

## MC 6.035 *Streptococcus pneumoniae* Susceptibility Reporting

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**Purpose** This procedure provides instruction and guidance for routine testing and selective and cascade susceptibility reporting on *Streptococcus pneumoniae*.

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**Principal and Clinical Significance** 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 decrease the chance of developing antibiotic resistance, harmful effects of inappropriate antimicrobial use and avoid reporting results that could adversely affect patient care using selective and cascade reporting rules.

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**Policy Statements** This procedure applies to Microbiologists who perform susceptibility testing.

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**Special Safety Precautions** Microbiologists are subject to occupational risks associated with specimen handling.

- [Biohazard Containment](#)
- [Biohazardous Spills](#)
- [Safety in the Microbiology Laboratory](#)

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### Procedure

1. Antibiotics appropriate for routine testing and reporting for *Streptococcus pneumoniae* include:
  - Erythromycin
  - Penicillin
  - Trimethoprim Sulfamethoxazole
  - Ceftriaxone
  - Cefotaxime
  - Clindamycin
  - Meropenem
  - Doxycycline
  - Tetracycline
  - Vancomycin
  - Levofloxacin
  - Amoxicillin
  - Amoxicillin-clavulanate
  - Cefepime
  - Ceftaroline
  - Ertapenem
  - Imipenem
  - Linezolid
  - Rifampin
2. Perform susceptibilities using Vitek cards ST02 and DTEST, MicroScan MicroStrep or Kirby Bauer Method.
  - Vitek AST-ST02 will be the primary method of testing.
  - DTEST testing is required for all non-urine, non-CSF isolates.
  - MicroScan MicroStrep is required for CSF isolates so you may want to skip the Vitek testing.
  - MicroScan MicroStrep and Kirby Bauer are back up if testing fails.

- Do not perform testing on multiple methods to cover all the antibiotics. It is acceptable if cascaded antibiotics are not reported.
- 3. Vitek results will be accepted under the Online Results tab. Modifications will be under the **VITMIC** keyboard under the Susceptibility tab.
- 4. Kirby Bauer results will be entered manually under the **KB** keyboards under the Susceptibility tab.
- 5. MicroScan MicroStrep will be entered manually under the **MMIC** keyboards under the Susceptibility tab.

### Selective Reporting

1. Antibiotics will be reported in a specific order indicating the first and subsequent preferences of the Antimicrobial Stewardship Committee and Infectious Disease physicians
2. Antibiotics will be reported depending on the source, if the sample is a urine, non-urine or CSF source.
3. There will be exceptions based on the method used for testing.
4. For all methods, if **Penicillin NM MIC is >0.5, send isolate to U of M for Amoxicillin.**
5. For **urine sources**, these 5 antibiotics will be reported routinely, in this order.
  1. Penicillin (meningitis and non-meningitis)
  2. Ceftriaxone (meningitis and non-meningitis)
  3. Levofloxacin

Figure 1 -Only PENNM, PENM, CTRNM, CTRM, and LEVO are reported. All other antibiotics are in HIDE

Organism #1 - (A)APPROXIMATELY 100000 COL/ML STREPTOCOCCUS PNEUMONIAE	
- VITMIC -	
SS	PENNM(0.06), PENM(0.06), CTRNM(0.5), CTRM(0.5), LEVO(2)
HIDE	VA(1-SS), LZD(2-SS), TS(10-SS), TE(1-SS), PENV(0.06-SS)

6. For **non-urine sources**, these 6 antibiotics will be reported routinely, in this order.
  1. Penicillin (meningitis and non-meningitis)
  2. Ceftriaxone (meningitis and non-meningitis)
  3. Clindamycin
  4. Levofloxacin

Figure 2-Only PENNM, PENM, CTRNM, CTRM, CD and LEVO are reported. All other antibiotics are in HIDE.

