against a gold standard method has been limited. Please take this into consideration when interpreting these results.”</td>
<td>November 18, 2018</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Updated Table of Contents links</td>
<td>November 18, 2018</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Add Rifampin (RI) to list of e-test abreviations</td>
<td>November 30, 2018</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Added H.pylori susceptibility requirements</td>
<td>December 10, 2018</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Corrected H.pylori set up from CM to CH (Clari)</td>
<td>January 11, 2019</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Corrected spelling of tetracycline in comments for reporting H.pylori</td>
<td></td>
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<tr>
<td>Modified step three in Denka procedure from water bath to 100C heating block with note.</td>
<td></td>
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</tr>
<tr>
<td>pg 7-9  &quot;Section: What to Test Enterobacteriaceae (not SPICE) sterile and on request - KB cefazolin, ertapenem, tobramycin, amikacin Enterobacteriaceae (not SPICE) on request - KB ampicillin SPIE - KB cipro, gentamicin, tobramycin, amikacin Proteus non-vulgaris on request - KB amox/clav Pseudomonas aeruginosa - KB pip-tazo, ceftaz, cipro, tobra, amikacin Salmonella, Shigella - KB/gradient strip all antimicrobials deleted Shigella enteric isolates AST testing reference”</td>
<td>July 16, 2019</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>pg 13  “Enterococcus - add “excluding respiratory” to all sites for</td>
<td>July 31, 2019</td>
<td>Dr. T. Mazzulli</td>
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</tbody>
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<tr>
<td>pg 26 Resp/Misc Gram Pos Reporting Table: update Footnote 14 for Daptomycin to exclude respiratory</td>
<td>November 29, 2019</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>pg 35 Blood/Sterile Sites Table: change Footnote 11 to Footnote 7 for Daptomycin/delete Footnote 11</td>
<td></td>
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</tr>
<tr>
<td>Update MRSA Screen test from DENKA to PBP2 Screen</td>
<td>November 29, 2019</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Removed need for CPO workup comment } \ NCRB and notification to ICPs.</td>
<td>December 31st, 2019</td>
<td>Dr. T. Mazzulli</td>
</tr>
<tr>
<td>Safety Precautions added to PBP2 MRSA Screen</td>
<td>February 21, 2019</td>
<td>Dr. T. Mazzulli</td>
</tr>
</tbody>
</table>