ANTIMICROBIAL USAGE IN ICU

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OBJECTIVES

Why give antimicrobials in ICU?

How to choose the proper antimicrobial?

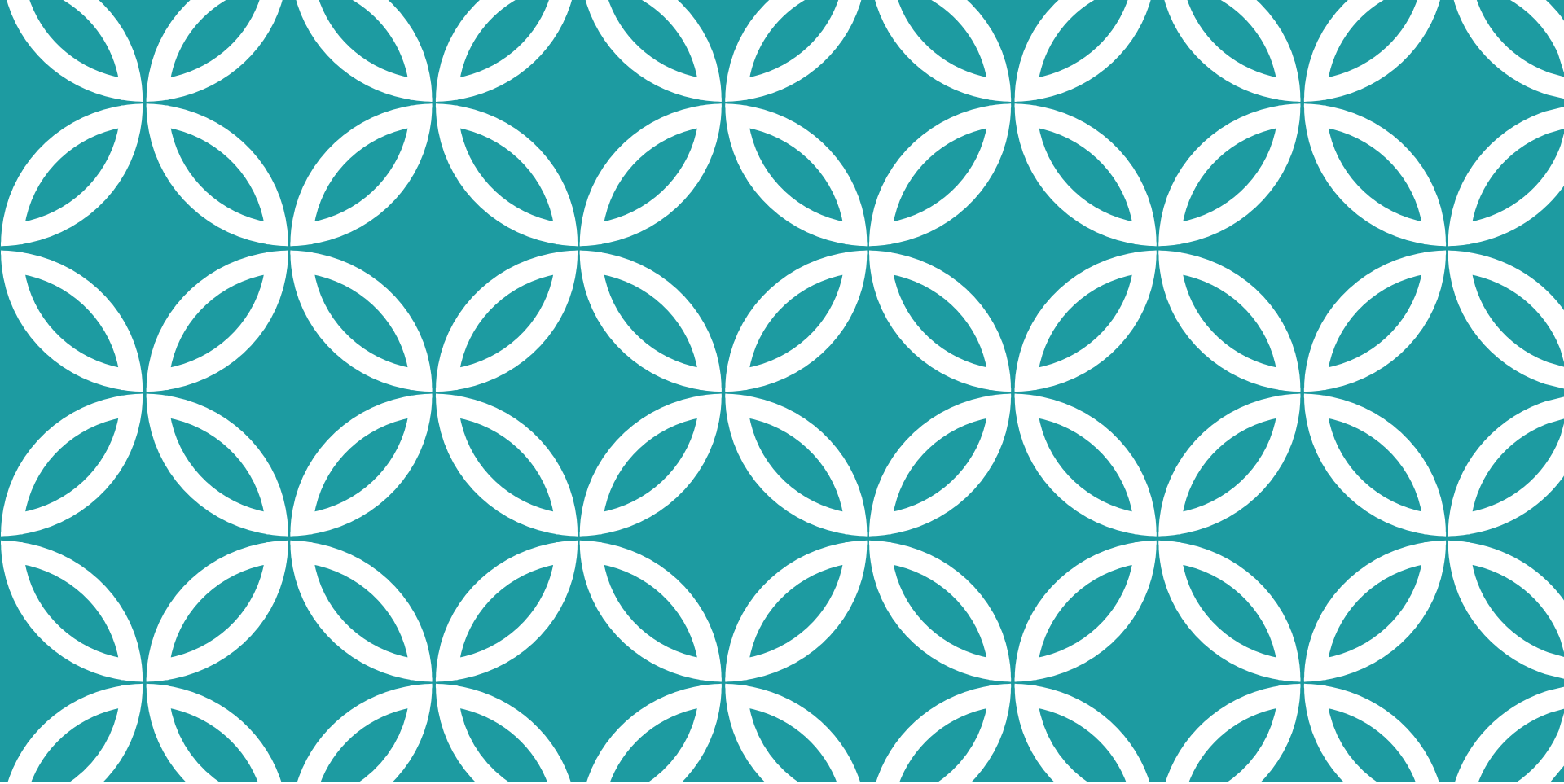
- Classification.
- Gram staining.
- Parameters.

