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MIC Basics

What is an MIC?

- Minimum inhibitory concentrations (MICs) are defined as the lowest concentration of an antimicrobial that will inhibit the visible growth of a microorganism after overnight incubation (Andrews JM. J Antimicrob Chemother 2001;48(suppl 1):5-16.)
- Each year, the Clinical and Laboratory Standards Institute (CLSI) publishes new antimicrobial susceptibility testing standards

Laboratory Reporting

- "R" is resistant, "I" is intermediate, "S" is susceptible. Some labs will additionally report the actual MIC.
- The farther the MIC is BELOW the breakpoint, the better the ODDS of efficacy become (Lower MIC ≠ Increased Efficacy (ie, don't just pick the drug with the lowest MIC from the list)
- The MIC does not reflect pharmacodynamics or patient-specific factors such as renal function, site of infection, volume of distribution, etc.

Antimicrobial Dosing

- If an MIC is reported as "I" (intermediate resistance), the following antibiotics may still be ok:
  - UTI - anything that concentrates well in the urine: beta-lactams, FQs, AMGs (normal doses)
  - Other sites of infection: beta-lactams @ increased frequency or extended/continuous infusion, concentration dept drugs (AMGs, dapto, FQs) - higher doses (e.g. dapto 10-12 mg/kg, AMGs target higher peaks)
- The actual bug doesn't matter so much as what the MIC is and what concentrations of drug are actually achievable (safely) in humans.

Two Examples

- Vancomycin and *S. aureus* (http://www.aliem.com/2013/diminishing-returns-vancomycin-and-mic/)
  - MIC cutoff for *S. aureus* was decreased to ≤ 2 mcg/mL in 2007
  - Over time it seems the MIC needed for vancomycin to eradicate MRSA is increasing, as evidenced by increasing vancomycin MIC distribution in *S. aureus* isolates. (Steinkraus G, et al. J Antimicrob Chemother 2007;60:788-94.)
  - Patients are dying from bacteremias even with MICs ≤ 2 mcg/mL **that appear as 'susceptible' on institutional reporting tools**. This is scary! Soriano A, et al. Clin Infect Dis 2008;46:193-200.) (Lodise TP, et al. Antimicrob Agents Chemother 2008;52:3315-20.) (van Hal SJ, et al. Clin Infect Dis 2012;54:755-71.)
  - What It All Means
    - Although in the ED we often don't have access to the patient's susceptibility data, make sure to look at previous records from your institution or the transferring institution. **Just because the culture report says 'S' (for susceptible), the MIC may be between 1.5 and 2 mcg/mL.**
    - For bacteremia/endocarditis: if the *S. aureus* MIC ≥ 1.5 mcg/mL, don't use vancomycin!
    - For all other MRSA infections: if the *S. aureus* MIC ≥ 2 mcg/mL, don't use vancomycin!
- IV Ceftriaxone for Gonorrhea (http://www.aliem.com/2012/trick-of-trade-iv-ceftriaxone-for/)
  - There is no depot effect with ceftriaxone for presumed gonococcal infection. IV and IM ceftriaxone have similar pharmacokinetic profiles, from the FDA-approved package insert.

Table 2: Time after dose administration (hrs) and Average urine concentration (mcg/mL)

Dose/route	0-2 hrs	2-4 hrs	4-8 hrs	8-12 hrs	12-24 hrs	24-48 hrs
0.5 g IV	526	366	142	87	70	15
0.5 g IM	115	425	308	127	96	28

- According to a 2012 CDC Report the MIC for *N. gonorrhoeae* strains to ceftriaxone is 0.125 mcg/mL. IV therapy provides concentrations above this resistance cutoff well after 24-48 hours, similar to IM therapy.