ANTIMICROBIAL STEWARDSHIP CONCEPTS 2

Northwestern Medicine®

PROGRAM OVERVIEW

Welcome to the Antibiotic Resistance Fighter Pharmacist Curriculum!

This module is focused on: infectious diseases knowledge to practice antimicrobial stewardship in daily patient care.

Part 1: Antimicrobial Stewardship Concepts 2

Join ADSP in the fight against antimicrobial resistance!

OBJECTIVES

Identify and learn your role in the treatment of sepsis.
(Click the first objective to begin)

Evaluate common infectious diseases and assess for effective treatment plans.

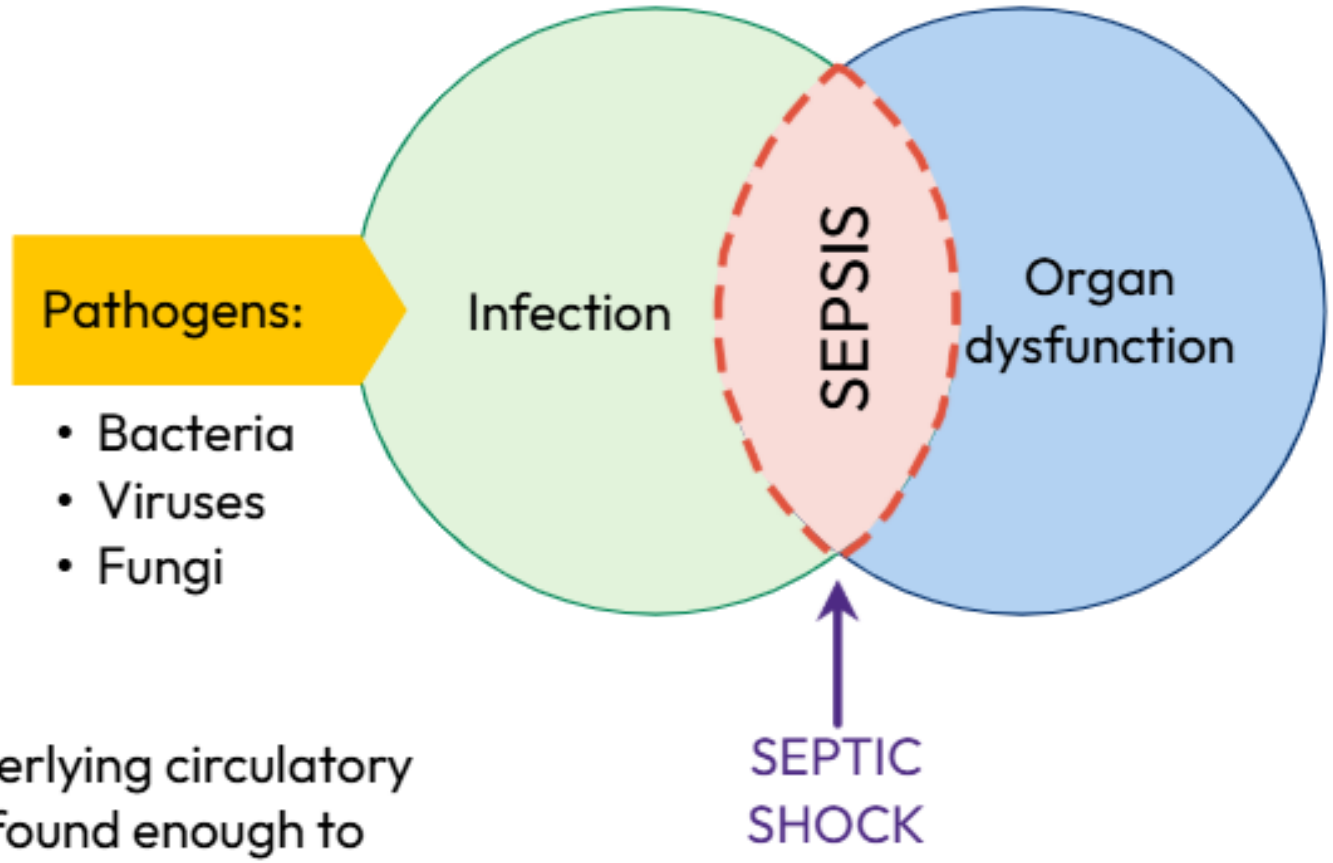
Apply NM system guidelines for interpretation and treatment of bloodstream infections.

SEPSIS 101

What is sepsis?

Sepsis is not blood stream infection.

Sepsis is a syndrome, not a disease. It is life threatening and may lead to tissue damage, organ failure and sometimes death.



Septic shock is a subset of sepsis in which underlying circulatory and cellular/metabolic abnormalities are profound enough to substantially increase mortality.

Clinical criteria (despite adequate volume resuscitation):

- Persistent hypotension requiring vasopressors to maintain MAP ≥ 65 mm Hg
- Serum lactate level >2 mmol/L (18 mg/dL)