Duration of therapy.

Combating resistance factors.

INDICATIONS FOR ANTIMICROBIALS

- Prophylactic.
- Empiric.
- Therapeutic.



PROPHYLAXIS

SURGICAL PROPHYLAXIS

- Prevent postoperative infection of the surgical site.
- Prevent postoperative infectious morbidity and mortality.
- Reduce the duration and cost of health care Produce no adverse effects.
- Have no adverse consequences for the microbial flora of the patient or the hospital.

SURGICAL PROPHYLAXIS

- Timing.
- Dose and redose.
- Choice:
  - Penetration of site.
  - Hospital microbiology.
  - Patient factors.

FACTORS AFFECTING THE INCIDENCE OF WOUND INFECTION

- Extremes of age.
- Under nutrition.
- Obesity.
- Diabetes.
- Hypoxemia.
- Remote infection.
- Corticosteroid or immunosuppressive therapy.
- Recent operation.

FACTORS AFFECTING THE INCIDENCE OF WOUND INFECTION

- Surgeon's experience.
- Length of the procedure.
- Hospital and operating-room environments.

FACTORS AFFECTING THE INCIDENCE OF WOUND INFECTION

- Instrument sterilization.
- Air filters.
- Hospital flora.

TIMING

By consensus, the ideal time of administration is within 30 minutes to one hour before the incision.

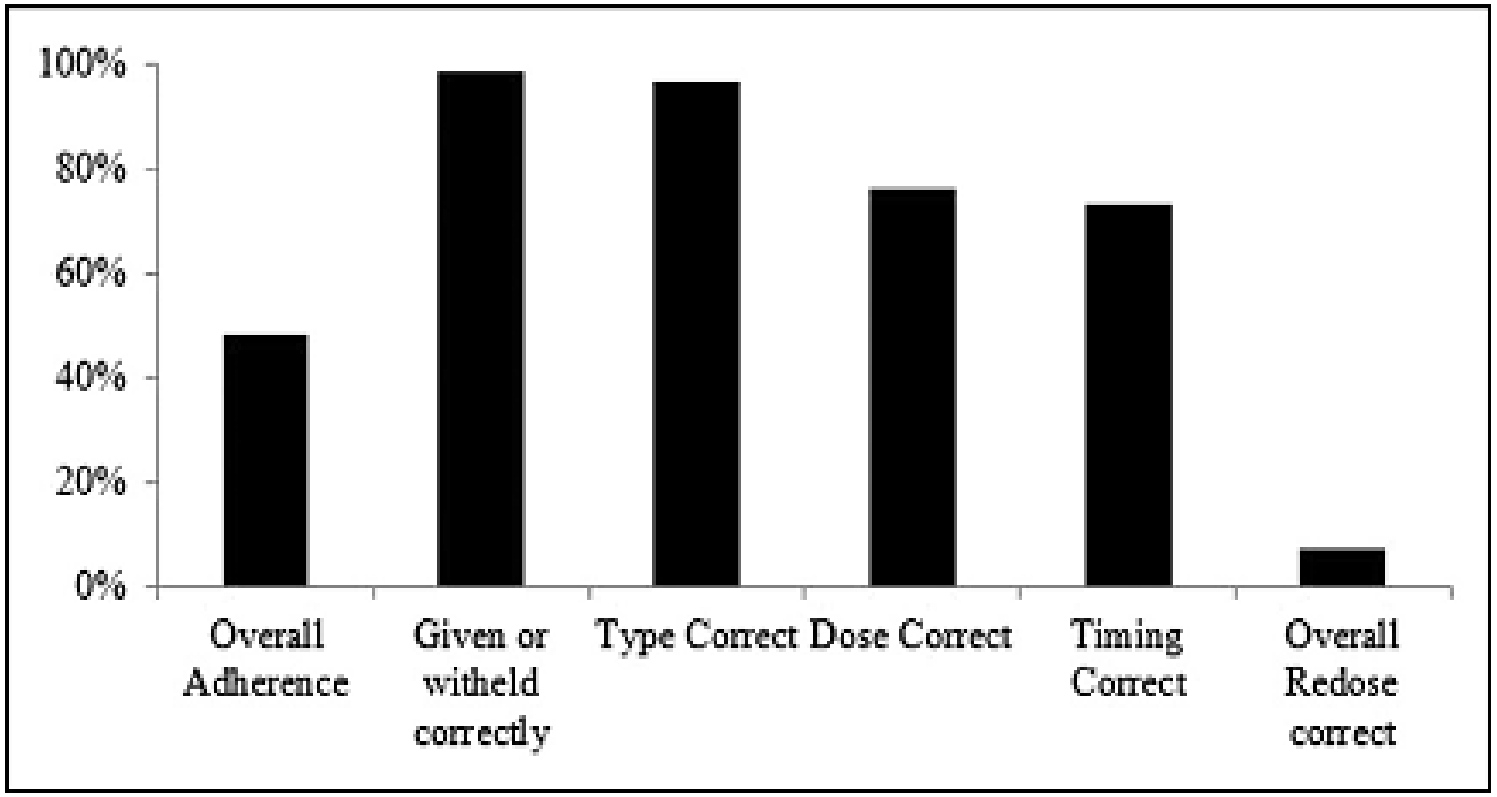
The exceptions are:

