Interpreting Microbiology Results

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2025 Nebraska Antimicrobial Stewardship Summit
LTC Fundamentals in Antibiotic Stewardship Track
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NEBRASKA
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DEPT. OF HEALTH AND HUMAN SERVICES

NE ICAP ASAP

NEBRASKA INFECTION CONTROL ASSESSMENT AND PROMOTION PROGRAM
ANTIMICROBIAL STEWARDSHIP ASSESSMENT AND PROMOTION PROGRAM

Relevant Financial Disclosures

No Disclosures

None of the faculty or planners for this activity have relevant financial relationship(s) to disclose with ineligible companies whose primary business is producing, marketing, selling, re-selling, or distributing healthcare products used by or on patients

Objectives

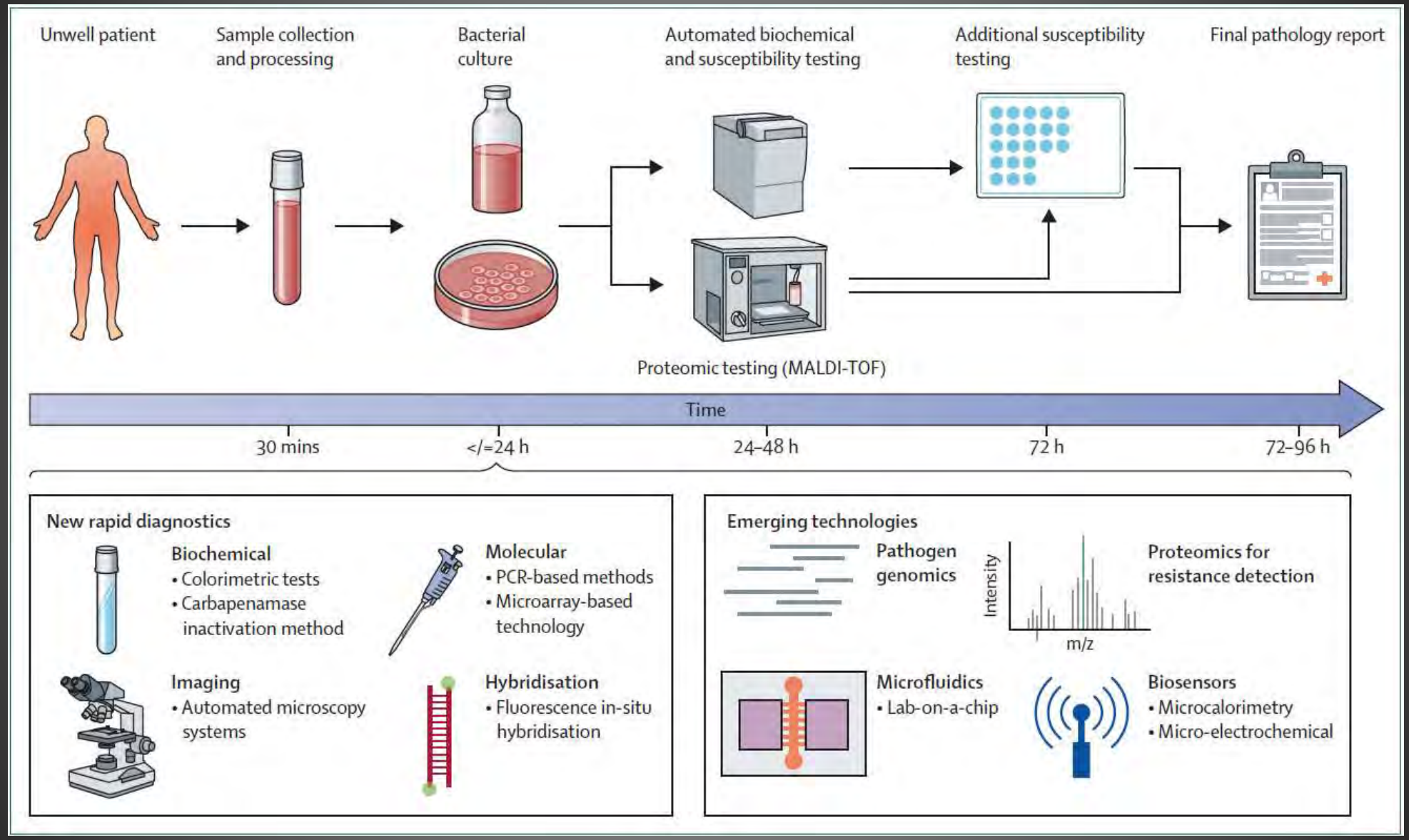
1. Equip infection preventionists (IPs) with the knowledge to accurately interpret microbiology results, including distinguishing between colonization and active infection.
2. Provide IPs with practical examples of microbiology results and guide them on how to interpret these findings in the context of infection prevention.
3. Highlight the critical factors that influence the interpretation of microbiology results.

Key Aspects of Interpreting Microbiology Results

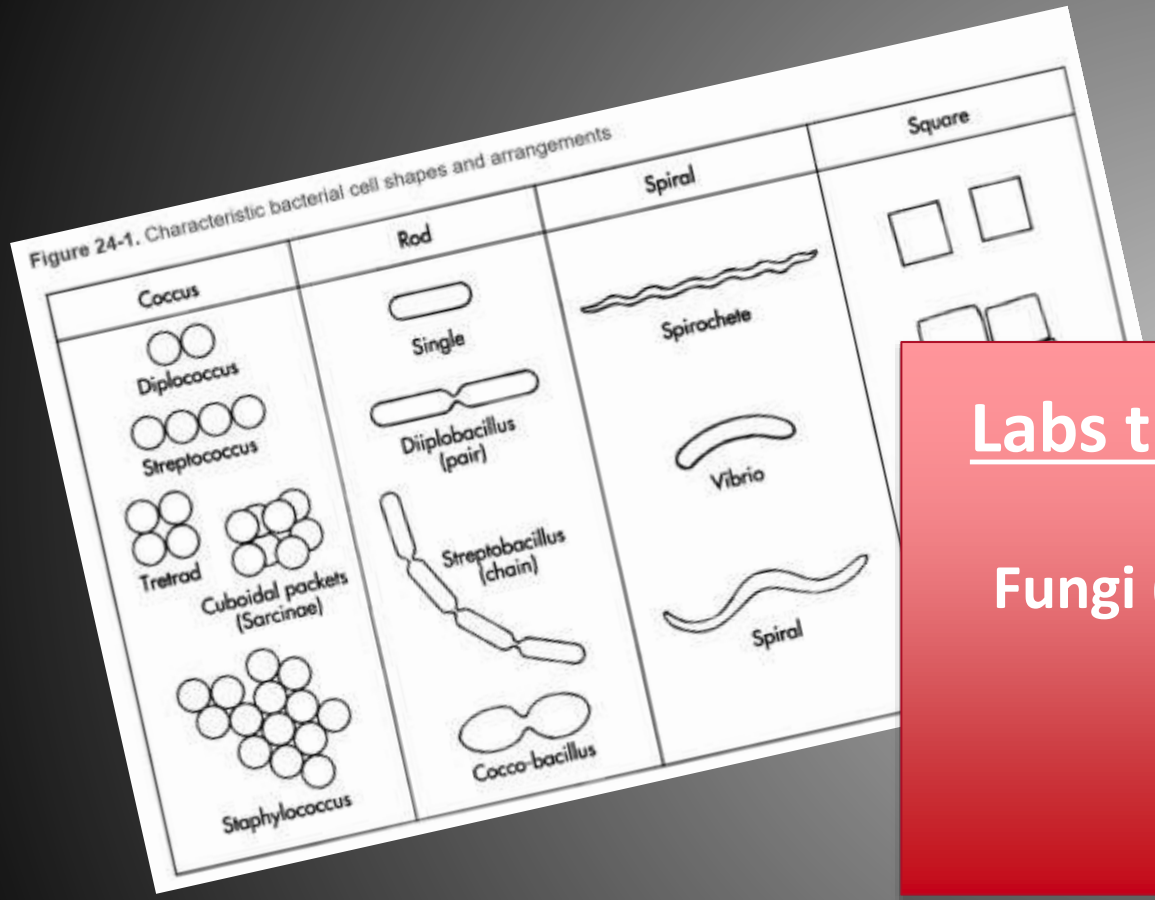
NE ICAP ASAP

The Microbiology Lab Process[3]

The Microbiology Lab Process[6]



Identifying the Organism[1,3, 14]



Labs try to identify:

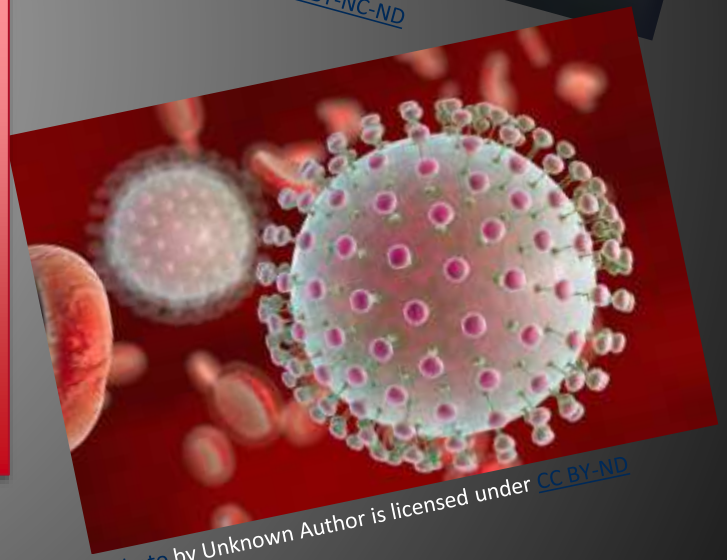
Bacteria

Fungi (Yeasts/Molds)