Organism #1 - (A)STREPTOCOCCUS PNEUMONIAE	
- VITMIC -	
SS	PENNM(<=0.06), PENM(<=0.06), CTRNM(<=0.12), CTRM(<=0.12), LEVO(0.5), CD(0.25)
HIDE	VA(0.25-SS), TS(<=10-SS), E(>=8-R), TE(<=0.25-SS), PENV(<=0.06-SS), LZD(2-SS), ICR(NEG)

5. DTEST is required to be set up for all non-urine, non-CSF isolates. Manually result under the ICR.
7. For **CSF** sources, these 4 antibiotics will be reported routinely, in this order.
  1. Penicillin (meningitis)
  2. Ceftriaxone (meningitis)
  3. Meropenem
  4. Vancomycin

Figure 3-Only PENM, CTRM, VA and MERO are reported. All other antibiotics are in HIDE.

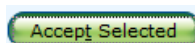
Organism #2 - (C) 4+ STREPTOCOCCUS PNEUMONIAE		
- VITMIC -		
SS	PENM(0.06),CTRM(0.5),VA(1)	
HIDE	LZD(2-SS),LEVO(2-SS)	
- MMIC -		
SS	MERO(0.25)	

- Set up MicroScan MicroStrep for Meropenem. Result under MMIC keyboard.
- CSF isolates do not need to be sent out for Amoxicillin.

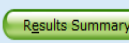
### Cascade Reporting-Vitek Method

If resistance is encountered, additional antibiotics will automatically be released.

- For Vitek method, hidden antibiotics will be released when Accept Selected is clicked.



The released results will be visible in Results Summary.



- Results can be edited under the **VITMIC** keyboard but is not needed to report the cascaded antibiotics.
- Manually enter the ICR result for all non-urine, non-CSF isolates.
- For all methods, if **Penicillin NM MIC is >0.5, send isolate to U of M for Amoxicillin (AMX)**.
- There are no cascade rules for CSF isolates.

### Method: Vitek -Urine sources

- If Ceftriaxone NM is I or R → report Vancomycin and Meropenem\*
  - If Vancomycin\*\*\* is R → report Linezolid

Figure 4- Urine culture example with resistant CTRNM and PENNM. Additional testing for MERO and AMX.

Organism #1 - (A) APPROXIMATELY 100000 COL/ML STREPTOCOCCUS PNEUMONIAE		
- VITMIC -		
SS	LEVO(2), VA(1)	
R	PENNM(8), PENM(8), CTRNM(4), CTRM(4)	
HIDE	LZD(2-SS), TS(10-SS), TE(1-SS), PENV(8-R)	
- MMIC -		
SS	AMX(0.5), MERO(0.25)	

Figure 5-Urine culture example with an intermediate result for CTRNM and resistant PENM. Additional testing for MERO and AMX.

Organism #1 - (A)APPROXIMATELY 100000 COL/ML STREPTOCOCCUS PNEUMONIAE		
- VITMIC -		
SS	LEVO(2),VA(1)	
I	CTRM(2)	
R	PENNM(8),PENM(8),CTRM(2)	
HIDE	LZD(2-SS),TS(10-SS),TE(1-SS),PENV(8-R)	
- MMIC -		
SS	AMX(0.5),MERO(0.25)	

## Method: **Vitek** -Non-Urine sources

- If Ceftriaxone NM is I or R → report Vancomycin and Meropenem\*
  - If ICR is positive\*\* → report Clindamycin as R, remove the MIC result
    - If Vancomycin\*\*\* is R → report Linezolid

Table 6-Ear Culture example with positive ICR, resistant CTRNM and PENNM MIC >0.5. Vancomycin, Meropenem and AMX reported. Clindamycin reported as R.

Organism #2	-	(A) 4+ STREPTOCOCCUS PNEUMONIAE
- VITMIC -		
	SS	LEVO(1), VA(1)
	R	PENNM(8), PENM(8), CTRNM(4), CTRM(4), CD(R)
	HIDE	LZD(2-SS), TS(10-SS), E(0.25-SS), TE(1-SS), PENV(8-R), ICR(POS)
- MMIC -		
	SS	AMX(1), MERO(0.25)