- Cesarean section, in which the antimicrobial should be administered after cross-clamping of the umbilical cord and
- Colonic procedures, in which oral antimicrobials should be administered starting 19 hours before the scheduled time of surgery.

DURATION

For most procedures, the duration of antimicrobial prophylaxis should be 24 hours or less, with the exception of cardiothoracic procedures (48 to 72 hours' duration).

SURGICAL PROPHYLAXIS



(THE AMERICAN JOURNAL OF SURGERY (2013) 206, 451-456)

CARDIOTHORACIC SURGERY

MEDIASTINITIS

The frequency of this infection with or without associated sternal dehiscence is 0.7% to 1.5%; however, the associated mortality rate is 13% to 33%.

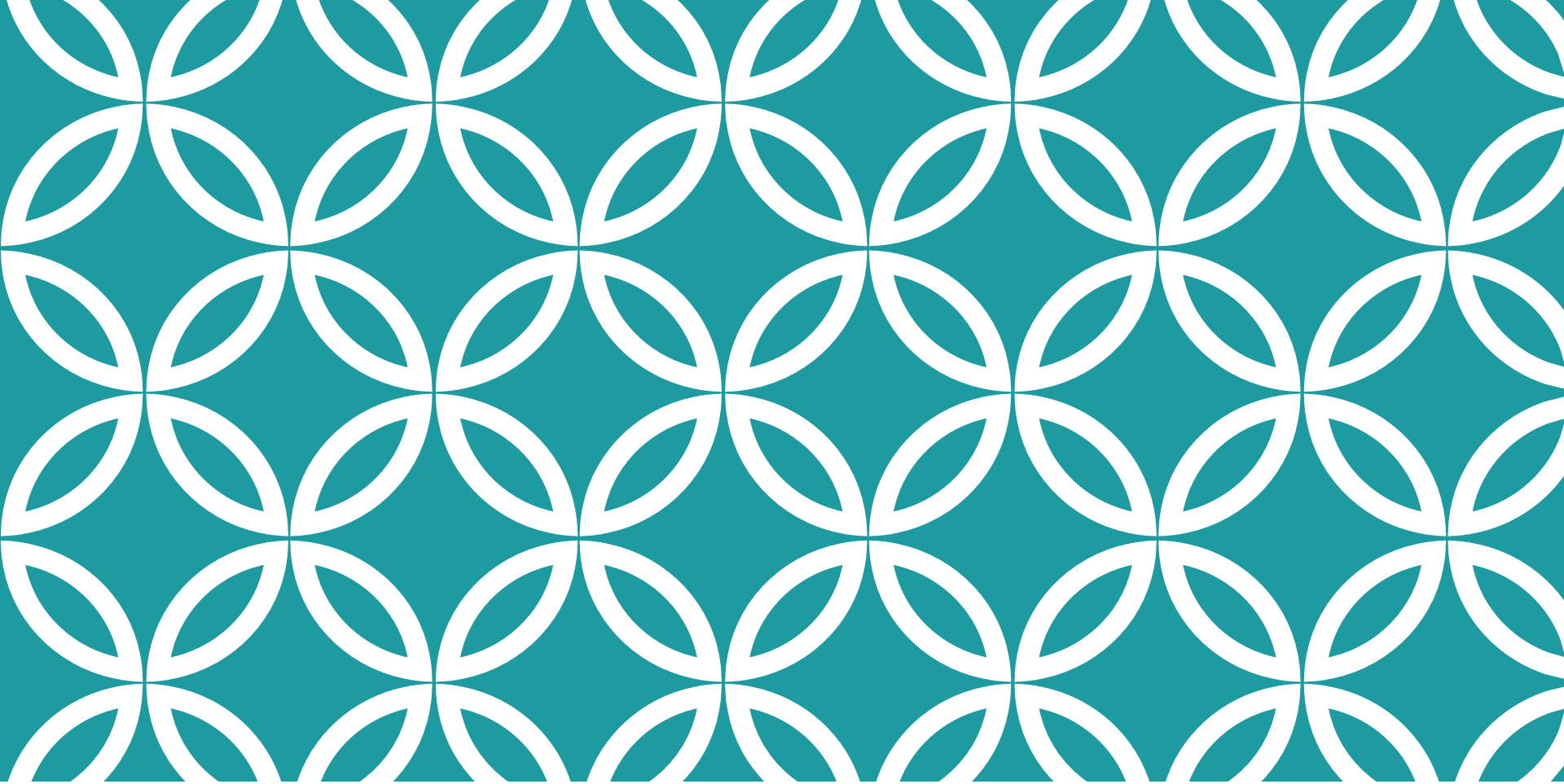
RISK FACTORS

- Chronic obstructive pulmonary disease.
- Prolonged stay in the intensive care unit.
- Respiratory failure.
- Male sex.
- Advanced age.
- Lengthy surgery.
- Diabetes mellitus.

ORGANISM AND ANTIMICROBIAL

- Endocardium: Staphylococcus aureus.
- Sternal wound and SVG wound: G-ve bacilli.