Viruses

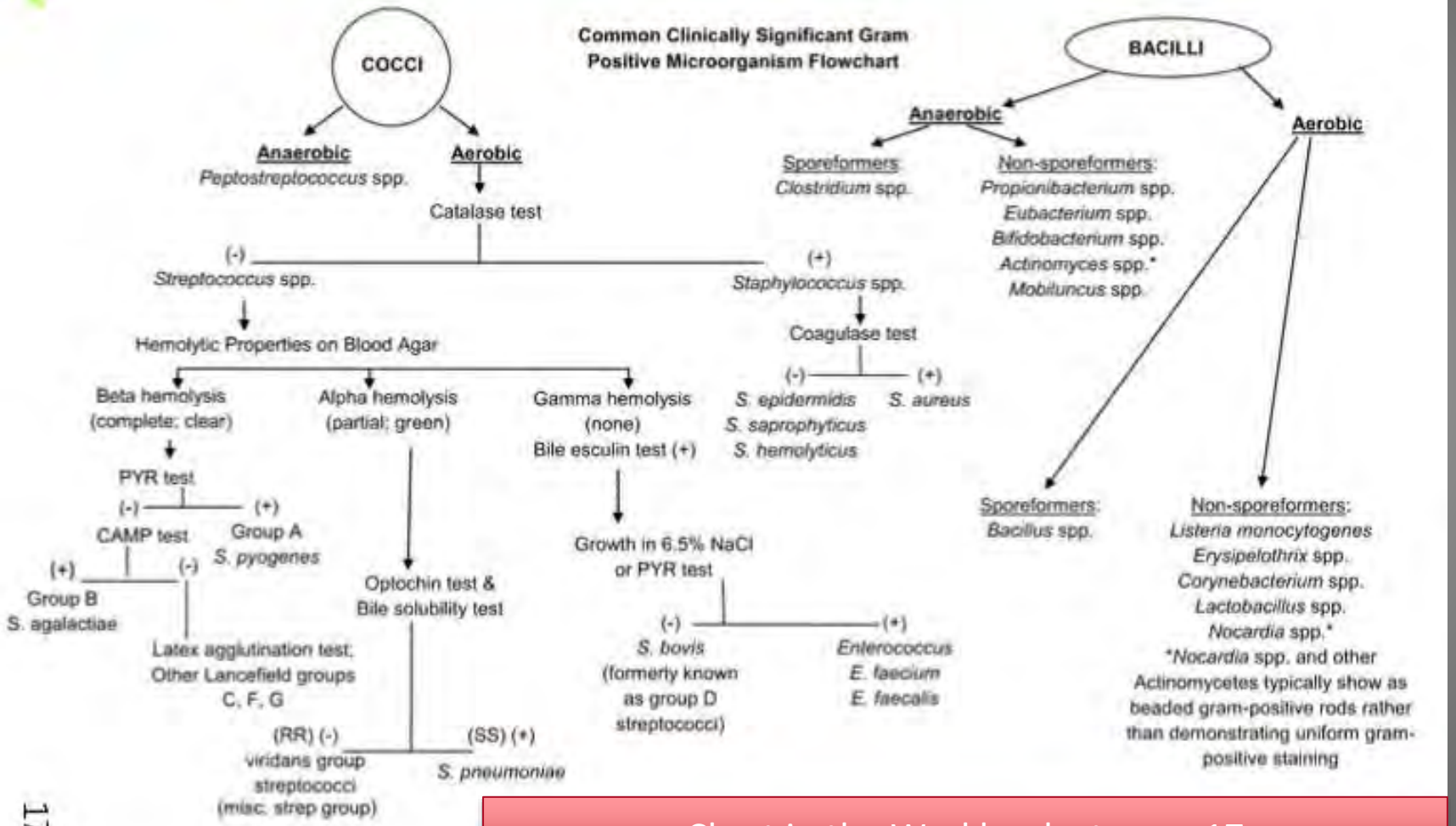
Protozoa

Algae



Organism Identification

GRAM POSITIVE FLOWCHARTS



17

Chart in the Workbook at page 17

Identifying the Organism

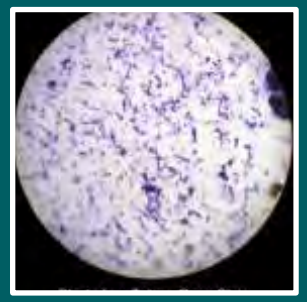
Common Types of Cultures[1,15]

- Blood
- Respiratory
- Urine
- Wound
- Stool

Common Methods Used for Identifying/Isolating the Organism[1,14]

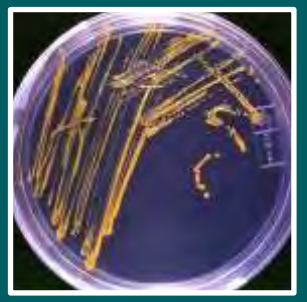
Microscope Slides

- Direct Examination
- Direct Wet Mount



Gram Stain

Acid-Fast Stain



Streak Plate

PCR

Example from Workbook on page 7

URINE CULTURE RESULTS

>100,000 col/ml Escherichia coli Note: Positive for extended spectrum beta-lactamase (ESBL)

Ampicillin	*<=16*	***Resistant***
Cefazolin	*>16*	***Resistant***
Cefepime	*8*	***Resistant***
Ceftriaxone	*>32*	***Resistant***
Cefuroxime	*>16*	***Resistant***
Gentamicin	*<=2*	***Susceptible***
Ciprofloxacin	*>4*	***Resistant***
Meropenem	*<=1*	***Susceptible***
Piperacillin/Tazobactam	*<=8*	***Resistant***
Ertapenem	*<=0.5*	***Susceptible***
Nitrofurantoin	*<=32*	***Susceptible***
Trimethoprim/sulfamethoxazole	*<=0.5*	***Susceptible***
	<=0.5/9.5	

Antibiotic Resistance[1]

- Understanding antibiotic resistance patterns is crucial for selecting the most effective treatment
- Also impacts Infection Prevention and Control Measures to implement, such as transmission-based precautions.

Antibiotic Susceptibility Testing (AST)[1,4]

Antibiotic	MIC	Interpretation
Aztreonam	8	S
Ceftriaxone	> 32	R
Cefepime	2	S
Ciprofloxacin	≤ 1	I

Next to each antibiotic is the susceptibility interpretation: S (sensitive), I (intermediate), or R (resistant), followed by the MIC in µg/mL

- Sensitive implies that the organism is inhibited by the serum concentration of the drug that is achieved using the usual dosage
- Intermediate implies that the organisms are inhibited only by the maximum recommended dosage
- Resistant implies that the organisms are resistant to the usually achievable serum drug levels.

Minimum Inhibitory Concentration (MIC)[1,4]

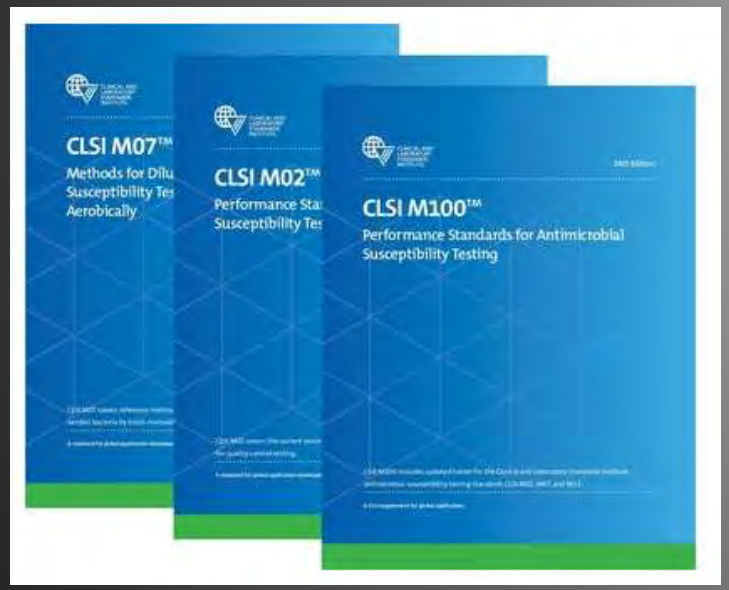
Measure of drug activity = minimum inhibitory concentration (MIC)

- Breakpoints established by the U.S. Clinical and Laboratory Standards Institutes (CLSI)

Result	MIC	Clinical Correlation
Susceptible	≤ the defined susceptibility breakpoint	high likelihood of therapeutic success
Intermediate or Indeterminate	Intermediate value	therapeutic effect uncertain
Resistant	> the defined susceptibility breakpoint	high likelihood of therapeutic failure

What is CLSI?[2,12]

- Clinical and Laboratory Standards Institute
- Establishes the standards used by all labs to do susceptibility testing
- Annually updated
- Developed by physicians, microbiologists, pharmacists, and industry



Aminoglycoside Breakpoints for Enterobacterales and *Pseudomonas aeruginosa*

Table 1. Current CLSI Aminoglycoside MIC Breakpoints[a]

Organism Group	Antimicrobial Agent	Interpretive Categories and MIC Breakpoints, µg/mL			
		S	SDD	I	R
Enterobacterales	Gentamicin	≤ 2	–	4^	≥ 8
	Tobramycin	≤ 2	–	4^	≥ 8
	Amikacin	≤ 4	-	8^	≥ 16
P. aeruginosa	Gentamicin	-	-	-	-
	Tobramycin	≤ 1	-	2^	≥ 4
	Amikacin (U)[b]	≤ 16	-	32^	≥ 64

Abbreviations: I, intermediate; MIC, minimal inhibitory concentration; R, resistant; S, susceptible; SDD, susceptible-dose dependent; U, urine.
Symbol: ^, designation for agents that have the potential to concentrate in the urine.
[a] Last reviewed June 2022; first published in CLSI M100-Ed33.[2]
[b] Report only on organisms isolated from the urinary tract.

