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**Most important thing to know as an
academic microbiology director**

Microbiology and Infectious diseases

Microbiology and Infectious disease Pharmacy

Microbiology and Antimicrobial Stewardship

Microbiology and Hospital Epidemiology

Microbiology and Public Health

All relationships built on trust and teamwork

These relationships are critical to the impact your laboratory will have on
patient care

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Examples of microbiology/stewardship collaboration

Susceptibility testing—how can data be used?	Appropriate β-lactam utilization	Molecular testing
<ul style="list-style-type: none">• BCID/rapid susceptibility testing	<ul style="list-style-type: none">• ESBL vs AmpC.• Detection of carbapenemases	<ul style="list-style-type: none">• Pneumonia panel• Utilization of WGS techniques

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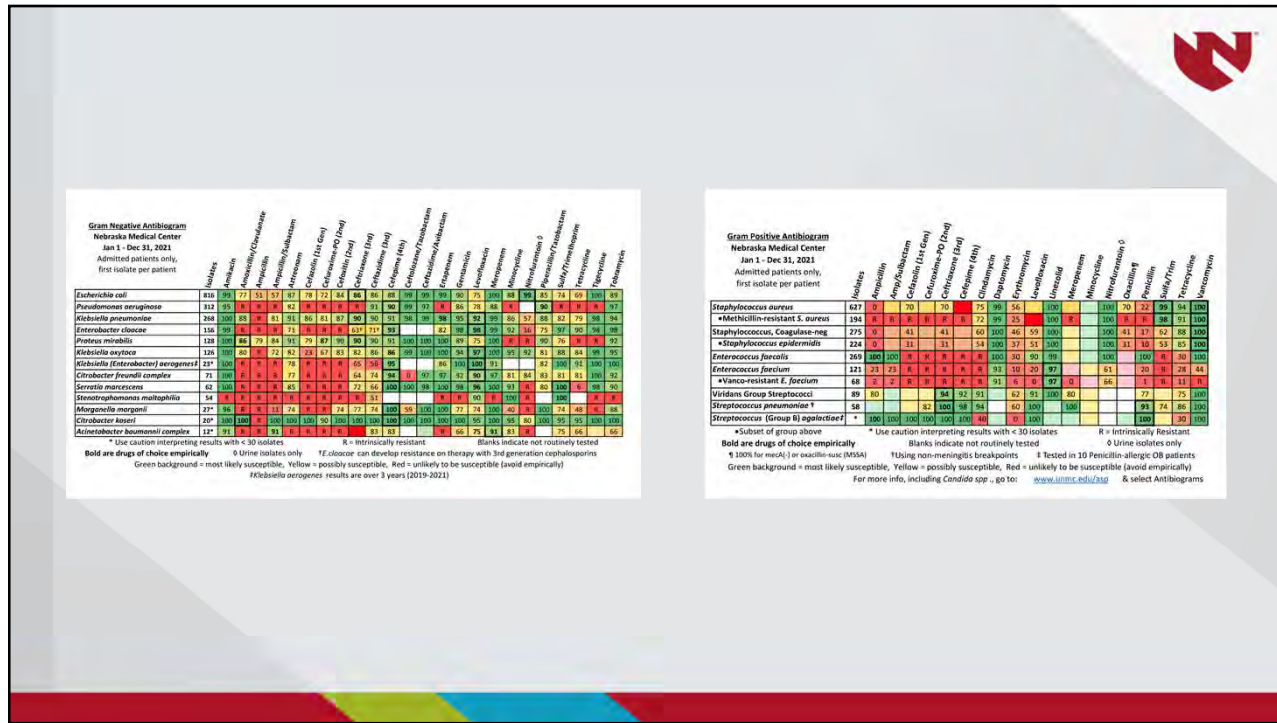
Susceptibility testing \rightarrow Antibigram

Required to generate

Major gaps in data from the US

How do you use the data?

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mecA → oxacillin resistance
vanAB → vancomycin resistance
 Carbapenemase genes → carbapenem resistance
mcr-1 → colistin resistance

ctxM → Expanded-spectrum cephalosporin resistance
 (70% of ESBLs at NM are CtxM)