6. \*Set up MicroScan MicroStrep for Meropenem when Ceftriaxone NM is I or R.
  - Enter Meropenem MIC under MMIC keyboard.
  - Release Meropenem from HIDE.
7. Manually enter the AMX MIC under the MMIC keyboard.
8. \*\*Manually enter the ICR result as Positive (POS) or Negative (NEG) on non-urine and non-CSF.
9. \*\*\* If Vancomycin is resistant, confirm with Etest.
10. Exception: Clindamycin is not reported on Urine or CSF. Amoxicillin is not reported on CSF.
11. All other antibiotics on the panel that are not part of the cascade are hidden. Do not release and report. Hidden antibiotics include:
  - Erythromycin
  - Trimethoprim-Sulfa
  - Tetracycline
  - Penicillin V
  - ICR
12. Requested antibiotics may be released with a provider request

### Cascade Reporting-MicroScan Method

If resistance is encountered, additional antibiotics will automatically be released.

1. Enter **all** listed results manually under the **MMIC** keyboard. Antibiotics will be released following the cascade rules.

## Method: **MicroScan**– urine source

- If Ceftriaxone NM is I or R → report Vancomycin and Meropenem

Figure 7 Urine Culture example with ceftriaxone NM and penicillin NM resistance. Additional testing for Amoxicillin.

Organism #2	-	(A) APPROXIMATELY 80000 COL/ML STREPTOCOCCUS PNEUMONIAE
- MMIC -		
	SS	LEVO(2), AMX(2), VA(1), MERO(0.25)
	R	PENNM(8), PENM(8), CTRNM(4), CTRM(4)
	HIDE	TS(10-SS), TE(1-SS), PENV(8), AUG(2-SS), CEFE(1-SS), TAXNM(0.5-SS), TAXM(0.5-SS)

## Method: MicroScan – non-urine source

- If Ceftriaxone NM is I or R → report Vancomycin and Meropenem
- If ICR is positive \*\* → report Clindamycin as R

Figure 8 Example with ceftriaxone and penicillin resistance and ICR positive. CD reported as R, Vancomycin, Meropenem and Amoxicillin reported after additional testing for Amoxicillin.

Organism #3 - (A)3+ STREPTOCOCCUS PNEUMONIAE		
- MMIC -		
SS	LEVO(1), AMX(0.5), VA(1), MERO(0.25)	
R	PENNM(8), PENM(8), CTRNM(4), CTRM(4), CD(R)	
HIDE	TS(10-SS), E(1-R), TE(1-SS), TAXNM(0.5-SS), TAXM(0.5-SS), PENV(8), AUG(2-SS), CEFE(1-SS), ICR(POS)	

13. \*\*Manually enter the ICR result as Positive (POS) or Negative (NEG).
14. If Vancomycin is resistant, confirm with Etest.
15. Exception: Clindamycin is not reported on Urine or CSF. Amoxicillin is not reported on CSF.
16. All other antibiotics on the panel that are not part of the cascade are hidden. Do not release and report. Hidden antibiotics include:
  - Erythromycin
  - Cefotaxime
  - Trimethoprim-Sulfa
  - Tetracycline
  - Penicillin V
  - Augmentin
  - Cefepime
  - ICR
17. Requested antibiotics may be released with a provider request.

### Cascade Reporting- Kirby Bauer Method

1. Kirby Bauer method will not be very helpful, as Penicillin, Ceftriaxone and Meropenem do not have KB breakpoints.
2. If Vitek or MicroScan MicroStrep do not yield results:
  - Set up Penicillin Etest and result under the MMIC keyboard
3. Enter **all** listed results manually under the **KB** keyboard.
4. There are no cascade rules. Vancomycin will be reported as Ceftriaxone is not available.

## Method: Kirby Bauer –urine source

Figure 9 Urine Culture. Penicillin tested by Etest.

Organism #3 - (A)>100000 COL/ML STREPTOCOCCUS PNEUMONIAE		
- KB - (ZZ03)		
SS	VA(17)	
HIDE	TS(20-SS)	
- MMIC - (ZZ04)		
SS	PENNM(0.06) , PENM(0.06)	

## Method: Kirby Bauer – non-urine source

- If ICR is positive → report Clindamycin as R

Figure 10 Example with ICR positive, CD reported as R. Penicillin tested by Etest.