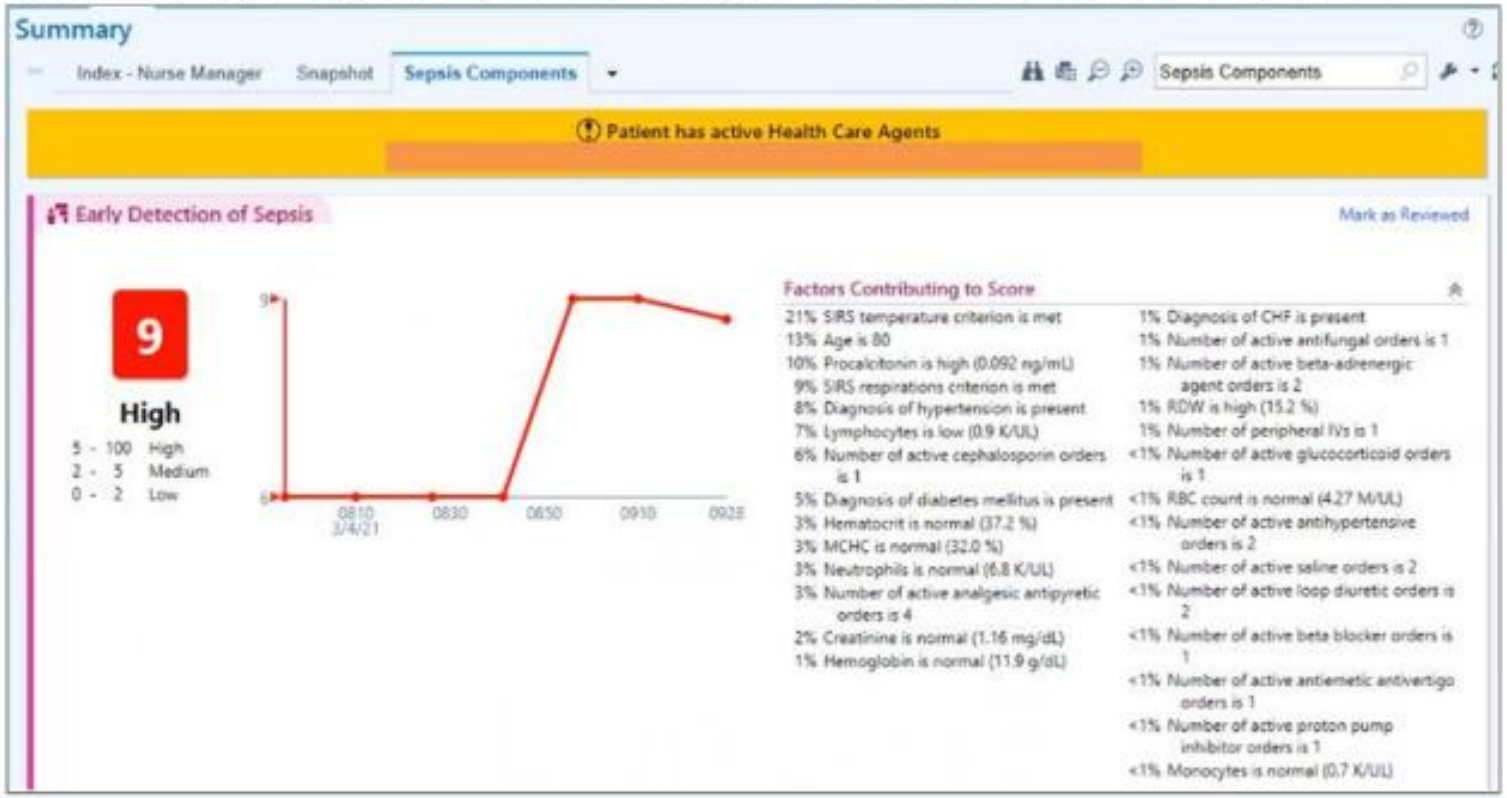
SEPSIS 101

How sepsis identification occurs

RISK SCORE

These next few EPIC views are the triggers the nurse and prescribers see. The lab triggers can be non-specific for infection versus other causes but should be used as an alert to review the patient as a whole.

Epic generates a risk score and predicts risk of sepsis or septic shock. A list of sepsis criteria that contribute to the risk score is provided alongside the score.