Example from CLSI's rationale document MR 16 "Aminoglycoside Breakpoints from Enterobacterales and Pseudomonas Aeruginosa", published March 2025

AST Methods Done in the Lab[1]

Manual Methods

- Disk diffusion
- MIC
- Gradient strips

Automated Methods

- Vitek 2
- Phoenix
- Microscan
- Sensititre

Resistance Genes[9,13]

Common Antibiotic Resistance Genes		
Gene	**Indicate resistance to:**	**Organisms most affected:**
mecA mecA/C MREJ	methicillin and other applicable beta-lactam antibiotics	Staphylococcus species
vanA/B	vancomycin	Enterococcus faecalis and Enterococcus faecium (and occasionally other organisms)
CTM-M	extended-spectrum β-lactamases (ESBLs)	Several types of Gram-negative bacteria can produce these enzymes
mcr-1	colistin	Enterobacterales
KPC	Carbapenems such as ertapenem, meropenem or imipenem	Carbapenemase Gene found most often associated with Carbapenem Resistant Enterobacterales (CRE), Pseudomonas Aeruginosa, and Acinetobacter species.
IMP		
VIM		
NDM		
OXA-48-like		

Active Infection vs. Colonization[1,16]

	Active Infection	Colonization
Definition	Infection occurs when an organism invades a body site and causes signs and symptoms of disease	When an organism is found in the body, but it is NOT causing any symptoms or disease.
Treatment	Treatment is based on case-by-case basis	Treatment is often not required
Infectiousness	Can spread to others	Can develop infections and spread to others
Identification	Usually identified as part of standard clinical process.	Usually identified through screening
Transmission Based Precautions for LTCF	Contact Precautions	Enhanced Barrier Precautions

Multidrug-Resistant Organisms (MDRO) Tiers for Nebraska[8]

Tier	Definition of Included Organisms and Mechanisms	Examples (not all inclusive) of organisms/mechanisms for Nebraska	Transmission-Based Precautions Recommendations
Tier 1	Never (or very rarely) been identified in the United States and for which experience is extremely limited	Novel Carbapenemases	Contact precautions until otherwise recommended by HAI/AR team
Tier 2	Primarily associated with healthcare settings and are not commonly identified in the region (i.e., not been previously identified in the region or have been limited to sporadic cases or small outbreaks), corresponding to "not detected" or "limited to moderate spread" epidemiologic stages. No current treatment options exist (pan not-susceptible) and potential to spread more widely.	Pan-resistant organisms* *Candida auris* Carbapenemase (e.g., KPC, NDM, OXA-48, VIM, IMP) producing organisms (CPO) • Enterobacterales • *Pseudomonas aeruginosa* • *Acinetobacter Baumannii*	Contact Precautions *Long-term Care Facilities (LTCF):* Enhanced barrier precautions (EBP) recommended for colonized resident(s)**
Tier 3	Include MDROs targeted by the facility or region for epidemiologic importance that have been identified frequently across a region, indicating advanced spread, but are not considered endemic	• Extended spectrum beta-lactamase (ESBL) producing organisms • Carbapenem-resistant *Enterobacterales* (CRE) • Carbapenem-Resistant *Pseudomonas aeruginosa* (CRPA)	Contact Precautions *Long-term Care Facilities (LTCF):* Enhanced barrier precautions (EBP) considered for colonized resident(s)**
Tier 4	Endemic in a region and have been targeted by public health for their clinical significance and potential to spread rapidly	• Methicillin-resistant Staphylococcus aureus (MRSA) • Vancomycin-Resistant Enterococci (VRE)	Contact precautions per facility risk assessment *Long-term Care Facilities (LTCF):* Enhanced barrier precautions (EBP) considered for colonized resident(s)**

* Contact tracing and colonization screening may not be indicated for these organisms
**Contact precautions for acute/active infections or uncontained drainage/secretions

Updated 5.26.2024 https://dhhs.ne.gov/HAI%20Documents/Nebraska%20MDRO%20Tiers.pdf

Examples of Microbiology Results and Interpretation

NE ICAP ASAP

MRSA Infection Versus Colonization

Nasal MRSA PCR Test- Detects Colonization

MRSAPCR (nares) (MRSAP_t13:2)

Start Date	[redacted]	Result Date	
Start Time	16:54	Result Time	
Ordering Clinician	[redacted]	Result Status	
Specimen	@Nasal Swab	Placer ID	
Collection Date	[redacted]	Last Updated	
Collection Time	16:54	Last Update Time	
Date Lab Received	[redacted]	Age at Time of T	
Specimen Received Time	18:22		

Test Item	Flag	Value	Units	Reference Range	Test Item Status
MRSA PCR		NOT DETECTED			Final

MRSA Culture Result- Detects Active Infection

3+ GROWTH STAPHYLOCOCCUS AUREUS
OXACILLIN RESISTANCE INDICATES RESISTANCE TO ALL BETA LACTAMS, BETA LACTAM/BETA LACTAMASE INHIBITOR COMBINATIONS AND IMIPENEM. RIFAMPIN SHOULD NOT BE USED ALONE FOR TREATMENT OF BACTERIAL INFECTIONS AS RESISTANCE MAY DEVELOP RAPIDLY.

SUSCEPTIBILITY RESULTS:

S AUREUS	MIC	INTERP
CLINDAMYCIN	<=0.5	S
ERYTHROMYCIN	<=0.5	S
LINEZOLID	<=2	S
OXACILLIN	>=8	R
PENICILLIN	>=16	R
RIFAMPIN	<=1	S
TETRACYCLINE	<=1	S
TMP/SMX	<=10	S
VANCOMYCIN	2	S

CP-CRE Infection Versus Colonization

CP- CRE Culture Result- Typically Detects Active Infection

Resistant E. coli

Escherichia coli (Isolate 1), 20,000 cfu/mL
*Carbapenemase detected. Notified [redacted]
on [redacted]
Results reported to the State Health Department.

Sensitivity Analysis	Isolate 1
Amikacin	<=16 S
Ampicillin	>16 R
Ampicillin/Sulbactam	>16/8 R
Aztreonam	>16 R
Cefazolin	>16 R
Cefepime	>16 R
Cefoxitin	>16 R
Ceftazidime	>16 R
Ceftazidime/Avibactam	>16 R
Ceftriaxone	>32 R
Ciprofloxacin	>2 R
Ertapenem	>1 R
Gentamicin	<=4 S
Imipenem	>4 R
Levofloxacin	>4 R
Meropenem	>8 R
Nitrofurantoin	<=32 S
Pipercillin/Tazobactam	>64 R
Tetracycline	<=4 S
Tobramycin	<=4 S
Trimethoprim/Sulfamethoxaz	>2/38 R

S = Susceptible I = Intermediate R = Resistant
R* = Resistant, Predicted
ESBL = Extended Spectrum Beta-Lactamase
Blac = Beta-Lactamase Positive
N/R = Not reported, contact micro lab if testing is indicated

Carbapenemase Screening Test- Detects Colonization

Test Item	Flag	Value	Units	Reference Range	Test Item Status
SPECIMEN SOURCE XXX		Rectal specimen submitted.			Final
CARBAPENEMASE RESISTANCE GENES ISLT PCR	Normal	Not Detected		NotDetected	Corrected
blaNDM Islt/Spm Ql	Normal	Not Detected		NotDetected	Final
blaKPC Islt/Spm Ql	Normal	Not Detected		NotDetected	Final

Test Item	Flag	Value	Units	Reference Range	Test Item Status
SPECIMEN SOURCE XXX		Rectal specimen submitted.			Final
CARBAPENEMASE RESISTANCE GENES ISLT PCR	Abnormal	DETECTED		NotDetected	Corrected
blaNDM Islt/Spm Ql	Normal	Not Detected		NotDetected	Final
blaKPC Islt/Spm Ql	Normal	Not Detected		NotDetected	Final

CP-CRE Infection Versus Colonization

CP-CRE Culture Result- Typically Detects Active Infection

Test Item	Flag	Value	Units	Reference Range	Test Item Status	Comments	Sensitivities
SPECIMEN SOURCE XXX		Rectum			Final		
ANNOTATION COMMENT IMP		None			Final		
MICROORGANISM/AGENT XXX	Abnormal	Organism submitted identified as: Klebsiella oxytoca / Raoultella ornithinolytica This isolate is positive for a KPC carbapenemase and may be clinically resistant to all beta-lactam antibiotics. Infectious Disease consult recommended.			Corrected		
Report Status		[redacted]			Corrected		
ORGANISM		Klebsiella oxytoca / Raoultella ornithinolytica This isolate is positive for a KPC carbapenemase and may be clinically resistant to all beta-lactam antibiotics. Infectious Disease consult recommended.			Corrected	Organism submitted identified as: Klebsiella oxytoca / Raoultella ornithinolytica This isolate is positive for a KPC carbapenemase and may be clinically resistant to all beta-lactam antibiotics. Infectious Disease consult recommended.	
BACTERIAL SUSC PNL ISLT MIC		MIC			Final		
AMPICILLIN SUSC ISLT		>16			Final		R
AMPICILLIN+SULBAC SUSC ISLT		>16/8			Final		R
AZTREONAM SUSC ISLT		>16			Final		R
CEFAZOLIN SUSC ISLT		>16			Final		R
CEFEPIME ISLT MIC		>16			Final		R

Candida Auris Infection Versus Colonization

C. Auris Colonization Culture Result- Detects Colonization

Candida auris Colonization Culture
Final Report 4/28/2025

Healthcare Facility of Origin Name
[redacted]

Healthcare Facility of Origin State
NE

Healthcare Facility of Origin Zip Code
[redacted]

Sample Type
Clinical sample

Source
Axilla/groin swab

Culture Result
Candida auris

C. Auris PCR Screening Test- Detects Colonization

Candida auris PCR
Final Report [redacted]

This test was developed and its performance characteristics determined by the MDH Public Health Laboratory. It has not been cleared or approved by the U.S. Food and Drug Administration:21CFR 809.30(e). The FDA has determined that such clearance is not necessary.

Test	Result	Ref Range
Sample Type	Clinical sample	
Source	Axilla/groin swab	
Candida auris PCR Result	POSITIVE	negative
Healthcare Facility of Origin Name	[redacted]	
Healthcare Facility of Origin State	NE	
Healthcare Facility of Origin Zip Code	[redacted]	

Candida auris PCR
Final Report [redacted]

This test was developed and its performance characteristics determined by the MDH Public Health Laboratory. It has not been cleared or approved by the U.S. Food and Drug Administration:21CFR 809.30(e). The FDA has determined that such clearance is not necessary.

Test	Result	Ref Range
Sample Type	Clinical sample	
Source	Axilla/groin swab	
Candida auris PCR Result	negative	negative
Healthcare Facility of Origin Name	[redacted]	
Healthcare Facility of Origin State	NE	
Healthcare Facility of Origin Zip Code	[redacted]	

Candida Auris Infection Versus Colonization

C. Auris Culture Result-
Could Detect Culture or Colonization

t:
DOB/Age/Se [redacted]
x: #:
Procedure: Fungal Culture [O1 ^1 Accession: [redacted]

@1]
Source: Tissue Body Site: Head
Collected Date/Time: [redacted] Received Date/Time: [redacted]
Start Date/Time: [redacted] Free Text Source:

FINAL REPORTS
Final Report []
Verified Date/Time/Personne [redacted]
Rare Candida auris isolated.

Further investigation is needed; likely need to consider if the patient has active infection symptoms

C. Auris Culture Result-
Could Detect Culture or Colonization

DOB/Age/Se [redacted]
x: #:
Procedure: Fungal Culture [O1 ^1 Accession: [redacted]

@1]
Source: Bronch Wash Body Site: Bronch Wash L
Collected Date/Time: [redacted] Received Date/Time: [redacted]
Start Date/Time: [redacted] Free Text Source:

FINAL REPORTS
Final Report []
Verified Date/Time/Personne [redacted]
Moderate Nakaseomyces glabratus (prev Candida glabrata) isolated.
Moderate Candida auris isolated.
With rare exceptions, Candida species are not thought to cause pulmonary infections and its isolation likely represents oropharyngeal colonization/contamination.