Organism #4 - (A)2+ STREPTOCOCCUS PNEUMONIAE		
- KB -		
SS	VA(17)	
R	CD (R)	
HIDE	TS(17-I), E(15-R), ICR(POS)	
- MMIC -		
SS	PENNM(0.06), PENM(0.06)	

- \* Perform Penicillin Etest for result. Result Vancomycin on the MMIC keyboard.

## Method: Kirby Bauer – CSF source

Figure 11 Example on CSF. Penicillin tested by Etest.

Organism #3 - (C)3+ STREPTOCOCCUS PNEUMONIAE		
- KB -		
SS	VA(17)	
- MMIC -		
SS	PENM(0.06)	

- All other antibiotics on the panel that are not part of the cascade are hidden. Do not release and report. Hidden antibiotics include:
  - Erythromycin
  - Trimethoprim-Sulfa
  - ICR
- Requested antibiotics may be released with a provider request.

### Method Performance Specifications

- Usually, only the Vitek card AST-ST02 will be required for testing *Streptococcus pneumoniae*.
- When Penicillin NM MIC is >0.5, send isolate to U of M for Amoxicillin. Result under MMIC keyboard.
- Set up a DTEST for all non-urine, non-CSF isolates. Result under the ICR as positive or negative.
- Set up a MicroScan MicroStrep on CSF isolates for *Streptococcus pneumoniae*.
- Set up Penicillin Etest including day of use QC when testing with Kirby Bauer Method. Result Penicillin under the MMIC keyboard.
- When setting up KB on non-urine, non-CSF, place the CC and E disks 12 mm apart. Manually read the zone sizes and observe if a flattening of the clindamycin zone is present. Refer to [MC 6.80 DTEST](#) for further instructions.
- Confirm Vancomycin resistance with Etest.

**Vitek  
Product  
Limitations**

Results for an antibiotic/organism combination may have limitations and may be suppressed from reporting. Refer to table below for specific limitations.

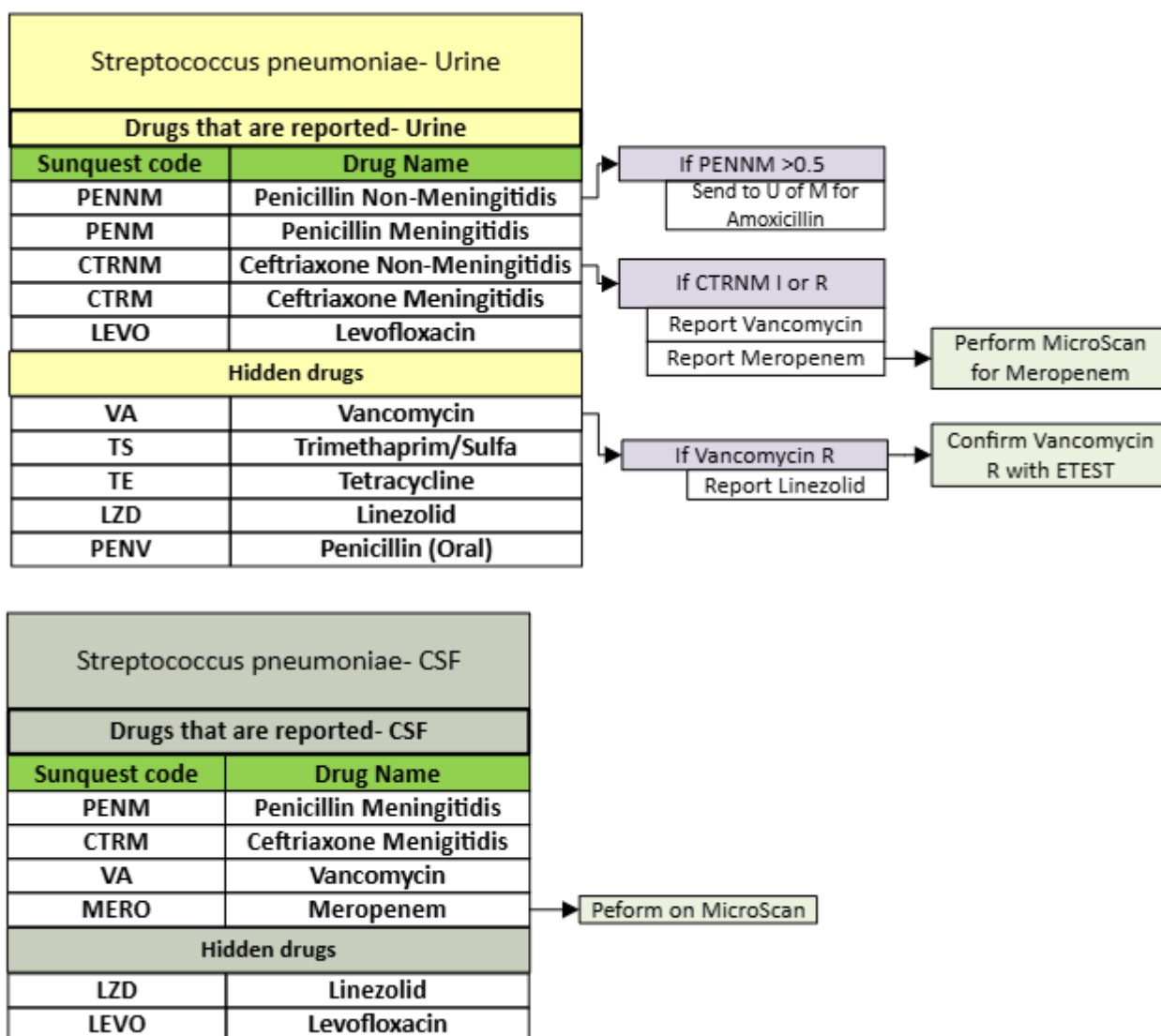
**AST-ST02 card for Streptococcus pneumoniae species**