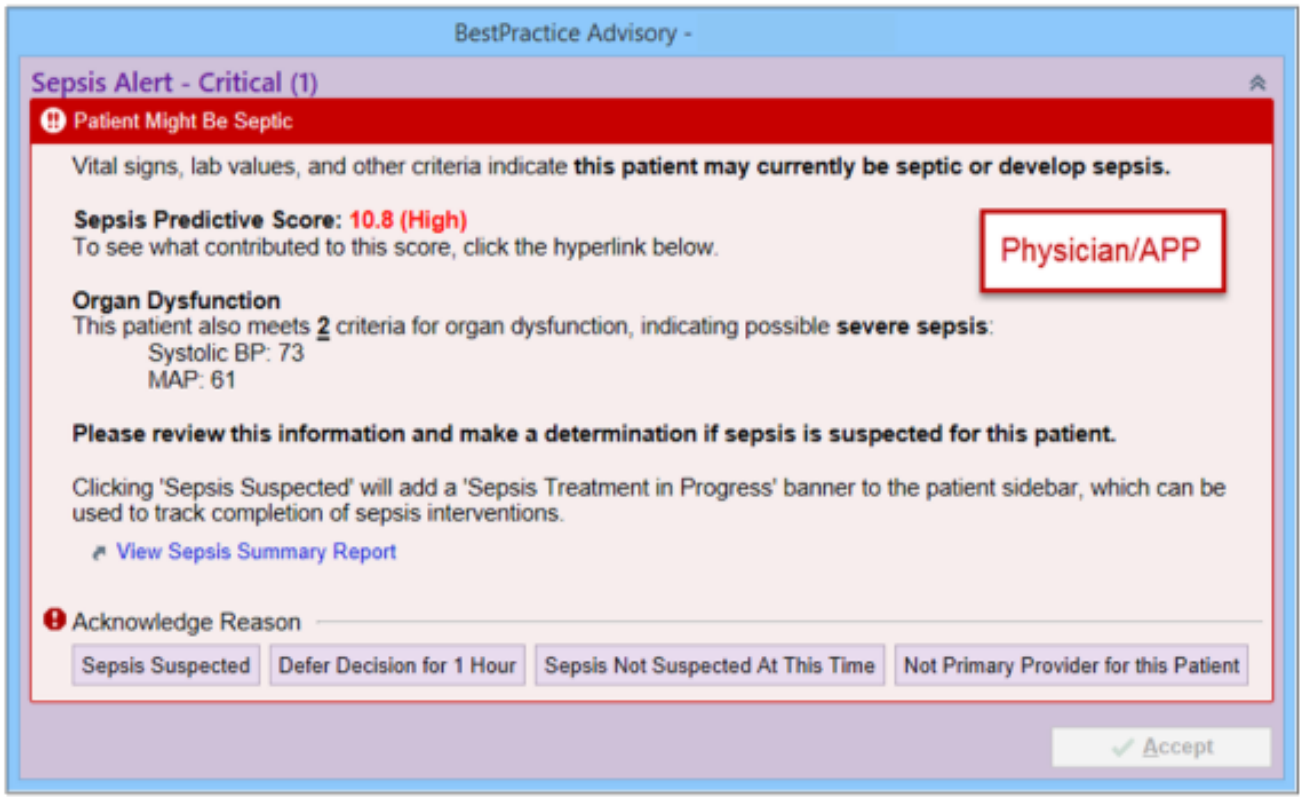


SEPSIS 101

How sepsis identification occurs

OPA NOTIFICATION

Our Practice Advisory (OPA) notification is sent to front line clinicians for assessment. If sepsis is suspected, the clock starts.



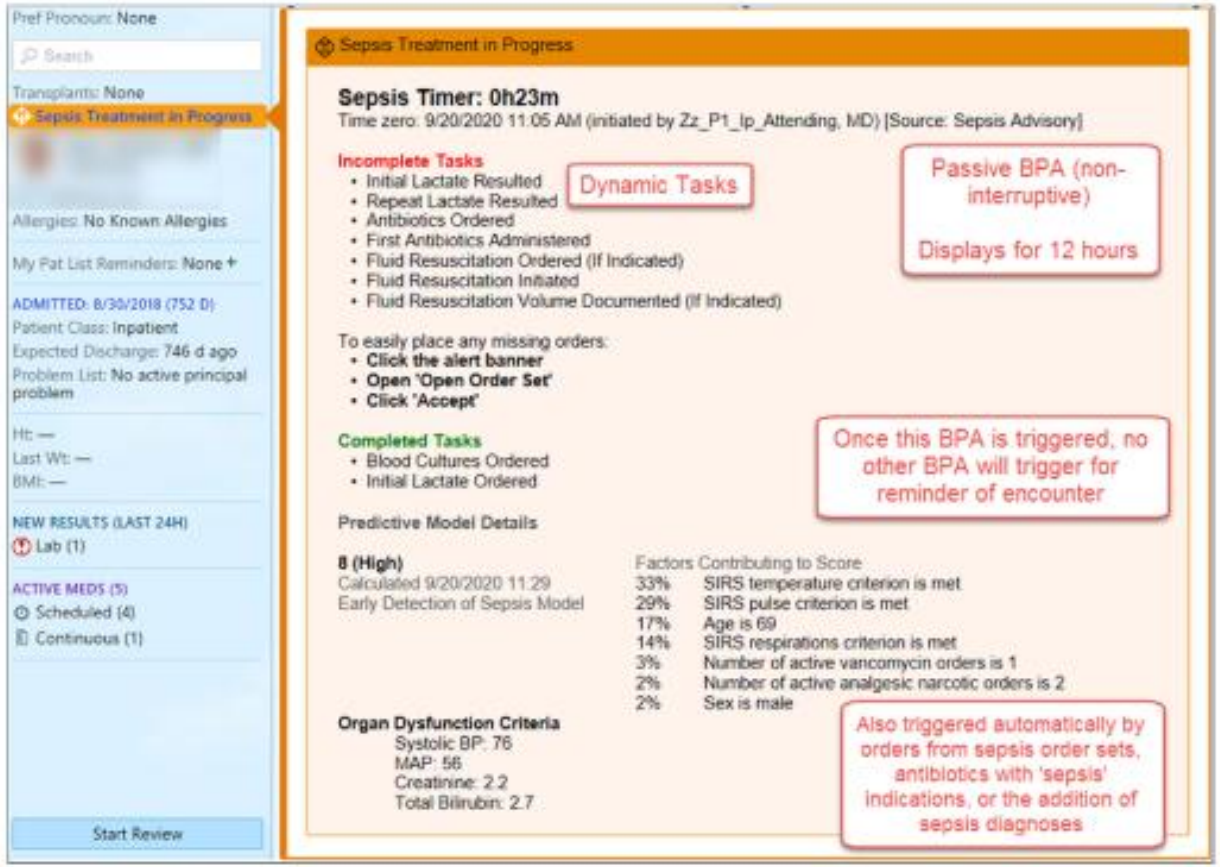
SEPSIS 101

How sepsis identification occurs

START GOAL DIRECTED THERAPY

Within 1 hour initiate sepsis bundle:

- Obtain lactic acid level
- Obtain blood cultures prior to antimicrobial initiation
- Initiate appropriate **antimicrobials within 1 hour**
- Fluid resuscitation **30 mL/kg** 0.9% normal saline or lactated ringers' solution
- Vasopressors as needed



SEPSIS 101

Pharmacist role in sepsis

Pharmacists are a vital component in the management of patients with sepsis.