Multiplex Nucleic Acid Tests[13]

Table 1: Pneumonia Panel Pathogen Targets and Associated Resistance Genes

Semi-quantitative Detection:	
Gram Positive Organisms: *Staphylococcus aureus* *Streptococcus pneumoniae* *Streptococcus agalactiae* *Streptococcus pyogenes*	Resistance Genes (*Staph aureus* only): *mecA/C* and MREJ
Gram Negative Organisms: *Acinetobacter calcoaceticus-baumannii* complex *Enterobacter cloacae* complex *E. coli* *Haemophilus influenzae* *Klebsiella aerogenes* *Klebsiella oxytoca* *Klebsiella pneumonia* *Moraxella catarrhalis* *Proteus* spp. *Pseudomonas aeruginosa* *Serratia marcescens*	Resistance Genes (All Gram Negatives): CTX-M IMP KPC NDM VIM OXA-48-like
Qualitative Detection:	
Atypical Pathogens: *Chlamydia pneumoniae* *Legionella pneumophila* *Myocplasma pneumoniae*	Viral Pathogens: Adenovirus Coronavirus Human Metapneumovirus Rhinovirus/Enterovirus Influenza A Influenza B Parainfluenza RSV

K oxytoca DNA Spt NAA+non-prb-NCncRng	Abnormal	DETECTED 1,000,000 COPIES/ML	NotDetected	Final
K pneumon DNA Spt NAA+non-prb-NCncRng	Normal	Not Detected	NotDetected	Final
M catarrhalis DNA Spt NAA+non-prb-NCncRng	Normal	Not Detected	NotDetected	Final
Proteus sp DNA Spt NAA+non-prb-NCncRng	Normal	Not Detected	NotDetected	Final
P aeruginosa DNA Spt NAA+non-prb-NCncRng	Normal	Not Detected	NotDetected	Final
S marcescens DNA Spt NAA+non-prb-NCncRng	Normal	Not Detected	NotDetected	Final
S aureus DNA Spt NAA+non-prb-NCncRng	Normal	Not Detected	NotDetected	Final
Gp B Strep DNA Spt NAA+non-prb-NCncRng	Normal	Not Detected	NotDetected	Final
S pneum DNA Spt NAA+non-prb-NCncRng	Normal	Not Detected	NotDetected	Final
S pyo DNA Spt NAA+non-prb-NCncRng	Normal	Not Detected	NotDetected	Final
blaCTX-M Islt/Spm Ql	Normal	Not Detected	NotDetected	Final
blaIMP Islt/Spm Ql	Normal	Not Detected	NotDetected	Final
blaKPC Islt/Spm Ql	Abnormal	DETECTED	NotDetected	Final

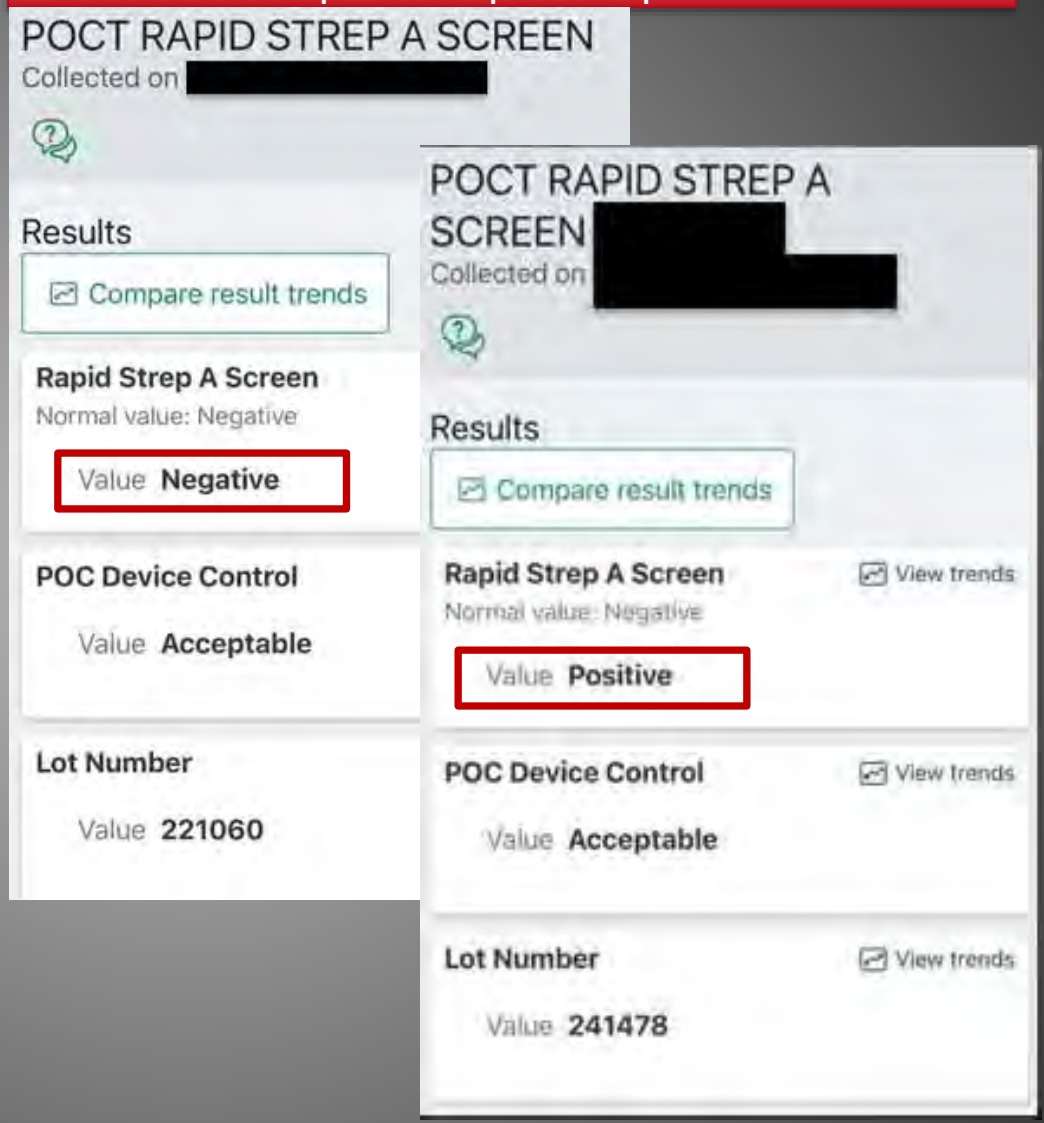
Multiplexed nucleic acid tests, which can detect several different bacteria, viruses and antibiotic resistance genes, can be done as quickly as one hour.

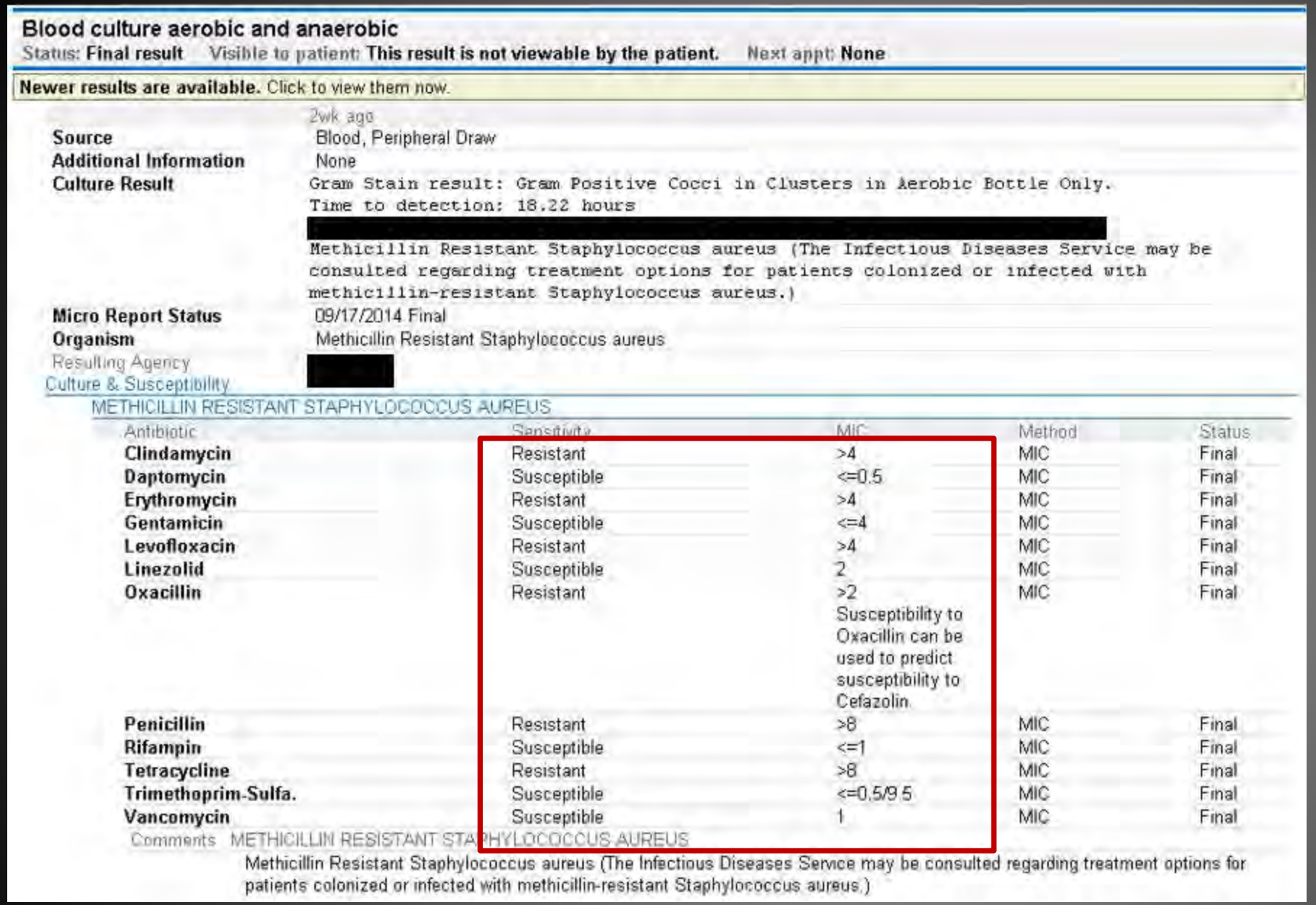
Nebraska Medicine "Guidance on Use of the Pneumonia Panel for Respiratory Infections "

Other Examples

COVID/Influenza Combined PCR

Rapid Group A Strep Test





Blood culture aerobic and anaerobic

Status: **Final result** Visible to patient: **This result is not viewable by the patient.** Next appt: **None**

Newer results are available. Click to view them now.