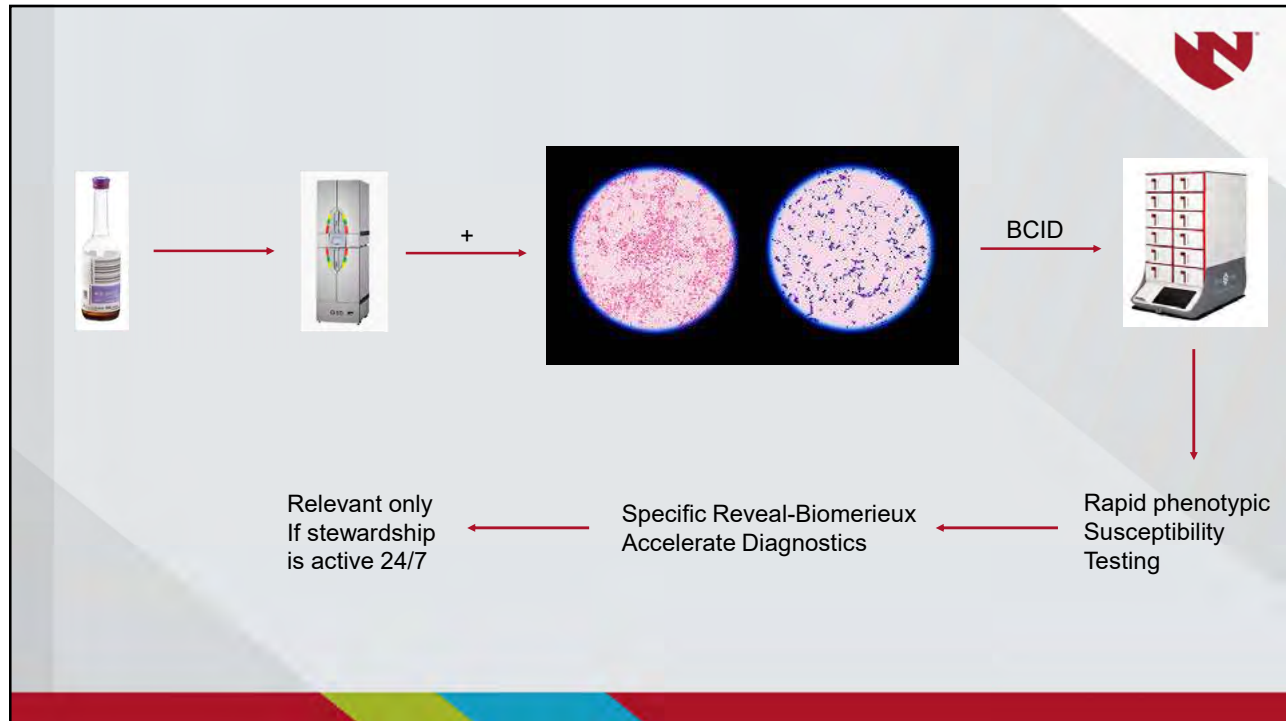
Why can't we use this approach for all antibiotics?

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Pneumonia	Penicillin 3 million units q4h or Ampicillin 2g IV q4h	PCN highly active against pneumococcus Severe PCN allergy: Ceftriaxone
CNS infection	Ceftriaxone 2g q12h + Vancomycin 15 mg/kg q12h	Continue vancomycin until susceptibilities return
Gram Negative Pathogens		
Enterobacteriales order only	CTX-M Negative: Cefepime 1g q6h or Piperacillin/tazobactam 4.5 g q8h	Formerly <i>Enterobacteriaceae</i> . Note this is a group of possible enteric Gram-negative organisms, not a specific bacterial genus.
CTX-M + = Possible Extended-Spectrum Beta-Lactamase (ESBL) present	CTX-M Positive or Nosocomial Onset: Ertapenem 1g q24h or Meropenem 500mg q6h	See Table 5 for potential pathogens included in this group.
KPC, IMP, VIM, NDM, OXA-48 + = Possible carbapenemase present	Carbapenemase positive consult ID	
Acinetobacter baumannii complex	Meropenem 500 mg IV q6h	Meropenem: 100% susceptible (cumulative) Levofloxacin: 92% susceptible (cumulative) Cefepime: 84% susceptible (cumulative) If severely ill or non-responding consult ID
Bacteroides fragilis	Metronidazole 500 mg q8h	Aerobic organism usually part of underlying infection (i.e. intra-abdominal, etc.) Piperacillin/tazobactam alternative to metronidazole.
Enterobacter cloacae complex	CTX-M Negative: Cefepime 1 g IV q6h	Cefepime: 85-94% susceptible
CTX-M + = Possible Extended-Spectrum Beta-Lactamase (ESBL) present	CTX-M Positive or Nosocomial-onset: Meropenem 500 mg IV q6h	<ul style="list-style-type: none"> • 94% CO susceptible (blood) • 89% NO susceptible (blood)
KPC, IMP, VIM, NDM, OXA-48 + = Possible carbapenemase present	Carbapenemase positive consult ID	<ul style="list-style-type: none"> Meropenem: 100% susceptible Levofloxacin: 98-100% susceptible Ertapenem: 70-92% susceptible • 92% CO susceptible (blood) • 70% NO susceptible (blood) Pip/tazo: (65-86%) susceptible • 86% CO susceptible (blood) • 65% NO susceptible (blood)

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Appropriate β -lactam utilization

ESBLs vs AmpC—Both enzymes hydrolyze expanded-spectrum cephalosporins (cefotaxime, ceftazidime, and ceftriaxone).

