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| Reporting Guidelines for Susceptibility Reporting |
| **Policy Statement** | The decisions for the most appropriate antimicrobial agents to test and report are made with input from Pharmacy, Infectious Disease and the Clinical Laboratory. The goal is to provide clinically relevant information that will support cost-effective utilization of antimicrobial agents and to avoid reporting results that could adversely affect patient care. |
| **Purpose** | This policy documents and provides guidance for the processes and procedures for routine testing and reporting of Antimicrobial Agents / organism groupings |
| **Responsibility** | Microbiologists who perform and result antimicrobial susceptibilities |
| *Enterobacterales*Vitek AST-GN95, XN08 orMSCN NC68 MIC orKBS disk diffusion | Pseudomonas aeruginosa Vitek AST-GN95, XN08 or MSCN NC68 MIC or**KBS disk diffusion** | ***Steno. maltophilia*****MSCN NC68 MIC** | ***Acinetobacter*****Vitek AST-GN95, XN08 or MSCN NC68 or KBS disk diffusion** | *Salmonella**Shigella***KB EBAC HAE NMEN for *Salmonella*, *Shigella***  |
| -Ampicillin-Amp/Sulbactam-Aztreonam-Cefazolin-Ceftazidime-Cefepime-Ceftriaxone-Ciprofloxacin-Gentamicin-Ertapenem-Imipenem-Piperacillin/Tazobactam-Tobramycin-Trimethoprim/Sulfa-Meropenem-Nitrofurantoin (urine only)See Supplemental section for *Proteus*, *Morganella* and *Providencia* spp. testing.  | -Aztreonam**-KBS-PMAT**-Ceftazidime-Cefepime-Ciprofloxacin-Levofloxacin-Gentamicin-Imipenem-Meropenem-**XN08**-Piperacillin/Tazobactam-Tobramycin**\*\*CF-Mucoid PMUC****-KBS only** **Added testing Meropenem on all isolates September 2022** | -Trimethoprim/Sulfa-Levofloxacin**Discontinued reporting Ceftazidime September 2022** | -Amp/Sulbactam-Ceftazidime-Cefepime-KBS-Ceftriaxone-Ciprofloxacin-Levofloxacin-Gentamicin-Imipenem-Piperacillin/Tazobactam-Tobramycin-Trimethoprim/Sulfa-Meropenem | -Ampicillin-Ciprofloxacin-Trimethoprim/Sulfa*Salmonella spp*. only-Ceftriaxone extraintestinal sources only -Chloramphenicol Extraintestinal isolates if requested.  |
| **Non-Enterobacterales****MSCN NC68 MIC or Vitek GN95, XN08**-Aztreonam-Ceftazidime-Ceftriaxone-Cefepime-Ciprofloxacin-Levofloxacin-Imipenem-Gentamicin-Meropenem-Piperacillin/Tazobactam-Tobramycin-Trimethoprim/Sulfa | **CF cultures*****Staph aureus*—****Small colony variant****KBS disk diffusion** **MH with SB in CO2**-Clindamycin-Erythromycin-Gentamicin-Oxacillin-Penicillin-Rifampin-Trimethoprim/Sulfa-ICR(Inducible Clindamycin resistance)**ETEST****-**Vancomycin | ***B. cepacia***MSCN—NC68 MIC-Trimethoprim/Sulfa -Ceftazidime -Levofloxacin -Meropenem  | ***N. meningitidis*****DO ALL PROCEDURES IN BSC****KBS disk diffusion MH with SB in CO2**Perform BL test-Trimethoprim/Sulfa-Ceftriaxone-Ciprofloxacin | ***Yersinia******Aeromonas*****(Stool)****KB EBAC HAE NMEN**-Ciprofloxacin-Trimethoprim/Sulfa-Ceftriaxone |
| *Staphylococcus* sp.Vitek AST 67 or KBS disk diffusion(Reported for urine \*\*)Add comment:If: OX SS🡪 STPH1 If: OX R🡪 STPH2  | ***Enterococcus* sp.**Vitek AST 67 or**KBS disk diffusion****(Reported for urine \*\*)** | ***Strep. pneumoniae***Vitek GP74 orMSTRP or **KBS disk diffusion****& Penicillin Etest****(Reported for CSF and Blood isolates\*\*)** | ***Streptococcus* sp. {αlpha or βeta}****(not ES or SPNE)****αlpha-strep🡪AST-ST02 or MSTRP****or KBS disk MHSB****β-strep Group A🡪AST-ST02 or MSTRP** **(or KBS disk diffusion****on MH with SB in CO2)** **(ONLY done per special request; i.e. penicillin allergy)****β-strep Group B🡪****Vitek-AST-ST02** | ***Haemophilus* sp.****HTM🡪KBS disk diffusion** **in CO2**--Perform BL testing **(Reported for CSF isolates)****\*\*** |
| -Ciprofloxacin\*\*-Clindamycin-Erythromycin-Gentamicin\*\*-Oxacillin\*\*-Penicillin\*\*-Rifampin-Trimethoprim/Sulfa\*\*-Vancomycin-Nitrofurantoin (urine only)-ICR(Inducible Clindamycin resistance) | -Ampicillin\*\*-Vancomycin-Ciprofloxacin (Urine only)\*\*-Nitrofurantoin (Urine only)\*\*-Gent Synergy - Screen(Systemic infections only) | -Amoxicillin-Penicillin\*\*-Ceftriaxone\*\*-Erythromycin-Trimethoprim/Sulfa-Vancomycin\* \*(Reported only if other drugs are resistant)-Meropenem\*\*-Chloramphenicol\*\*(Reported only if other drugs are resistant)Do not report Pen V (oral) | -Ampicillin-Penicillin-Ceftriaxone-Erythromycin-Clindamycin-ICR for beta strep-Vancomycin**[DO NOT REPORT: Erythro / Clinda on URINE isolates]**  | -Ampicillin\*\*-Ampicillin/Sulbactam-Ciprofloxacin-Ceftriaxone\*\*-Trimethoprim/Sulfa |