They help with:

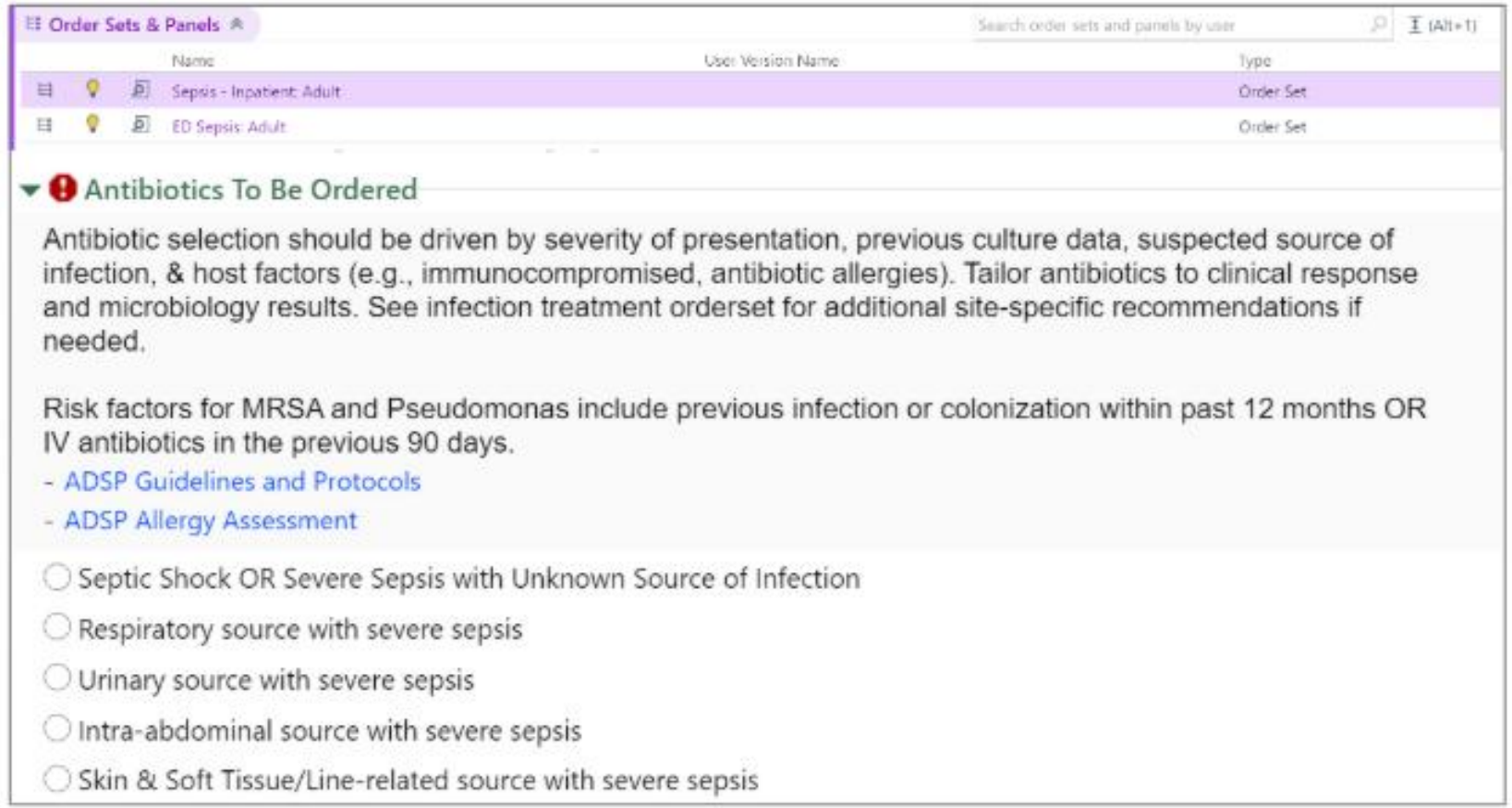
- Antibiotic management
  - **Dose aggressively in the first 24 hours**
  - Order of antibiotics matter; schedule β-lactam before vancomycin if not compatible
- Fluid dosing (fluid resuscitation using crystalloid fluids at a dose of 30 mL/kg)
- Medication dosing

Pharmacist involvement has been shown to decrease time to antibiotic administration, increase appropriate selection of medications and decrease mortality.

SEPSIS 101

Sepsis order set

Antibiotics don't have to be unnecessarily broad if there is a suspected source!



CHECK YOUR UNDERSTANDING

What are different ways a pharmacist can help manage a patient with sepsis?

- ○ Initiate antimicrobials within an hour
- ○ Help dose norepinephrine for a patient with MAP <65 mmHg
- ○ Help dose LR or NS for a patient at 30 mL/kg
- ○ All of the above

SUBMIT ✓

MICROBIOLOGY 102

Sterile body sites

Many parts of our body produce fluid, **however not all body fluids are sterile**. Sterile sites in our body typically do not have bacteria unless there is an infection. Non-sterile body fluids can have bacteria present, which is not always infectious.