2wk ago

Source	Blood, Peripheral Draw
Additional Information	None
Culture Result	Gram Stain result: Gram Positive Cocci in Clusters in Aerobic Bottle Only. Time to detection: 18.22 hours [redacted] Methicillin Resistant Staphylococcus aureus (The Infectious Diseases Service may be consulted regarding treatment options for patients colonized or infected with methicillin-resistant Staphylococcus aureus.)
Micro Report Status	09/17/2014 Final
Organism	Methicillin Resistant Staphylococcus aureus
Resulting Agency	[redacted]

Culture & Susceptibility

METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS

Antibiotic	Sensitivity	MIC	Method	Status
Clindamycin	Resistant	>4	MIC	Final
Daptomycin	Susceptible	<=0.5	MIC	Final
Erythromycin	Resistant	>4	MIC	Final
Gentamicin	Susceptible	<=4	MIC	Final
Levofloxacin	Resistant	>4	MIC	Final
Linezolid	Susceptible	2	MIC	Final
Oxacillin	Resistant	>2 Susceptibility to Oxacillin can be used to predict susceptibility to Cefazolin.	MIC	Final
Penicillin	Resistant	>8	MIC	Final
Rifampin	Susceptible	<=1	MIC	Final
Tetracycline	Resistant	>8	MIC	Final
Trimethoprim-Sulfa.	Susceptible	<=0.5/9.5	MIC	Final
Vancomycin	Susceptible	1	MIC	Final

Comments METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS

Methicillin Resistant Staphylococcus aureus (The Infectious Diseases Service may be consulted regarding treatment options for patients colonized or infected with methicillin-resistant Staphylococcus aureus.)

Blood culture[15]

A blood culture can help diagnose bloodstream infections caused by bacteria or fungi.

Negative Blood Culture

BLOOD CULTURE (BLDCU_t13)

Start Date	[redacted]	Result Date	
Start Time	04:55	Result Time	
Ordering Clinician	[redacted]	Result Status	Corrected
Specimen	BLPH	Placer ID	[redacted]
Collection Date	[redacted]	Last Updated	
Collection Time	05:47	Last Update Time	
Date Lab Received	[redacted]	Age at Time of Test	[redacted]
Specimen Received Time	05:53		

Order Details | Trend

Test Item	Flag	Value	Units	Reference Range	Test Item Status	Comments	Sensitivities	Other Flags	Collection Date
SPECIMEN SOURCE XXX		Blood, Peripheral Draw			Final				[redacted]
ANNOTATION COMMENT IMP		None			Final				
MICROORGANISM/AGENT XXX		No Growth at 5 Days			Corrected				
Report Status		04/24/2025 Final			Final				

Urine Cultures Examples

Procedure: Culture Urine [^2 @2] Accession: [redacted]
Source: Urine Body Site:
Collected Date/Time: [redacted] Received Date/Time: [redacted]
Start Date/Time: [redacted]ree Text Source:

FINAL REPORTS
Final Report []
Verified Date/Time/Personnel: [redacted]
Normal urogenital flora isolated.

Example of a urine culture that grew normal urogenital flora

Cultures are often be ordered as a reflex test following an abnormal urinalysis.

Urinalysis

UA Dipstick

Procedure	Result	Units	Reference Range
UA Color	Yellow *1		[Light Yellow]
UA Clarity	**Cloudy** *1		[Clear]
UA Glucose	**2+** *1	mg/dL	[Negative]
UA Ketones	**Trace** *1		[Negative]
UA Spec Grav	1.015 *1		[1.005-1.030]
UA Blood	Negative *1		[Negative]
UA pH	7.0 *1		[5.0-8.5]
UA Protein	Negative *1		[Negative]
UA Urobilinogen	**1.0** *1	EU/mL	[0.2]
UA Nitrite	Negative *1		[Negative]
UA Leuk Est	**3+** *1	mcL	[Negative]
UA Bilirubin	Negative *1		[Negative]
Micro?	Yes *1		

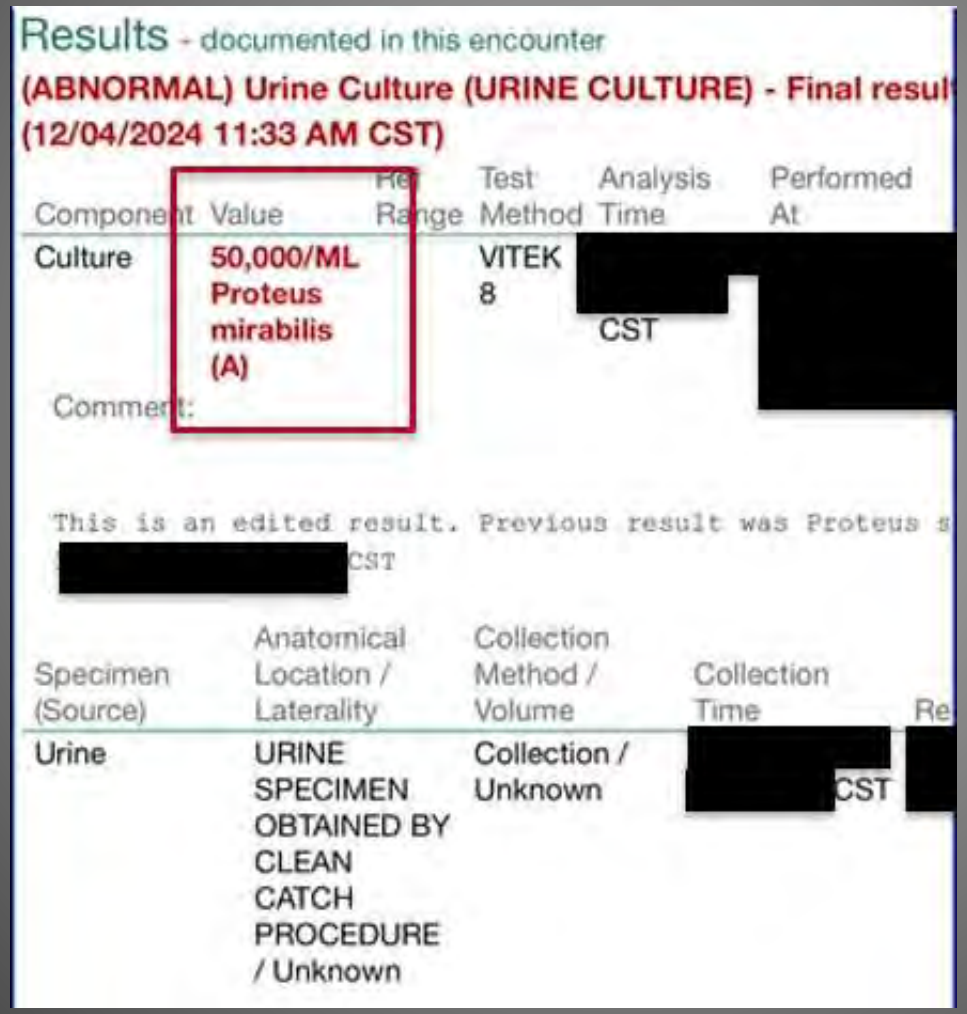
UA Microscopic

Procedure	Result	Units	Reference Range
Culture?	Cult to Follow *1		

Urine Culture Examples[15]

A urine culture may show the presence of specific bacteria, such as E. coli or Proteus Mirabilis.

The results may also include the number of bacteria per milliliter (CFU/ml)



Results - documented in this encounter

(ABNORMAL) Urine Culture (URINE CULTURE) - Final resul
(12/04/2024 11:33 AM CST)

Component	Value	Ref Range	Test Method	Analysis Time	Performed At
Culture	50,000/ML Proteus mirabilis (A)		VITEK 8	[redacted] CST	[redacted]

Comment:

This is an edited result. Previous result was Proteus s
[redacted] CST

Specimen (Source)	Anatomical Location / Laterality	Collection Method / Volume	Collection Time	Re
Urine	URINE SPECIMEN OBTAINED BY CLEAN CATCH PROCEDURE / Unknown	Collection / Unknown	[redacted] CST	[redacted]

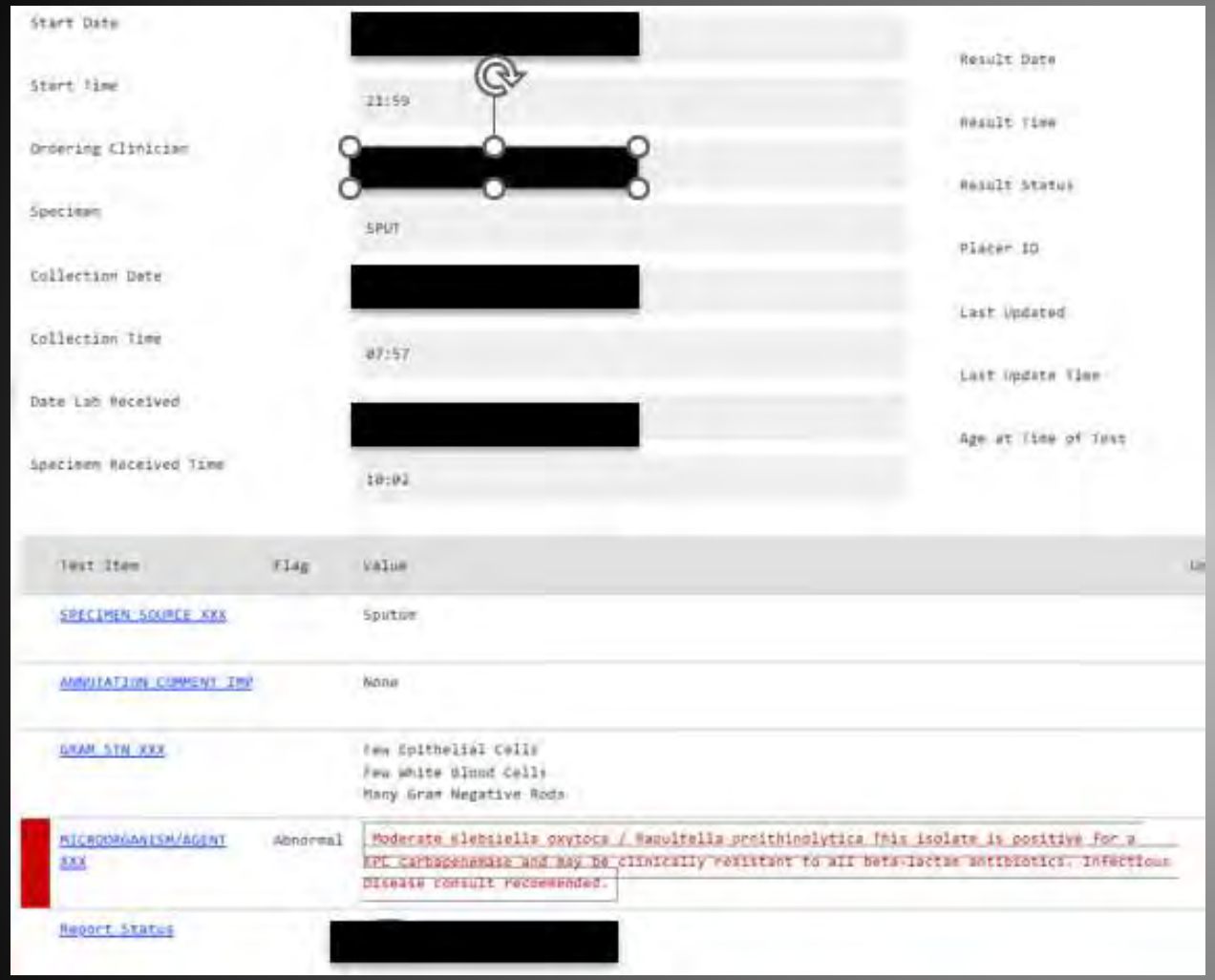
Sensitive example:

