MIC Drop: A One-Stop-Shop Review of Minimum Inhibitory Concentrations (MICs)

By: Antimicrobial Stewardship Team

Duke University School of Medicine

dcasip.medicine.duke.edu

Duke Center for Antimicrobial Stewardship and Infection Prevention

Understanding Minimum Inhibitory Concentrations (MICs)

Key Points

Definition:

MIC is the **lowest antibiotic concentration** that prevents visible bacterial growth *in vitro*.

Why it matters:

Adequate drug exposure **reduces resistance** and improves outcomes.

Common Pitfall:

The lowest MIC isn't automatically the best choice.

How are MICs Determined?

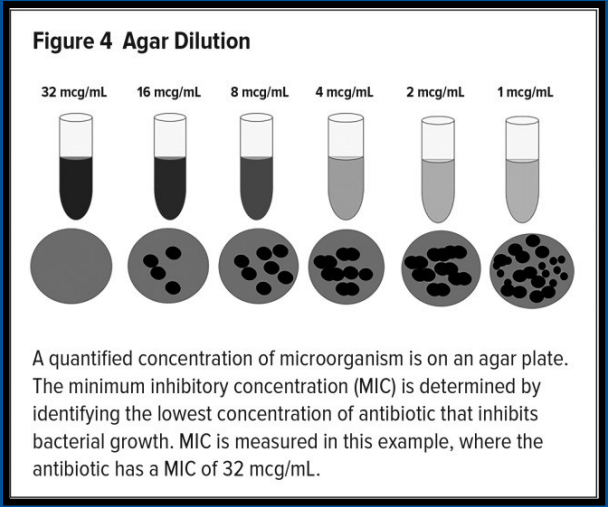

Figure 1: Example of MIC obtained by Agar Dilution. Figure from Giuliano C, et al. A Guide to Bacterial Culture Identification and Results Interpretation. *P T* 2019;44(4):192-200.

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Most of the MIC results we see in Epic come from automated testing methods

Some bug/drug combinations require manual MIC testing methods:

Kirby Bauer	**E-Test**
18-24H incubation	24H incubation
No Numerical MIC	**MIC provided**
Interpretation provided	Interpretation provided

Note: MIC variability can occur between susceptibility techniques

Breakpoints: Translating MICs to Clinical Decisions

Breakpoints Set By

- Clinical and Laboratory Standards Institute (CLSI)
- Food and Drug Administration (FDA)

Breakpoint Considerations

- Microbiologic data
- Pharmacokinetics (PK)/ Pharmacodynamics (PD)
- Clinical studies and outcomes

Breakpoints evolve as new data emerge

CLSI M100

Note: there is frequently a lag time between CLSI breakpoint updates and implementation by the Duke Microbiology Lab given the need for validation on their internal antimicrobial susceptibility testing devices

Interpreting MIC Breakpoints

BREAKPOINT		WHAT IT MEANS FOR THERAPY	ACTION
Susceptible (S)	☑	Standard dosing highly likely to succeed.	Proceed with standard therapy.
Susceptible Dose Dependent (SDD)	☑	Higher or more frequent dosing needed for success.	Increase dose or dosing frequency.
Intermediate (I)	⚠	MIC ≥ the level of antibiotic than can ordinarily be achieved; clinical response is less likely	Use only if drug concentrates highly in body fluid (e.g., urine).
Resistant (R)	✕	High likelihood of failure, even with increased drug exposure.	Select an alternative agent.

Avoiding Missteps in MIC-Based Decision Making

Myth

Lower MIC always means better antibiotic choice

NO!!!

Reality

MIC values are **bug-drug specific** and cannot be directly compared across antibiotics

Considerations Beyond MIC

- Site of Infection
- Drug Pharmacodynamics
- Host factors (e.g., renal function, immunocompetence)

Understanding MIC Creep

What's MIC Creep

- **Gradual increase** in the MIC of an antibiotic over time, often **within the "susceptible" range,** due to prolonged or repeated antibiotic exposure
- **Example**: *S. aureus* isolates with vancomycin **MIC increasing from ≤1 to 2 µg/mL**.

Clinical Implications

- **Higher MICs (e.g., 2 µg/mL) have been associated with poorer outcomes**, regardless of antibiotic choice.
- MIC alone **does NOT** determine treatment failure—**clinical response is key.**

Staphylococcus aureus	
Key Concept	**Recommendation**
✓ **If MIC ≤2 and the patient is improving**	Continue vancomycin (still first-line).
⚠ **If MIC is elevated and the patient is not improving**	Consider alternatives & consult ID

MIC Quick Reference Cheat Sheet

Key Concept	Quick Explanation
MIC ≠ Automatic Efficacy ⃠	MICs should be interpreted based on the breakpoint for that bug-drug combination. They cannot be compared across antibiotics and **lower isn't always better.**

Breakpoint	What to Do
Susceptible (S) ✓	Standard dosing works — proceed with usual therapy.
Susceptible Dose Dependent (SDD) ☑	Increase dose or frequency to achieve success.
Intermediate (I) ⚠	Avoid the drug — Use only if drug concentrates at the site (e.g., urine).
Resistant (R) ✕	Avoid the drug — choose an alternative agent.

Essential Tools for Decision-Making	Why They Matter
CLSI M100 Guidelines	Provides the most up-to-date MIC breakpoints.
Institutional Antibiogram	Shows local resistance patterns to guide empiric therapy.
Ask ASET **or** ID Consult	Crucial for complex infections or unexpected MIC results.