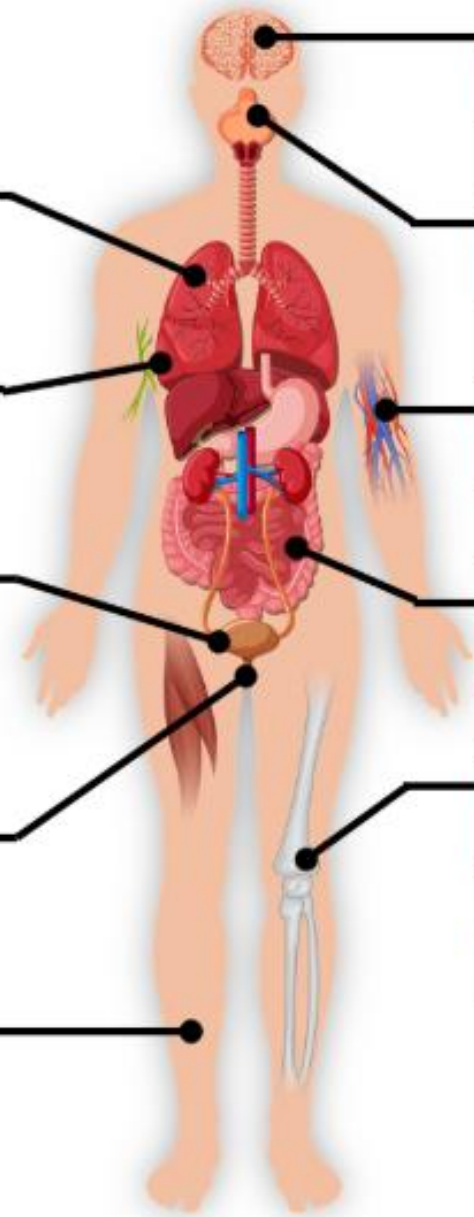
Why is this important?

Distinguishing between bacteria causing infection and normal flora, colonization, or contamination or non-sterile cultures is important for deciding when to treat with an antimicrobial.

MICROBIOLOGY 102

Is it sterile?

Click on each site to see which parts of the body are sterile and non-sterile. Some sites have additional information. Click the *i* for more.



Pleural Fluid ✓
Sterile

BAL/Sputum ✗
Not sterile *i*

Urine ✗
Not sterile *i*

Genitals - vagina ✗
Not sterile

Skin ✗
Not sterile *i*

Cerebral Spinal Fluid ✓
Sterile

Nasal Cavity ✗
Not sterile

Blood ✓
Sterile

Peritoneal Fluid ✓
Sterile

Bone or Joint Fluid ✓
i Both of these sites are sterile

MICROBIOLOGY 102

De-escalation considerations

The team calls for de-escalation recommendations, what things should you consider?

IV options:

MICROBIOLOGY 102

De-escalation considerations

The team calls for de-escalation recommendations, what things should you consider?

Always consider if they can switch to orals:
Click each consideration

What is the source of infection?

1. **AMOXICILLIN**
   Don't forget, amoxicillin comes alone, not just with clavulanic acid! If you can use amoxicillin for appropriate types of infection, there may be less chance of diarrhea.
2. Examples include urinary infections that are amoxicillin susceptible, CAP with *S. pneumoniae* susceptible to penicillin.
3.
4.

MICROBIOLOGY 102

HECK-Yes

AmpC producing bacteria: Throw out SPACE AND SPICE and get onboard with **HECK-Yes**

What is AmpC?

It is an enzyme produced by some Enterobacterales.
AmpC β-lactamases are capable of hydrolyzing β-lactam agents to make them ineffective. The most common pathogens at moderate risk of producing AmpC are *Enterobacter cloacae*, *Klebsiella aerogenes*, *Citrobacter freundii*.
Don't forget to check the ADSP Guidelines and Protocols website for MDR guidelines including AmpC recommendations.

***H**afnia alvei*

***E**nterobacter cloacae*

***C**itrobacter freundii*

***K**lebsiella aerogenes*

***YE**r**S**inia enterolitica*

MICROBIOLOGY 102

HECK-Yes I am on board! Which antibiotic should I use?

NO

Ceftriaxone, cefotaxime, ceftazidime, and piperacillin-tazobactam

- Not useful for moderate risk bacteria (HECK-Yes organisms)
- Though these drugs are often reported as susceptible in the microbiology result, resistance can be induced with their use and patients can fail therapy
- Ceftriaxone may be useful for HECK-Yes organisms if indication is cystitis due to sufficient urinary excretion

YES

Cefepime

- May use empirically for most AmpC producing organisms with moderate risk
- Studies show similar clinical outcomes in patients treated with cefepime over carbapenem therapy

Non-β-lactam antibiotics can be used if susceptible: trimethoprim-sulfamethoxazole, fluoroquinolones or tetracyclines

BLOOD BIOFIRE (BCID)

Introduction to and interpretation of Blood Biofire (BCID)

Blood Biofire (BCID) is blood culture identification.

The identification of bacteria and many common resistance gene results are available within 1-2 hours after a Gram-stain turns positive, saving 1-2 days from traditional culture methods.

Getting patients onto optimal therapy quickly can improve patient outcomes such as length of stay and potentially mortality if uncovered for a serious infection.

Check out the Biofire® FilmArray® Blood Culture Identification Panel Clinician Guidance on ADSP Guidelines and Protocols page.