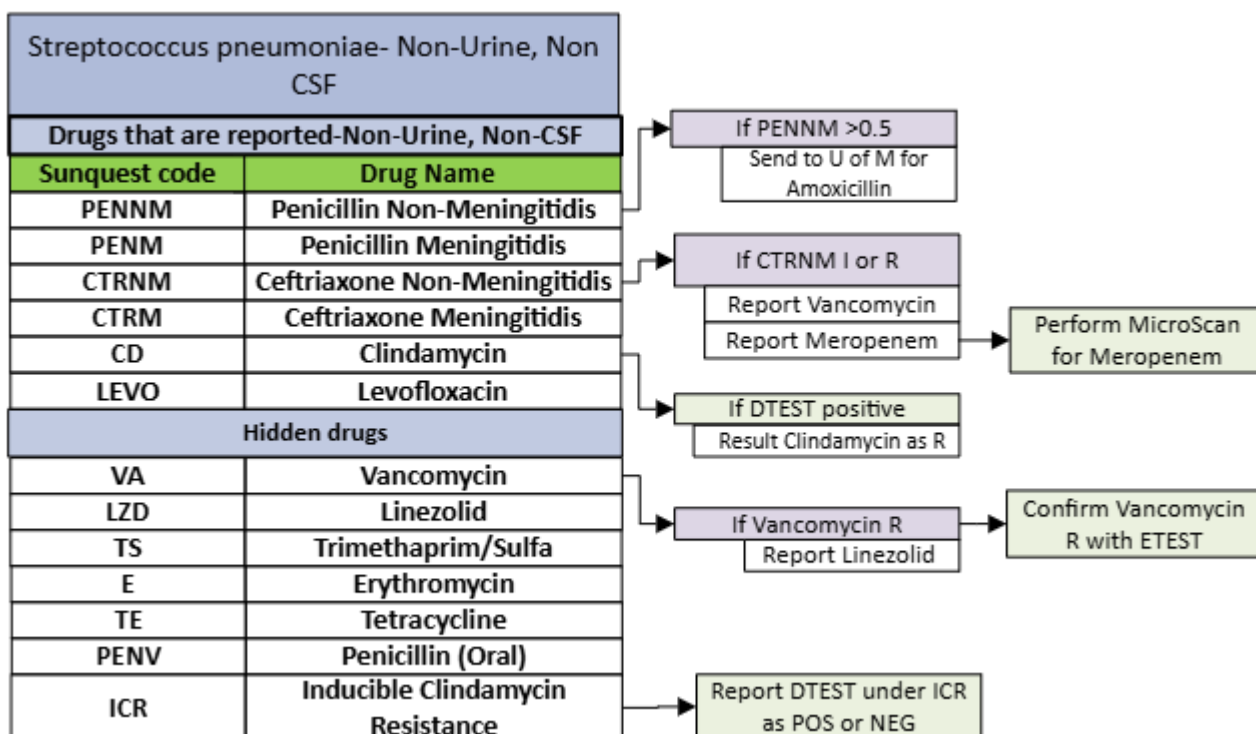
Antibiotic	Product Limitations
Penicillin	Penicillin will be suppressed when resistant on <i>Streptococcus pneumoniae</i> .
Linezolid	Linezolid will be suppressed when resistant on <i>Streptococcus pneumoniae</i> .