Escherichia coli (Isolate 1), >100,000 cfu/mL

Sensitivity Analysis	Isolate 1
Amikacin	<=16 S
Ampicillin	<=8 S
Ampicillin/Sulbactam	<=8/4 S
Aztreonam	<=4 S
Cefazolin	<=2 S
Cefepime	<=2 S
Cefoxitin	<=8 S
Ceftazidime	<=1 S
Ceftriaxone	<=1 S
Ciprofloxacin Enterobact.	S
Ertapenem	<=0.5 S
Gentamicin	<=4 S
Imipenem	<=1 S
Levofloxacin Enterobact.	S
Meropenem	<=1 S
Nitrofurantoin	<=32 S
Pipercillin/Tazobactam	<=16 S
Tetracycline	<=4 S
Tobramycin	<=4 S
Trimethoprim/Sulfamethoxaz	<=2/38 S

S = Susceptible I = Intermediate R = Resistant
R* = Resistant, Predicted
ESBL = Extended Spectrum Beta-Lactamase
Blac = Beta-Lactamase Positive
N/R = Not reported, contact micro lab if testing is indicated

Sputum Culture Examples



Start Date	[redacted]
Start Time	21:59
Ordering Clinician	[redacted]
Specimen	SPUT
Collection Date	[redacted]
Collection Time	07:57
Date Lab Received	[redacted]
Specimen Received Time	10:01

Test Item	Flag	Value
SPECIMEN SOURCE XXX		Sputum
ANNOTATION COMMENT IMP		None
GRAM STN XXX		Few Epithelial Cells Few White Blood Cells Many Gram Negative Rods
MICROORGANISM/AGENT XXX	Abnormal	Moderate klebsiella oxytoca / Raoultella ornithinolytica this isolate is positive for a KPC carbapenemase and may be clinically resistant to all beta-lactam antibiotics. Infectious Disease consult recommended.
Report Status		[redacted]

DOB/Age/Sex: [redacted]

Procedure: Culture Sputum [^1 @1] Accession: [redacted]

Source: Sputum Body Site:

Collected Date/Time: [redacted] eived Date/Time: [redacted]

Start Date/Time: [redacted] e Text Source:

FINAL REPORTS

Final Report []

Verified Date/Time/Personnel: [redacted]

Many Staphylococcus aureus Negative for penicillin-binding protein 2a.

Isolate is presumed to be resistant to clindamycin based on detection of inducible clindamycin resistance.

Methicillin susceptible staphylococci are also susceptible to first generation cephalosporins (e.g. cefazolin) and beta-lactam/beta-lactamase inhibitor combinations (e.g. amoxicillin/clavulanate).

SUSCEPTIBILITY RESULTS

Staphylococcus aureus

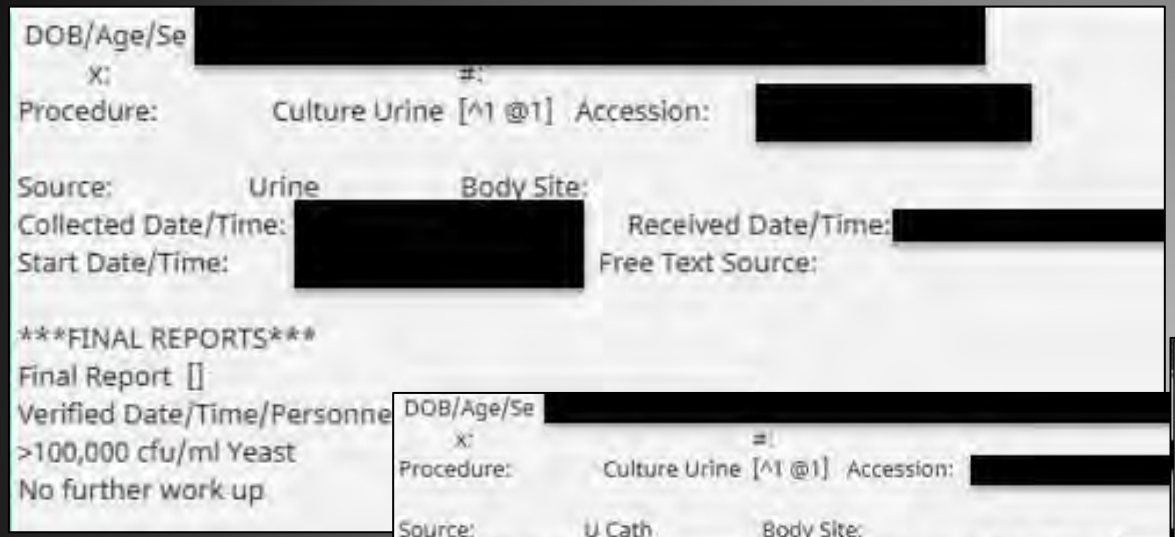
Antibiotic	MDIL	MINT
Clindamycin	0.25	Resistant
Erythromycin	>=8	Resistant
Minocycline	<=0.5	Susceptible
Oxacillin	0.5	Susceptible
Trimethoprim/Sulfa	<=0.5/9.5	Susceptible
Vancomycin	1	Susceptible

Interpretive Data

^1: Culture Sputum

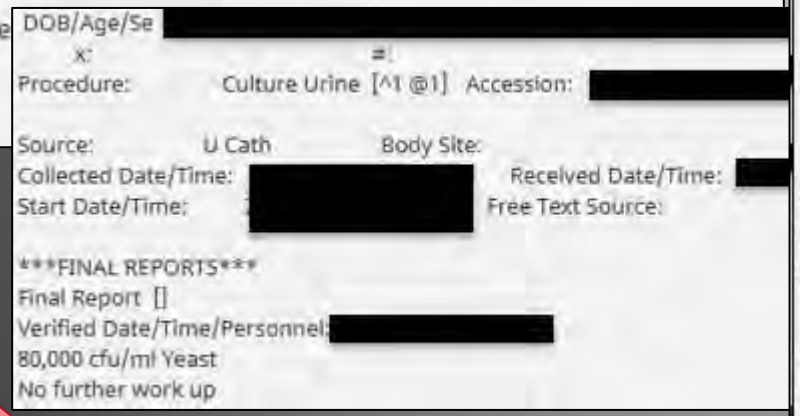
Per Nebraska Department of Health and Human Services regulations at 173-NAC (Communica Diseases); mandated results are reported to the Nebraska Department of Health and Human Services, Division of Public Health, Office of Epidemiology, 301 Centennial Mall South, Lincoln, NE.

Yeast/Fungal Cultures Examples


DOB/Age/Se [redacted]
X: #:
Procedure: Culture Urine [^1 @1] Accession: [redacted]

Source: Urine Body Site:
Collected Date/Time: [redacted] Received Date/Time: [redacted]
Start Date/Time: Free Text Source:

FINAL REPORTS
Final Report []
Verified Date/Time/Personne
>100,000 cfu/ml Yeast
No further work up

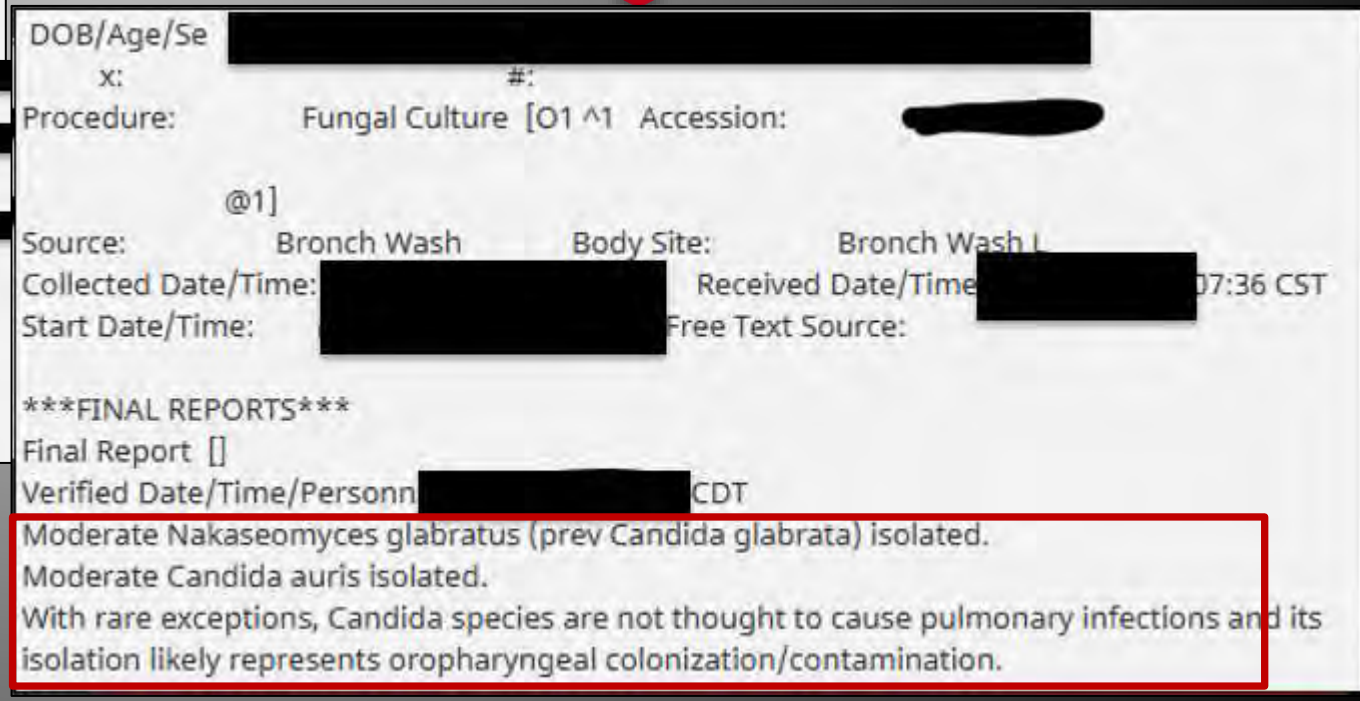

DOB/Age/Se [redacted]
X: #:
Procedure: Culture Urine [^1 @1] Accession: [redacted]