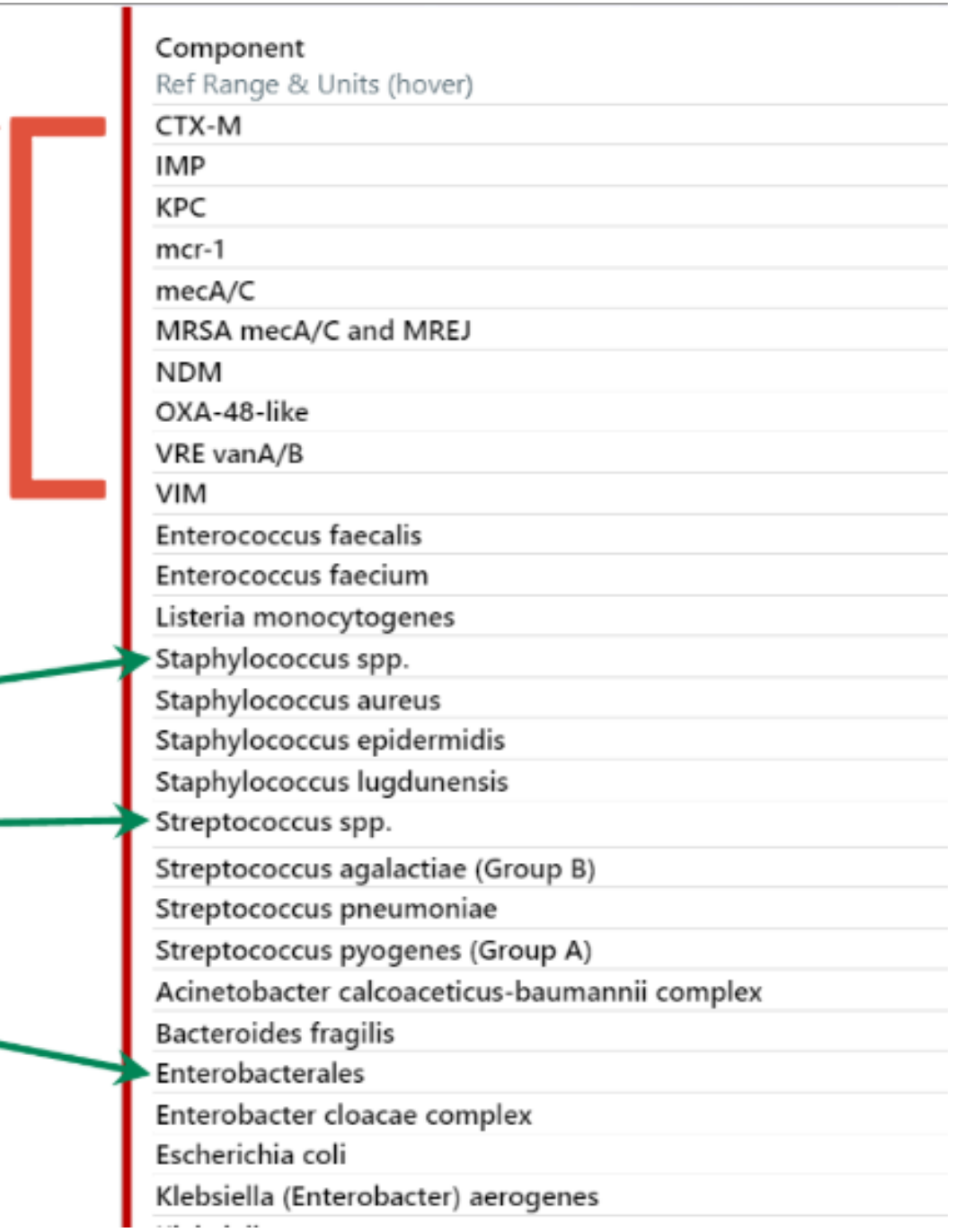
BLOOD BIOFIRE (BCID)

Interpretation of results

The top 10 lines of the results are resistance markers for both gram-negative and gram-positive bacteria. The rest of the panel is made up of specific bacteria and group targets.

There are three group targets:

1. *Staphylococcus* spp.
2. *Streptococcus* spp.
3. Enterobacterales



BLOOD BIOFIRE (BCID)

How to read the Blood Biofire (BCID) panel

Enterococcus faecalis	Not Detected
Enterococcus faecium	Not Detected
Listeria monocytogenes	Not Detected
Staphylococcus spp.	Not Detected
Staphylococcus aureus	Not Detected
Staphylococcus epidermidis	Not Detected
Staphylococcus lugdunensis	Not Detected
Streptococcus spp.	Detected !
Streptococcus agalactiae (Group B)	Not Detected
Streptococcus pneumoniae	Not Detected
Streptococcus pyogenes (Group A)	Detected !
Acinetobacter calcoaceticus-baumannii complex	Not Detected
Bacteroides fragilis	Not Detected
Enterobacterales	Not Detected
Enterobacter cloacae complex	Not Detected
Escherichia coli	Not Detected
Klebsiella (Enterobacter) aerogenes	Not Detected
Klebsiella oxytoca	Not Detected

The panel will show one target detected for the individual bacteria and one for the group. This **does not** mean there are 2 bacteria growing!

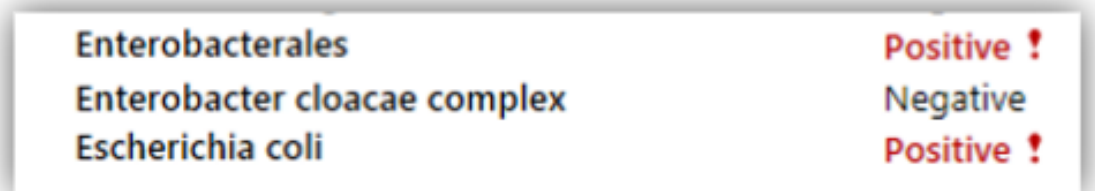
In this example, the patient has bacteremia with *Streptococcus pyogenes* (Group A *Streptococcus*) and we can recommend cefazolin per the NM System Blood Biofire (BCID) Guidance.

BLOOD BIOFIRE (BCID)

Enterobacterales

Common misconception: Enterobacterales detected on the Blood Biofire (BCID) is often misinterpreted as an additional organism in the blood – THIS IS NOT THE CASE.

Enterobacterales is the taxonomic order name for the enteric gram-negatives, while *E. coli* is a specific organism on the panel.



If you see Enterobacterales with no other gram-negative identified, it indicates that there is a gram-negative present that is not listed on the panel, like *Citrobacter* spp., *Morganella* or *Hafnia*.