**Appendix**

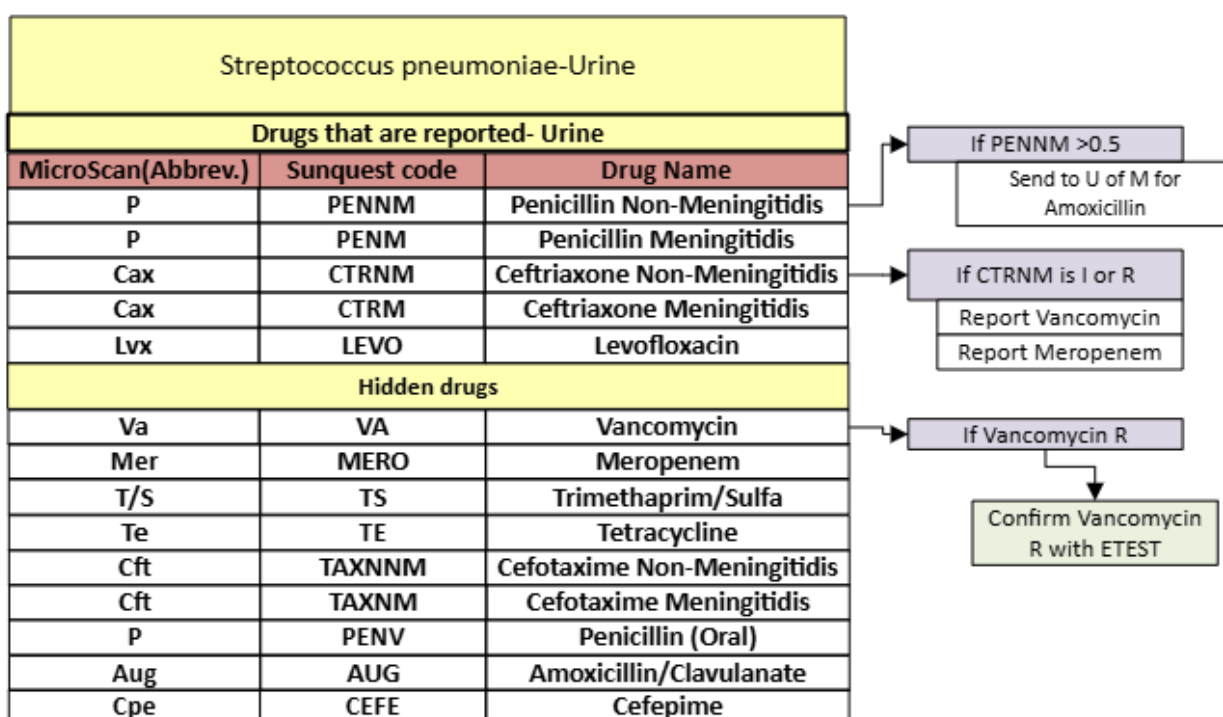
Additional Tables and Flowcharts

Vitek





## MicroScan





Streptococcus pneumoniae- Non-Urine, Non-CSF			
Drugs that are reported- Non-Urine, Non-CSF			
MicroScan(Abbrev.)	Sunquest code	Drug Name	
P	PENNM	Penicillin Non-Meningitidis	If PENNM >0.5 Send to U of M for Amoxicillin
P	PENM	Penicillin Meningitidis	
Cax	CTRNM	Ceftriaxone Non-Meningitidis	If CTRNM is I or R Report Vancomycin Report Meropenem
Cax	CTRM	Ceftriaxone Meningitidis	
Cd	CD	Clindamycin	If DTEST positive Result Clindamycin as R
Lvx	LEVO	Levofloxacin	
Hidden drugs			
Va	VA	Vancomycin	
Mer	MERO	Meropenem	
SXT	TS	Trimethaprim/Sulfa	
	ICR	Inducible Clindamycin Resistance	Report DTEST under ICR as POS or NEG
E	E	Erythromycin	
Te	TE	Tetracycline	
Cft	TAXNNM	Cefotaxime Non-Meningitidis	
Cft	TAXNM	Cefotaxime Meningitidis	
P	PENV	Penicillin (Oral)	
Aug	AUG	Amoxicillin/Clavulanate	
Cpe	CEFE	Cefepime	

Streptococcus pneumoniae- CSF		
Use Meningitidis breakpoints for P, Cax and Cft		
Drugs that are reported- CSF		
MicroScan(Abbrev.)	Sunquest code	Drug Name
P	PENM	Penicillin Meningitidis
Cax	CTRM	Ceftriaxone Meningitidis
Va	VA	Vancomycin
Mer	MERO	Meropenem
Hidden drugs		
Cft	TAXM	Cefotaxime Meningitidis
Lvx	LEVO	Levofloxacin

## Kirby-Bauer

Streptococcus pneumoniae-Urine		
Drugs that are reported- Urine		
Disk (Abbrev.)	Sunquest code	Drug Name
Va	VA	Vancomycin
P	PENM	Penicillin Meningitidis
P	PENNM	Penicillin Non-Meningitidis
Hidden drugs		
SXT	TS	Trimethaprim/Sulfa

E-Test: Enter in MicroScan Keyboard

Streptococcus pneumoniae-Non-Urine, Non-CSF		