| ***Lactobacillus* sp.****Refer AST** **U of M**  | ***Bacillus* sp.****Refer AST** **U of M**  | ***Pasteurella* sp.****Refer AST** **U of M**  |  |  |
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| Supplemental or Confirmatory Testing | **XN08 Gram negative extension card** | Set up this card when additional antibiotics are requested. This card tests Amikacin, Aztreonam, Cefoxitin, Cefpodoxime, Ceftolozane/Tazobactam, Cefuroxime, Meropenem and Tetracycline. Only report antibiotics that are requested. Review product limitations.  |
| **Use code MDRO** | For ***Enterobacterales****,* use code **MDRO** with any resistance to any carbapenem.For ***Pseudomonas aeruginosa*,** use code **MDRO** when there is non-susceptible results for 3 or more classes of antibiotics. (Example: non-susceptible to a penicillin, cephalosporin, fluoroquinolones, aminoglycoside or carbapenem.  |
| ***Proteus* spp, *Morganella* spp and *Providencia* spp** | Test for **Meropenem** when Imipenem, Piperacillin/Tazobactam, Ceftriaxone and Ceftazidime are resistant. Use code **MDRO** when non-susceptible to Imipenem and one other carbapenem.  |
| **Reflex testing for Cefpodoxime**  | Report Cefpodoxime when cefazolin is resistant on urine cultures that isolated ***E.coli,******Klebsiella pneumoniae,******Proteus mirabilis***and is ESBL negative.Run a XN08 card to obtain a Cefpodoxime result and release only the Cefpodoxime. Refer to the MC 6.02 AST-XN08 for further reporting instructions. |
| **Inducible Clindamycin Resistance -- ICR** | This is performed on the Vitek AST 67 card for all *Staphylococci* and the AST-ST02 for β- hemolytic strep. If the ICR is positive, the Clindamycin MIC is reported as R. Disk diffusion D-testing is also available for SCV *Staph aureus,* andβ- hemolytic strep. Place the E and CC disks 15-26 mm apart for Staph; For β- hemolytic strep, place disks 12 mm apart. |
| **Deduced Cefazolin**  | Cefazolin (1st generation cephalosporin) is a deduced result on Vitek GP67 cards. If Vitek OX MIC is falsely resistant and is disproved by the FOX disk, change CFZ to susceptible to agree with FOX. **Do not report for CSF**. |
| **Cefoxitin Disk Screen for MRSA** | Cefoxitin is a surrogate for oxacillin for *Staphylococcus aureus*. If performed, report the oxacillin susceptible or resistant based on the cefoxitin result. Isolates that test resistant by cefoxitin should be reported as oxacillin resistant (report only the interpretation under the MIC keyboard). Isolates that test cefoxitin susceptible should be reported as oxacillin susceptible (report only the interpretation under MIC keyboard). FOX zone of ≥ 22mm: report as: SS --MSSAFOX zone of ≤ 21mm: report as: R --MRSA |
| **Penicillin Etest for** ***St. pneumoniae*** | Per the package inserts for Etest strips, please round UP to the next doubling dilution. Enter Etest reading in the Sunquest culture work-up along with “reported as \_\_\_\_\_”.Report in Sunquest Susceptibility tab, resulting **PENNM**, **PENM,** with the same result (do not release the Vitek 74 online result for P).  **DO NOT REPORT PENV (oral) from any body site.**  readings of .002 thru .047 are reported as **<=0.06** readings of .064 and .094 are reported as **0.12** readings of .125 and .25 are reported as **0.25** readings of .38 and .5 are reported as **0.5** readings of .75 and 1.0 are reported as **1** readings of 1.5 and 2 are reported as **2**readings of 3 and 4 are reported as **4** readings 6 or greater are reported as **>=8** |
| **ESBL detection** | This is performed on Vitek AST-GN95 card for *E. coli, K. pneumoniae, K. oxytoca.*If Vitek AES phenotype is ESBL or ESBL (CTX-M LIKE), report the ESBL as positive. Change bracketed [ ] results to R. Do not report MIC. For *Proteus mirabilis:* Perform MicroScan if the Vitek AES reports an ESBL phenotype, to confirm.  |
