KY Antimicrobial Stewardship Innovation Consortium

Educational Pearl

What is a Minimum Inhibitory Concentration?

The minimum inhibitory concentration (MIC) is defined as the lowest concentration of an antimicrobial that prevents visible growth of a microorganism. The MIC is reported as a numerical value usually expressed in µg/mL. MIC values are interpreted with breakpoints to provide interpretive categories, most commonly "Susceptible", "Intermediate", or "Resistant". Breakpoints are MIC values that define which interpretive category a specific drug-bug combination falls. In the US, breakpoints are determined by regulatory bodies such as the Food and Drug Administration or the Clinical and Laboratory Standards Institute, and are based on data from microbiologic, pharmacokinetic, pharmacodynamic, and clinical studies. See the KASIC educational pearl on MIC from Lab to Chart for a visual of how MIC values are determined, interpreted with breakpoints, and reported.

Interpretive Categories for MICs	
Susceptible	High likelihood of treatment success. Standard doses of antibiotic are likely to be effective.
Intermediate	Moderate likelihood of treatment success. Likelihood of success can be increased if drug dose is increased and/or infection is at a site where the drug concentrates.
Resistant	Low likelihood of treatment success. Safe doses of antimicrobial are unlikely be effective.

Do we need to know the exact MIC?

In the example susceptibility report below, the nitrofurantoin MIC is reported as ≤ 32 µg/mL. The exact MIC is not known. The actual nitrofurantoin MIC could be 0.0125 µg/mL, 1 µg/mL, or 16 µg/mL, but all we know is that it is less than or equal to 32 µg/mL. The reason we do not know the exact MIC is due to a limited number of antibiotic wells on automated susceptibility testing platform panels. Because there is finite space on these panels, only clinically relevant concentrations (e.g. breakpoints) are included. Exact MICs may be determined with further testing (e.g. E-test), but are not usually clinically relevant.

The lower the MIC number, the better?

No! Pharmacokinetic and pharmacodynamics profiles differ between different drug-bug combinations. After susceptibility is demonstrated, drug choice should depend on site of infection, patient characteristics, and drug properties rather than comparison of reported MIC values. In the below example the ampicillin-sulbactam (8/4) has a higher MIC than cefazolin (≤ 2), however they are both still within the susceptible range and therefore are both options.

Urine culture: *E. coli*		
Drug	**MIC (µg/mL)**	**Interpretation**
Amoxicillin/clavulanate	≤ 8/4	Susceptible
Ampicillin	> 16	Resistant
Ampicillin/sulbactam	8/4	Susceptible
Cefazolin	≤ 2	Susceptible
Ciprofloxacin	≤ 1	Susceptible
Gentamicin	4	Susceptible
Nitrofurantoin	≤ 32	Susceptible
Trimethoprim/sulfamethoxazole	≤ 2/38	Susceptible

Key Takeaway: Exact MICs are often not known. Do NOT choose an antibiotic based on lowest MIC.

References:

1. Patel R. The clinician and the microbiology laboratory: test ordering, specimen collection, and result interpretation. In: Bennett JE, Dolin R, Blaser MJ, ed. Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases. 9th ed. Philadelphia, PA: Elsevier; 2020:194-210.
2. Clinical and Laboratory Standards Institute (CLSI). Accessed September 16, 2022. https://clsi.org.