Drugs that are reported- Non-Urine, Non-CSF		
Disk (Abbrev.)	Sunquest code	Drug Name
Va	VA	Vancomycin
CC	CD	Clindamycin
P	PENM	Penicillin Meningitidis
P	PENNM	Penicillin Non-Meningitidis
Hidden drugs		
SXT	TS	Trimethaprim/Sulfa
E	E	Erythromycin
	ICR	Inducible Clindamycin Resistance

If DTEST positive  
Result Clindamycin as R

E-Test: Enter in MicroScan Keyboard

Report DTEST under ICR as POS or NEG

Streptococcus pneumoniae- CSF Use Meningitidis breakpoints for P		
Drugs that are reported- CSF		
Disk (Abbrev.)	Sunquest code	Drug Name
P	PENM	Penicillin Meningitidis
Hidden drugs		
Va	VA	Vancomycin

E-Test: Enter in MicroScan Keyboard

### References

1. bioMerieux Vitek 2 AST-ST02 Streptococcus Susceptibility Card 046685-02 2021-08
2. Beckman Coulter, Inc. MicroScan® MICroSTREP™ plus Panel Revised August 2023, Brea, CA. [www.beckmancoulter.com](http://www.beckmancoulter.com)
3. CLSI M100 edition 35 Performance Standards for Antimicrobial Susceptibility Testing 2025

**Training Plan/  
Competency  
Assessment**

Training Plan	Initial Competency Assessment
<ol style="list-style-type: none"> <li>Employee must read the procedure.</li> <li>Employee will observe trainer performing the procedure.</li> <li>Employee will demonstrate the ability to perform procedure, record results and document corrective action after instruction by the trainer.</li> </ol>	<ol style="list-style-type: none"> <li>Direct observation.</li> </ol>

**Historical  
Record**

Version	Written/Revised by:	Effective Date:	Summary of Revisions
1	Susan DeMeyere	4/15/2025	Initial version