BLOOD BIOFIRE (BCID)

Enterococcus species

The Blood Biofire (BCID) detects 2 types of *Enterococcus* :

1. ***Enterococcus faecalis***
   - Typically very susceptible - recommend ampicillin empirically
     - *E. faecalis* is a common cause of endocarditis
     - In the rare case of intra-abdominal source, piperacillin-tazobactam can be used
   - Ampicillin-sulbactam does not provide better coverage of *E. faecalis* than ampicillin alone
   - If vancomycin resistant *E. faecalis* is encountered once susceptibilities return, may treat with ampicillin if susceptible

VRE vanA/B	Not Detected
VIM	Not Detected
Enterococcus faecalis	Detected !
Enterococcus faecium	Not Detected

2. ***Enterococcus faecium***
   - Use vancomycin empirically due to higher likelihood of ampicillin resistance
   - Look for VRE vanA/B resistance gene-if present, that indicates vancomycin resistance
     - Use daptomycin or linezolid if vanA/B gene detected empirically

BLOOD BIOFIRE (BCID)

Staphylococcus

When to treat? Some *Staphylococci* are common contaminants but some should always be treated like MSSA and MRSA.

Staph species that require treatment:

- *Staphylococcus aureus*
  - ID consult strongly recommended due to improved patient outcomes
  - If *mec*A and MREJ or *mec*A/C gene is positive, the organism has methicillin resistance and requires vancomycin

MRSA Result

Component Ref Range & Units (hover)	2 wk ago
CTX-M	Not Detected
IMP	Not Detected
KPC	Not Detected
mcr-1	Not Detected
mecA/C	Not Detected
MRSA mecA/C and MREJ	Detected !
NDM	Not Detected
OXA-48-like	Not Detected
VRE vanA/B	Not Detected
VIM	Not Detected
Enterococcus faecalis	Not Detected
Enterococcus faecium	Not Detected
Listeria monocytogenes	Not Detected
Staphylococcus spp.	Detected !
Staphylococcus aureus	Detected !
Staphylococcus epidermidis	Not Detected
Staphylococcus lugdunensis	Not Detected
Streptococcus spp.	Not Detected

BLOOD BIOFIRE (BCID)

Approach to potential contaminants

Indications of possible contamination:

- Only 1 of 2 blood cultures is positive
- Patient lacks systemic signs of infection such as fever, hypotension or leukocytosis

Consider treatment, if:

- The patient has an implanted device or hardware (which increases risk of true infection)
  - For example dialysis catheter, central line/ PICC, cardiac device (pacemaker or ICD), prosthetic valve or prosthetic joint
- Engage ID if treatment team is uncertain

BLOOD BIOFIRE (BCID)

Approach to gram-negative resistance

Understanding mechanisms of resistance can help improve confidence with selecting newer antibiotics. Note that for many cases although ID consult is required, delaying therapy until ID can evaluate is not appropriate. Contact ID if necessary to ensure timely order entry if primary provider is unwilling.

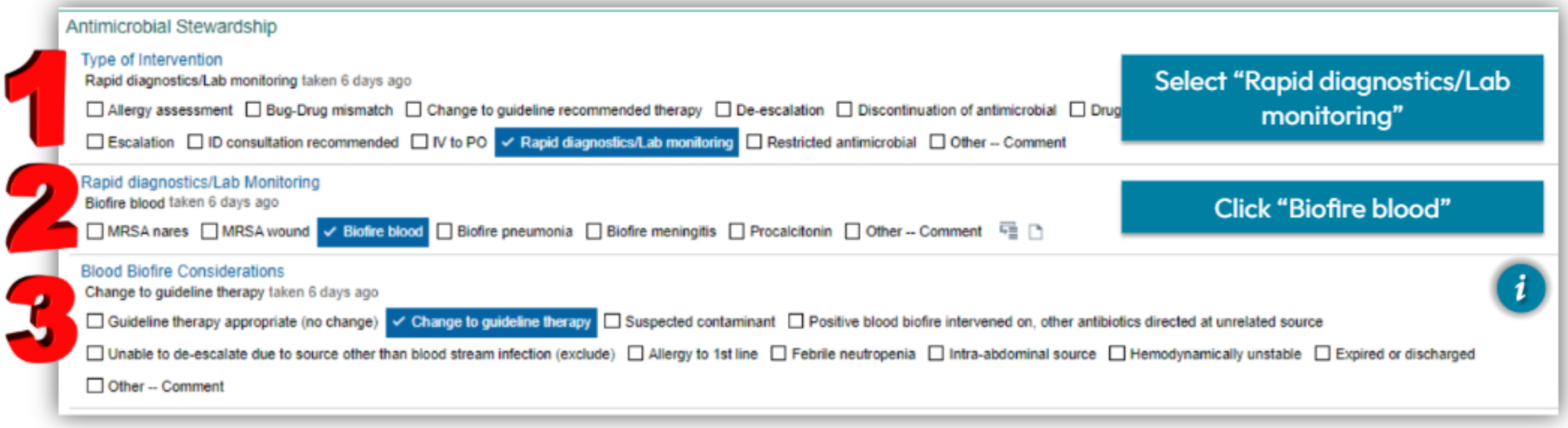
Resistance Gene	What this means	Recommended empiric drug
CTX-M	ESBL detected	Meropenem
KPC	Carbapenemase (β-lactamase) “CRE”	Ceftazidime-avibactam or meropenem-vaborbactam
OXA-48	Carbapenemase (β-lactamase) “CRE”	Ceftazidime-avibactam
IMP VIM NDM	Carbapenemase (metallo-beta lactamase, ‘MBL’s’) "CRE"	Ceftazidime-avibactam + Aztreonam