Source: U Cath Body Site:
Collected Date/Time: [redacted] Received Date/Time:
Start Date/Time: Free Text Source:

FINAL REPORTS
Final Report []
Verified Date/Time/Personnel: [redacted]
80,000 cfu/ml Yeast
No further work up

Examples of a urine culture that grew yeast; no further workup completed

Example of C. Auris result, noting that it could be colonization or contamination


DOB/Age/Se [redacted]
X: #:
Procedure: Fungal Culture [O1 ^1 Accession: [redacted]

@1]
Source: Bronch Wash Body Site: Bronch Wash L
Collected Date/Time: [redacted] Received Date/Time [redacted] 07:36 CST
Start Date/Time: Free Text Source:

FINAL REPORTS
Final Report []
Verified Date/Time/Personn [redacted] CDT
Moderate Nakaseomyces glabratus (prev Candida glabrata) isolated.
Moderate Candida auris isolated.
With rare exceptions, Candida species are not thought to cause pulmonary infections and its isolation likely represents oropharyngeal colonization/contamination.

Lab Report Examples: ESBL+ Escherichia Coli

Resistance Example 1:

Culture Result::
>100,000 col/ml Escherichia col POSITIVE for Extended Spectrum Beta-Lactamase (ESBL) This is an extended spectrum Beta-lactamase (ESBL) producing strain which is clinically resistant to cephalosporins and aztreonam. Although isolates that produce ESBLs may be susceptible or intermediate to Piperacillin/Tazobactam, clinical efficacy has not been documented. The Infectious Disease Service may be consulted.

ORGANISM:
Escherichia coli

>100,000 col/ml Escherichia coli POSITIVE for Extended Spectrum Beta-Lactamase (ESBL) This is an extended spectrum Beta-lactamase (ESBL) producing strain which is clinically resistant to cephalosporins and aztreonam. Although isolates that produce ESBLs may be susceptible or intermediate to Piperacillin/Tazobactam, clinical efficacy has not been documented. The Infectious Disease Service may be consulted.

METHOD:
MIC

Amikacin:	<=16 Susceptible
Ampicillin:	>16 Resistant
Amp-Sulbactam:	8/4 Resistant
Aztreonam:	16 Resistant
Cefazolin:	>16 Resistant
Cefepime:	8 Resistant
Cefotaxime:	>32 Resistant
Ceftazidime:	16 Resistant
Ceftriaxone:	>32 Resistant
Cefuroxime:	>16 Resistant
Gentamicin:	<=2 Susceptible
Levofloxacin:	>4 Resistant
Meropenem:	<=1 Susceptible
Pip/Tazo:	<=8 Resistant
Tobramycin:	<=2 Susceptible
Trimethoprim-Sulfa:	<=0.5/9.5 Susceptible
Amoxacillin/Clavulanic Acid:	<=8/4 Resistant
Cefoxitin:	<=8 Resistant
Ertapenem:	<=0.5 Susceptible
Nitrofurantoin:	<=32 Susceptible
Tetracycline:	>8 Resistant
Tigecycline:	<=2 Susceptible
Minocycline:	8 Intermediate

Resistance Example 2:

Bacteria Ur Cult
ESBL Escherichia coli
Final
>100000 CFU/mL Escherichia coli ESBL This organism has been confirmed as an ESBL producer.

Factors to Consider During Interpretation

NE ICAP ASAP

Clear and Accurate Reporting[11]

URINE CULP, VOIDED [redacted]

COLLECT DATE AND TIME: [redacted]

STATUS: [redacted]

SPECIMEN DESCRIPTION: Urine
SPECIAL REQUESTS: None

COLONY COUNT: >IV0,000 col/aL

CULTURE: 1. Escherichia coli This organism has been confirmed as an ESBL producer.

	ISOLATE #1		
DRUG	MIC	INT.	COST/DAY
Ampicillin	>16	R	$$$$$
Amox/Clavulanate	16/8	I	$ **
Ceftriaxone	32	R	$$
Ceftazidime	4	R	$$$$
Cefotaxime	>16	R	$$$
Cefazolin	>16	R	$$
Ciprofloxacin	>2	R	$$$$
Cefuroxime	>16	R	$$
Ertapenem		SS	$$$
Nitrofurantoin	<=32	SS	$ **
Gentamicin	<=4	SS	$$$
Imipenem	<=1	SS	$$$$$$
Levofloxacin	>4	R	$$
Meropenem	<=1	SS	
Pip/Tazobactam	<=16	SS	$$$$$$$
Tobramycin	>8	R	$$
TMP/SMX	>2/38	R	$$$$

SS = SUSCEPTIBLE I = INTERMEDIATE
BLANK = NOT AVAILABLE NEA = NO INTERPRETATION AVAILAB
$ = <$50/DAY $$$$$$ = >$300/DAY
COST/DAY = BASED ON IV PRODUCTS UNLESS OTHERWISE NOTED.

The testing includes pathogens (bacterial, parasitic and viral) commonly known to cause gastroenteritis. Note that not all individuals with positive findings will present with symptoms. Many factors, including the health of the individual (such as immune health, digestive function, and microbiome balance), the transient nature of most pathogens, and the presence and expression of virulence factors, all contribute to pathogen virulence and individual symptoms.

BACTERIAL PATHOGENS	Result		Reference
Campylobacter	<dl		< 1.00e3
C. difficile Toxin A	6.77e6	High	< 1.00e3
C. difficile Toxin B	2.65e6	High	< 1.00e3
Enterohemorrhagic E. coli	<dl		< 1.00e3
E. coli O157	<dl		< 1.00e3
Enteroinvasive *E. coli/Shigella*	<dl		< 1.00e3
Enterotoxigenic *E. coli* LT/ST	<dl		< 1.00e3
Shiga-like Toxin *E. coli* stx1	<dl		< 1.00e3
Shiga-like Toxin *E. coli* stx2	<dl		< 1.00e3
Salmonella	<dl		< 1.00e4
Vibrio cholerae	<dl		< 1.00e5
Yersinia enterocolitica	<dl		< 1.00e5
PARASITIC PATHOGENS			
Cryptosporidium	<dl		< 1.00e6
Entamoeba histolytica	<dl		< 1.00e4
Giardia	<dl		< 5.00e3
VIRAL PATHOGENS			
Adenovirus 40/41	<dl		< 1.00e10
Norovirus GI/II	<dl		< 1.00e7

Examples of unclear/hard to read lab results

Essential for several reasons, including:

- Patient care
- Patient safety
- Effective treatment

Intrinsic Resistance[5]

- Some bacteria have inherent resistance to certain antibiotics
  - Example: Pseudomonas and ceftriaxone
- Results of antibiotics that are intrinsically resistant will often be suppressed in the results

Note that Ceftriaxone is not an antibiotic reported for this Pseudomonas Aeruginosa result.

Pseudomonas Aeruginosa AST Results:

	Pseudomonas aeruginosa MIC	
Aztreonam	<=4	Susceptible
Cefepime	<=2	Susceptible
Ceftazidime	4	Susceptible
Ceftolozane/tazobactam	<=2	Susceptible
Levofloxacin	<=0.5	Susceptible
Meropenem	<=1	Susceptible
Piperacillin + Tazobactam	<=8	Susceptible
Tobramycin	<=2	Susceptible [1]

Enterobacterales	Antimicrobial Agent											
Organisms	Ampicillin	Amoxicillin-clavulanic acid	Ampicillin-sulbactam		Ticarcillin	Cephalosporin I: Cefazolin, Cephalothin	Cephamycins: Cefoxitin, Cefotetan	Cephalosporin II: Cefuroxime	Imipenem	Tetracyclines and Tigecycline	Nitrofurantoin	Polymyxin B/Colistin
Citrobacter freundii	R	R	R			R	R	R				
Citrobacter koseri	R				R							
Klebsiella aerogenes (prev.Enterobacter)	R	R	R			R	R	R				
Enterobacter cloacae complex	R	R	R			R	R	R				
Escherichia coli	There is no intrinsic resistance to beta-lactams in this organism											
Escherichia hermannii	R				R							
Hafnia alvei	R	R	R			R	R					
Klebsiella pneumoniae	R				R							
Morganella morganii	R	R				R		R	*	R	R	R
Proteus mirabilis	No intrinsic resistance to penicillins and cephalosporins								*	R	R	R
Proteus penneri	R					R		R	*	R	R	R
Proteus vulgaris	R					R		R	*	R	R	R
Providencia rettgeri	R	R				R			*	R	R	R
Providencia stuartii	R	R				R				R	R	R
Salmonella* and *Shigella spp	No intrinsic resistance to beta-lactams in these organisms 1ST AND 2ND generation cephalosporins may appear active in vitro, but are not effective clinically.											
Serratia marcescens	R	R	R			R	R	R			R	R
Yersinia enterocolitica	R	R			R	R						

Note: Cephalosporins III, cefepime, aztreonam, ticarcillin-clavulanate, piperacillin-tazobactam, and the carbapenems are not listed, because there is no intrinsic resistance in Enterobacteiaceae.

Intrinsic Resistance[5,10]

Example of organisms with their respective intrinsic antimicrobial resistance from LMH Health Antimicrobial and Clinical Microbiology Guidebook, 9th Edition, January 2023.