| **Carbapenemase detection** | If Vitek AES phenotype is a possible Carbapenemase producer, confirm by alternate method. Using current breakpoints, report MIC results as tested. Do no change interpretations. Send to MDH Project 1380, using the Clinical Isolate Submission Form. If MDH results are positive for Carbapenemase Producer, add code (KPC, NDM, etc.) to organism. **If MDH results ae negative for Carbapenemase Producer, use code NCPO (Non-Carbapenemase Producing Organism).** |
| **Enterococcus--HLAR** | High-Level Aminoglycoside resistance (HLAR) is tested with the Vitek AST 67 card. Gentamycin synergy (GMSS) is reported on systemic enterococcus isolates.  |
| **Enterococcus--VRE** | If the Vancomycin MIC is =8 μg/ml or higher, confirm with Etest vancomycin strip and perform MALDI for identification to distinguish species from those with acquired resistance (*vanA* and *vanB)* from those with intrinsic, intermediate level resistance to vancomycin such as *E.gallinarum* and *E.casseliflavus*.  |
| **Supplemental Antimicrobial Agents** | If additional susceptibility testing is requested and cannot be performed in our lab the test is sent to UM Fairview Medical Center. Refer to [MCVI 5.2 Micro Send-out Reporting](file:///G%3A%5CLab%20Procedures%5CMicrobiology%5C1NEW%20Micro%20Procedure%20Manual.%20%28same%20as%20in%20Starnet%29%5CMCVI%205%20Computer%5CMCVI%205.2%20Micro%20Sendout%20Resulting.docx) Procedure for additional information. |
| Misleading Results | **Do not report the following:** | *Salmonella and Shigella*: first and second generation cephalosporins and aminoglycosides Staph sp.: do not report CF; AM; AMC-- the beta-lactam drugs—(except Penicillin and Cefazolin)*Enterococcus* sp.: cephalosporins, trimeth/sulfa, clindamycin, and aminoglycosides  |
| CLSI CSF Reporting Rule | **“Warning”: The following antimicrobial agents should not be routinely reported for bacteria isolated from CSF.** | --Agents administered by oral route only—Do not report Cefazolin1st -and 2nd-generation cephalosporins (except Cefuroxime parenteral) and cephamycins--Clindamycin--Macrolides (Erythromycin)--Tetracycline’s --Fluoroquinolones—e.g. Ciprofloxacin, and the other “floxacins" |
| Inconsistent Antimicrobial Results | Inconsistent or unusual results must be confirmed. The Vitek AES, Advanced Expert System and the Bio-ART rules flag results from the Vitek cards. The Sunquest Susceptibility Quality Assurance rules will give a pop-up QA warning when entering inconsistent results that need to be confirmed. Do not accept these flagged results until verified. |
| Pan Resistant results | Confirm results when all antibiotics are resistant, preferably with another method.  |
| Strains and Morphology | When multiple isolates of the same organism appear differently but tested similarly, describe as a different morphology. Use codes MOR2, MOR3 after the organism. List organism on the same Observation line.  Example: 3+ Staphylococcus hominis (2 colony morphologies)When multiple isolates of the same organism appear differently and their susceptibility pattern vary but at least 3 doubling dilutions or a different interpretation, describe as a different strain.Use codes S1, S2 after the organism. List the organisms on different Observations lines. Example: 3+ Pseudomonas aeruginosa (Strain 1) 2+ Pseudomonas aeruginosa (Strain 2)  |
| AST Frequency | Isolates that are initially susceptible may become intermediate or resistant after the initiation of therapy. Susceptibilities are repeated every three days if the same isolate is recovered from subsequent cultures. Special requests for earlier repeat susceptibility testing may be warranted due to the severity of the patient’s condition. These will be determined after consultation with the medical staff and Infectious Disease physicians. |
| References | 1. Hindler, J.F., Section editor, “Antimicrobial Susceptibility Testing” in *Clinical Microbiology Procedures Handbook,* Garcia, Lynne, editor, 2010, ASM Press, Washington, D.C.