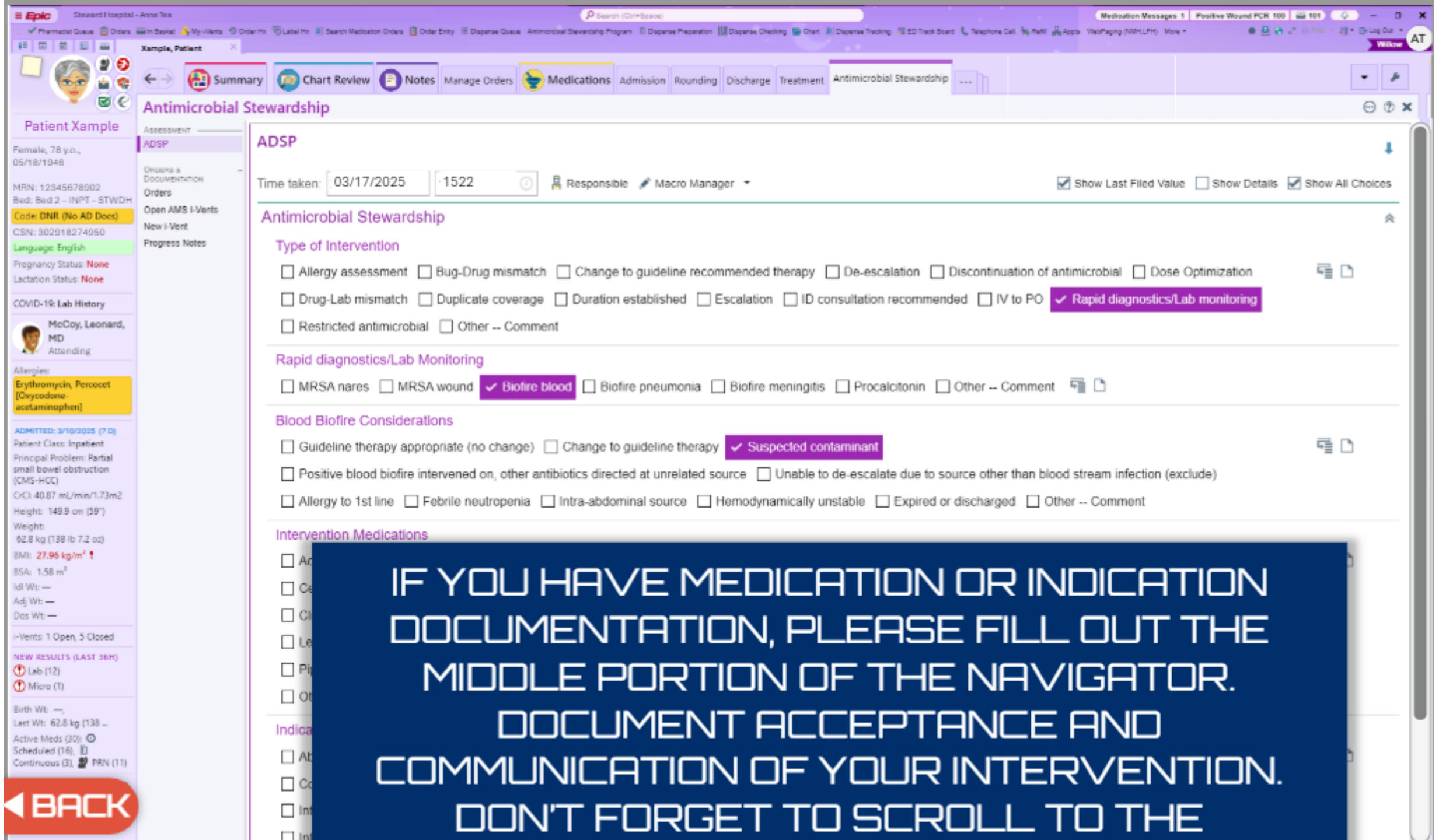
USING THE EPIC NAVIGATOR

Quick pharmacy process review

FOR EACH BIOFIRE RESULT THAT FIRES THE NAVIGATOR MUST BE FILLED OUT!

Open and fill out a navigator entry each time.




Summary
Chart Review
Notes
Manage Orders
Medications
Admission
Rounding
Discharge
Treatment
Antimicrobial Stewardship
Antimicrobial Stewardship
Patient Xample
ADSP
Orders
Open AMS I-Vents
New I-Vent
Progress Notes
ADSP
Time taken: 03/17/2025 1522
Responsible
Macro Manager
Show Last Filed Value
Show Details
Show All Choices
Antimicrobial Stewardship
Type of Intervention
Allergy assessment
Bug-Drug mismatch
Change to guideline recommended therapy
De-escalation
Discontinuation of antimicrobial
Dose Optimization
Drug-Lab mismatch
Duplicate coverage
Duration established
Escalation
ID consultation recommended
IV to PO
Rapid diagnostics/Lab monitoring
Restricted antimicrobial
Other -- Comment
Rapid diagnostics/Lab Monitoring
MRSA nares
MRSA wound
Biofire blood
Biofire pneumonia
Biofire meningitis
Procalcitonin
Other -- Comment
Blood Biofire Considerations
Guideline therapy appropriate (no change)
Change to guideline therapy
Suspected contaminant
Positive blood biofire intervened on, other antibiotics directed at unrelated source
Unable to de-escalate due to source other than blood stream infection (exclude)
Allergy to 1st line
Febrile neutropenia
Intra-abdominal source
Hemodynamically unstable
Expired or discharged
Other -- Comment
Intervention Medications
IF YOU HAVE MEDICATION OR INDICATION DOCUMENTATION, PLEASE FILL OUT THE MIDDLE PORTION OF THE NAVIGATOR. DOCUMENT ACCEPTANCE AND COMMUNICATION OF YOUR INTERVENTION. DON'T FORGET TO SCROLL TO THE
BACK