NE ICAP ASAP

Predictable Susceptibility[11]

Some bacteria, like those causing common don't typically undergo routine susceptibility testing because their susceptibility to common antibiotics is often predictable OR because they are commonly considered to be contaminants.

Examples:

- Streptococcus pyogenes (Group A Strep)
- Candida albicans
- Streptococcus agalactiae (Group B Strep)
- Anaerobic Gram-Positive Rods

Yeast Result:

DOB/Age/Se [redacted]
X: #:
Procedure: Culture Urine [^1 @1] Accession: [redacted]

Source: Urine Body Site:
Collected Date/Time: [redacted] Received Date/Time: [redacted]
Start Date/Time: Free Text Source:

FINAL REPORTS
Final Report []
Verified Date/Time/Personnel: [redacted]
>100,000 cfu/ml Yeast
No further work up

Group B Strep Result:

Few Streptococcus agalactiae (Group B Streptococcus) (Susceptibilities to beta hemolytic Streptococci are not routinely performed due to predictable susceptibility to penicillin and most other antibiotics used for gram positive organisms)

Anaerobic Gram-Positive Rods Result:

Additional Information View trends
Value [redacted]

Gram Stain Result View trends
Value **Many White Blood Cells**

Gram Stain Result View trends
Value **Rare Gram Negative Rods**

Culture Result View trends
Value **Few Normal Skin Flora**

Culture Result View trends
Value
Rare Anaerobic Gram Positive Rods Susceptibility for anaerobes is not routinely performed. Contact the Microbiology Director at [redacted] if further testing is required.

Chart in the Workbook on page 18

CONTAMINANTS vs PATHOGENS

BLOOD
Normally sterile

Pathogens - any organism isolated

Likely Contaminants
Coagulase-negative staphylococci
Alpha-hemolytic streptococci
Bacillus spp.
Corynebacterium spp. (except *C. jeikeium*)
Propionibacterium acnes
NOTE: Must take into consideration how many cultures were drawn versus how many are positive and what the organism is

TISSUE AND BODY FLUIDS
Should be sterile

Pathogens - any organism isolated; use judgement to evaluate the possibility of normal flora being present in relation to the source of the specimen

Normal Flora
Eye/Ear
Coagulase-negative staphylococci
non-hemolytic streptococci
alpha-hemolytic streptococci
Diphtheroids
Skin
Coagulase-negative staphylococci
Propionibacterium acnes
diphtheroids
alpha-hemolytic streptococci
Bacillus spp.

GENITAL

Pathogens
Neisseria gonorrhoeae
B-hemolytic streptococci
Listeria spp.
Gardnerella vaginalis
Predominant numbers of *S. aureus*
Predominant numbers of yeast

Normal flora
Staphylococcus spp.
Lactobacillus spp.
Diphtheroids
Enterococcus spp.
Streptococcus spp.
Gram-negative rods
Anaerobes
Yeast

URINE
Should be sterile

Pathogens
Enterobacteriaceae
Enterococcus spp.
Pseudomonas spp. and other non-fermenters
group B *Streptococcus (Streptococcus agalactiae)*
S. aureus and *S. saprophyticus*

Likely Contaminants
Diphtheroids
coagulase-negative staphylococci
alpha-hemolytic streptococci
Lactobacillus spp.

Bacillus spp.
NOTE: significance of organism is determined by colony count and symptoms

GASTROINTESTINAL TRACT

Pathogens
Salmonella spp.
Shigella spp.
Campylobacter jejuni
E. coli O157:H7
Aeromonas/Plesiomonas spp.
Yersinia enterocolitica
Vibrio spp.
Clostridium difficile (toxin)
S. aureus (in the context of enterotoxin food poisoning)
Helicobacter pylori (antigen)

Normal Flora
Enterobacteriaceae
Staphylococcus spp.
Streptococcus spp.
Enterococcus spp.
Pseudomonas spp.
Anaerobes
Yeast

RESPIRATORY TRACT

Pathogens
Group A *Streptococcus- (Streptococcus pyogenes)*
Streptococcus pneumoniae
Predominant *S. aureus*
H. influenzae
Neisseria meningitidis/gonorrhoeae
Predominant *Enterobacteriaceae*
Predominant *Pseudomonas spp.* and other non-fermenters
Corynebacterium diphtheriae
Bordetella pertussis
Legionella pneumophila
Mycobacterium spp.
Nocardia spp.
Predominant *Moraxella catarrhalis*

Normal Flora
Staphylococcus spp. (coag. negative)
alpha-hemolytic streptococci
Gram-negative rods
B-hemolytic streptococci other than group A
Neisseria spp.
Enterococcus spp.
Corynebacterium spp.
Bacillus spp.
Yeast
Anaerobes
Haemophilus spp.
Micrococcus spp.
Stomatococcus spp.
NOTE: amount of organism present, source of culture, and patient age may determine significance as a pathogen

https://www.unmc.edu/intmed/_documents/id/asp/clinicmicro-id_guidebook.pdf

Pathogen-Specific Considerations[1]

Normal flora versus probable pathogen

- Example- staph epi on the skin
- Example- candida in the lungs

Specimen Contamination

- Example- Bacillus spp. on a blood culture

Specimen Contamination[1,7]

Contamination of Specimens (no more than 2 potential pathogens per culture)

- 3 or more indicate a poorly collected specimen

Possibly Contaminated Urine Culture

DOB/Age/Sex: [redacted] #:
Procedure: Culture Urine [^1 @1] Accession: [redacted]

Source: Urine Body Site: Urine
Collected Date/Time: [redacted] Received Date/Time: [redacted]
Start Date/Time: Free Text Source:

FINAL REPORTS
Final Report []
Verified Date/Time/Personnel: [redacted]
Mixed microbial flora isolated; unable to determine clinical significance. If clinically indicated, please recollect a new sample.

Possibly Contaminated Blood Culture

See Direct Blood Pathogen Identification Panel for rapid identification panel.
Staphylococcus species coagulase negative Probable contaminant, clinical significance of 1 positive out of 2 sets is unclear. If further workup is required, please contact Microbiology [redacted]

Possibly Contaminated Urine Culture

Test Item	Flag	Value	Units	Reference Range	Test Item Status
SPECIMEN SOURCE XXX		Urine Clean Catch			Final
ANNOTATION COMMENT IMP		None Reflexed from S52625			Final
MICROORGANISM/AGENT XXX		Three or more colony types indicate contamination. If clinically indicated, please submit a new specimen.			
Report Status		[redacted]			Final

Summary[1]

- Interpreting microbiology results requires a combination of technical expertise and clinical judgment.
- It is important to accurately identify the microorganisms, understand their susceptibility patterns, and consider the patient's overall clinical picture.
- The clinical microbiology laboratory is an important partner in the practice of infection prevention.

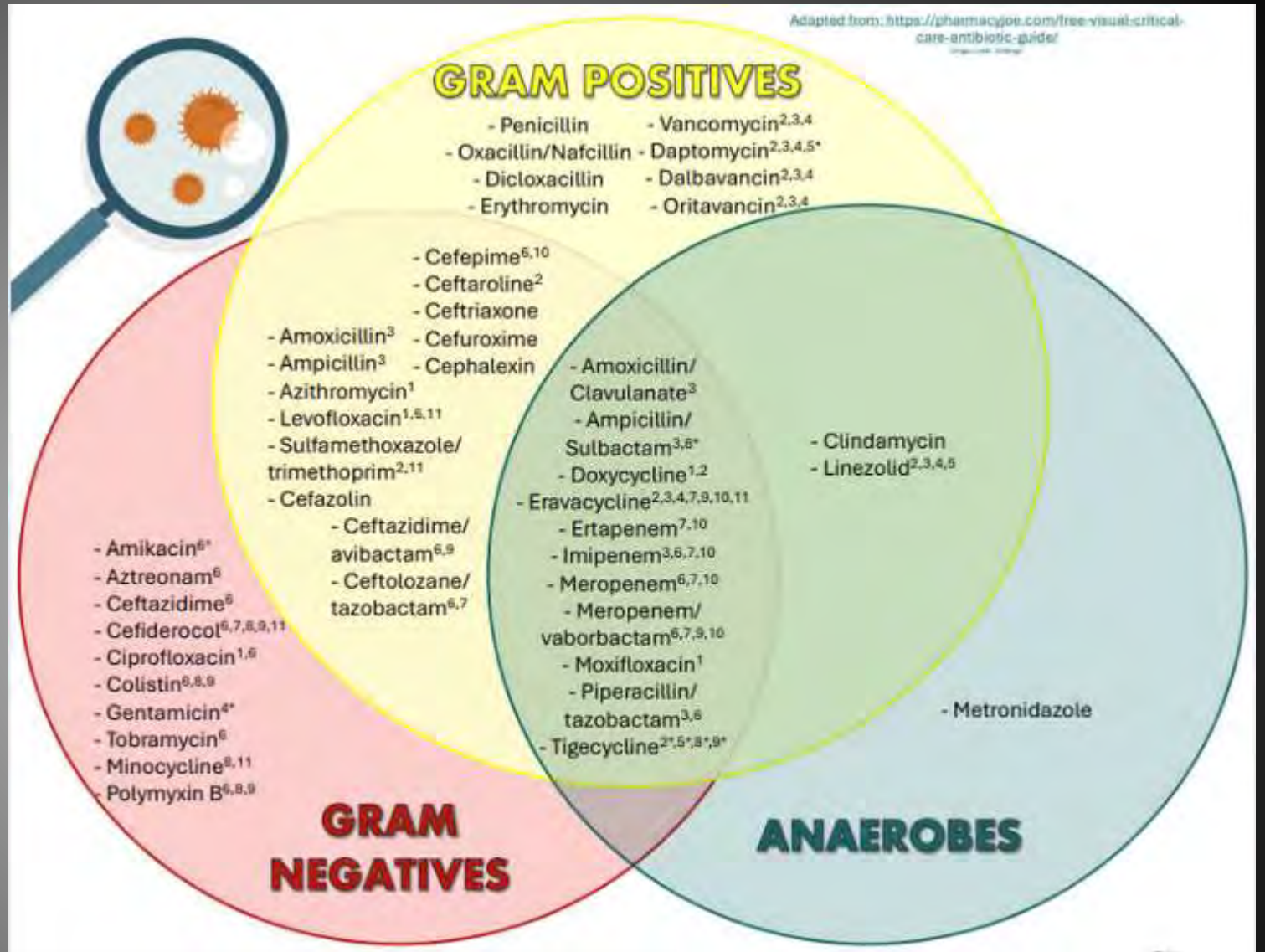


Figure in the Workbook on page 19

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