-Within certain species, one can differentiate between an ESBL vs AmpC enzyme.

-*E. coli*, *K. pneumoniae*, *K. oxytoca*, *P. mirabilis*, *Salmonella*, *Shigella*

ESBL phenotype

Clavulanate susceptible

Cefoxitin susceptible

Cefepime resistant

Pip/Tazo resistant

AmpC phenotype

Clavulanate resistant

Cefoxitin resistant

Cefepime susceptible

Pip/Tazo variable (CMY-2 is inhibited by Tazobactam)

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Appropriate β -lactam utilization



Detection of carbapenemase genes to ensure appropriate therapy.

Enterobacteriales isolates intermediate or resistant to ertapenem, imipenem, or meropenem. Used to differentiate between carbapenem-resistant *Enterobacteriales* (CRE) vs. carbapenemase producing *Enterobacteriales* (CPE).

CRE (most common). Porin mutations plus ESBL/AmpC production

CPE (uncommon in Nebraska). Specific transferable carbapenemase gene that cleaves the carbapenem. Infection control issue.

PCR specific for carbapenemase genes is required for appropriate treatment (*kpc*, *oxa-48*, *ndm*, *vim*, *imp*)

KPC

Meropenem/vaborbactam
Imipenem/relebactam
Ceftazidime/avibactam

Oxa-48

Ceftazidime/avibactam

NDM

Aztreonam + ceftazidime/avibactam

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Molecular testing



Respiratory panels

GI panels

Meningitis/encephalitis panels

Blood culture panels

Virology (HSV/VZV/HIV/BK/EBV/etc)

Pneumonia panel—New opportunity

Bacterial results are semi-quantitative
Sputum or BAL

VIRUSES:

- Adenovirus
- Coronavirus
- Human Metapneumovirus
- Human Rhinovirus/Enterovirus
- Influenza A
- Influenza B
- Parainfluenza Virus
- Respiratory Syncytial Virus

ANTIMICROBIAL RESISTANCE GENES:

Methicillin resistance:

- *mecA/C* and *MREJ*

Carbapenemases:

- KPC
- NDM
- Oxa-48-like
- VIM
- IMP

ESBL:

- CTX-M

BACTERIA:

Semi-Quantitative Bacteria

- *Acinetobacter calcoaceticus-baumannii* complex
- *Enterobacter cloacae* complex
- *Escherichia coli*
- *Haemophilus influenzae*
- *Klebsiella aerogenes*
- *Klebsiella oxytoca*
- *Klebsiella pneumoniae* group
- *Moraxella catarrhalis*
- *Proteus* spp.
- *Pseudomonas aeruginosa*
- *Serratia marcescens*
- *Staphylococcus aureus*
- *Streptococcus agalactiae*
- *Streptococcus pneumoniae*
- *Streptococcus pyogenes*

ATYPICAL BACTERIA:

Qualitative Bacteria

- *Chlamydia pneumoniae*
- *Legionella pneumophila*
- *Mycoplasma pneumoniae*

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Use of Pneumonia panel (PNP)



- Not utilized for CAP
- Orderable only by ID and pulmonary/critical care for ICU patients
 - Diagnostic (since May of 2020-6 positive *Legionella*;~3500 ordered)
 - Use as a tool to de-escalate anti-pseudomonal or anti-staphylococcal therapy
- Culture is required for a PNP order. Both results are utilized to interpret the test.
 - If *Pseudomonas* or *S. aureus* not noted in culture, a comment is added to the culture: **Negative for *S. aureus* and *P. aeruginosa*.**
- Studies are being currently being performed to determine the impact of this test.

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Stewardship group as a tool for appropriate use of molecular testing?



Future of our discipline is linked to sequencing and metabolomics.

- expensive and significant expertise required

Current examples:

- Sequencing of microbial DNA from in blood
- WGS shotgun sequencing from CSF/sterile fluid
- Targeted 16s sequencing from tissue/fluid

Which patients should be tested? Who makes the decisions?

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