2. CLSI. Performance Standards for Antimicrobial Susceptibility Testing: Twenty-ninth Informational Supplement. CLSI document M100-29. Wayne, PA: Clinical Laboratory Standards Institute; 2019
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| **Training Plan/ Competency Assessment** | **Training Plan** | **Initial Competency Assessment** |
| * + 1. Employee must read the procedure
		2. Employee will observe trainer performing the procedure.
		3. Employee will demonstrate the ability to perform procedure, record results and document corrective action after instruction by the trainer.
 | 1. Direct Observation.
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| Historical Record | **Version** | **Written/ Revised by:** | **Effective Date:** | **Summary of Revisions** |
|  | 1.0 | Pat Ackerman | 5/1/1990 | Initial Version |
|  | 1.1 | Pat Ackerman | 9/16/2001 |  |
|  | 1.2 | Pat Ackerman | 9/5/2005 |  |
|  | 1.3 | Pat Ackerman | 12/20/2006 | Update Salmonella drugs to include Nalidixic acid |
|  | 1.4 | Pat Ackerman | 10/23/2007 | Added TIM, CAX, LEVO to PSMA drugs |
|  | 1.5 | Becky Carlson | 7/8/2013 | Reformatted, updated procedure |
|  | 2.0 | Becky Carlson | 10/29/2013 | Added sections for: Pen Etest interpretation sectionDeduced antibiotic resulting CLSI CSF Reporting Rule |
|  | 2.1  | Becky Carlson | 1/16/2014 | Added *N. meningitidis* section. Amended Group A strep—perform AST only per special request; i.e. penicillin allergic. Added beta lactamase testing to *Haemophilis* section. |
|  | 2.2 | Becky Carlson | 8/6/2014 | Added *Lactobacillus* section. |
|  | 3.0  | Becky Carlson  | 10/20/2016 | Revised PSMA reporting, TIM not available in U.S. Discontinued Vitek AST. |
|  | 4.0 | Becky Carlson | 11/02/2016 | Removed method for in-house performance of AST for Bacillus and *Lactobacillus*.Removed Trimethoprim-sulfa drug reporting for *Listeria.* |
|  | 5 | Susan DeMeyere | 5/17/2019 | Changed KPC instructions, removed inappropriate drugs from table.  |
|  | 6 | Susan DeMeyere | 11/5/2019 | Updated ESBL, Carbapenems and Aeromonas instructions. Changed to GN95 card.  |
|  | 7 | Susan DeMeyere | 10/20/2020 | Added ST02 card. Removed confirmation of resistant Gent synergy on Enterococcus. Added Pasteurella susceptibilities be sent to U of M. |
|  | 8 | Susan DeMeyere | 8/9/2021 | Added instructions for reflex testing for Cefpodoxime |
|  | 9 | Susan DeMeyere | 9/10/2021 | Added instruction to set up KB for cefepime with Acinetobacter and to use MicroScan for primary testing for Non-Enterobacteriaceae |
|  | 10 | Susan DeMeyere | 6/8/2022/ | Changed all Spne tested on GP74 card, not ST02 card. Stop reported oral Pen V on Spne.  |
|  | 11 | Susan DeMeyere | 9/19/2022 | Added code NCPO, testing MERO on all PSAR, and testing for Mero on PROT, MORG, and PROV spp. with resistance. Discontinue reporting CAZ on PSMA, add more MDRO rules.  |