- Cephalosporins, as single agents, are at least as effective as combination regimens of antistaphylococcal penicillins and aminoglycosides and are much easier to administer.
- Cefazolin has been the traditional cephalosporin of choice.

OTHER PROPHYLACTIC INDICATIONS



EMPIRIC THERAPY

INTERPRETATION OF GRAM STAIN RESULTS

Gram-Positive Cocci (GPC)

- **Pairs, chains, clusters:** *Staphylococcus sp.*
- **Pairs, chains:**
  Streptococcus sp.
  Enterococcus sp.
- **Pairs, lancet-shaped:**
  Streptococcus pneumoniae

GRAM NEGATIVE COCCI (GNC)

Diplococci

- *Pairs:*
  Neisseria meningitidis
  Neisseria gonorrhoeae
  Moraxella catarrhalis

Other:

Acinetobacter sp

GRAM-POSITIVE BACILLI (GPB)

Diphtheroids:

- *Small, pleomorphic:*
  Corynebacterium
  Propionibacterium

Large, with spores:

- *Clostridium sp*
- *Bacillus sp*

Branching, beaded, rods:

- ***Nocardia sp***
- ***Actinomyces sp***

Other:

- ***Listeria sp (blood/cerebrospinal fluid)***
- ***Lactobacillus sp (vaginal/blood)***

GRAM NEGATIVE BACILLI (GNB)

Enterobacteriaceae:

- *Escherichia coli*
- *Serratia sp*
- *Klebsiella sp*
- *Enterobacter sp*

Nonfermentative:

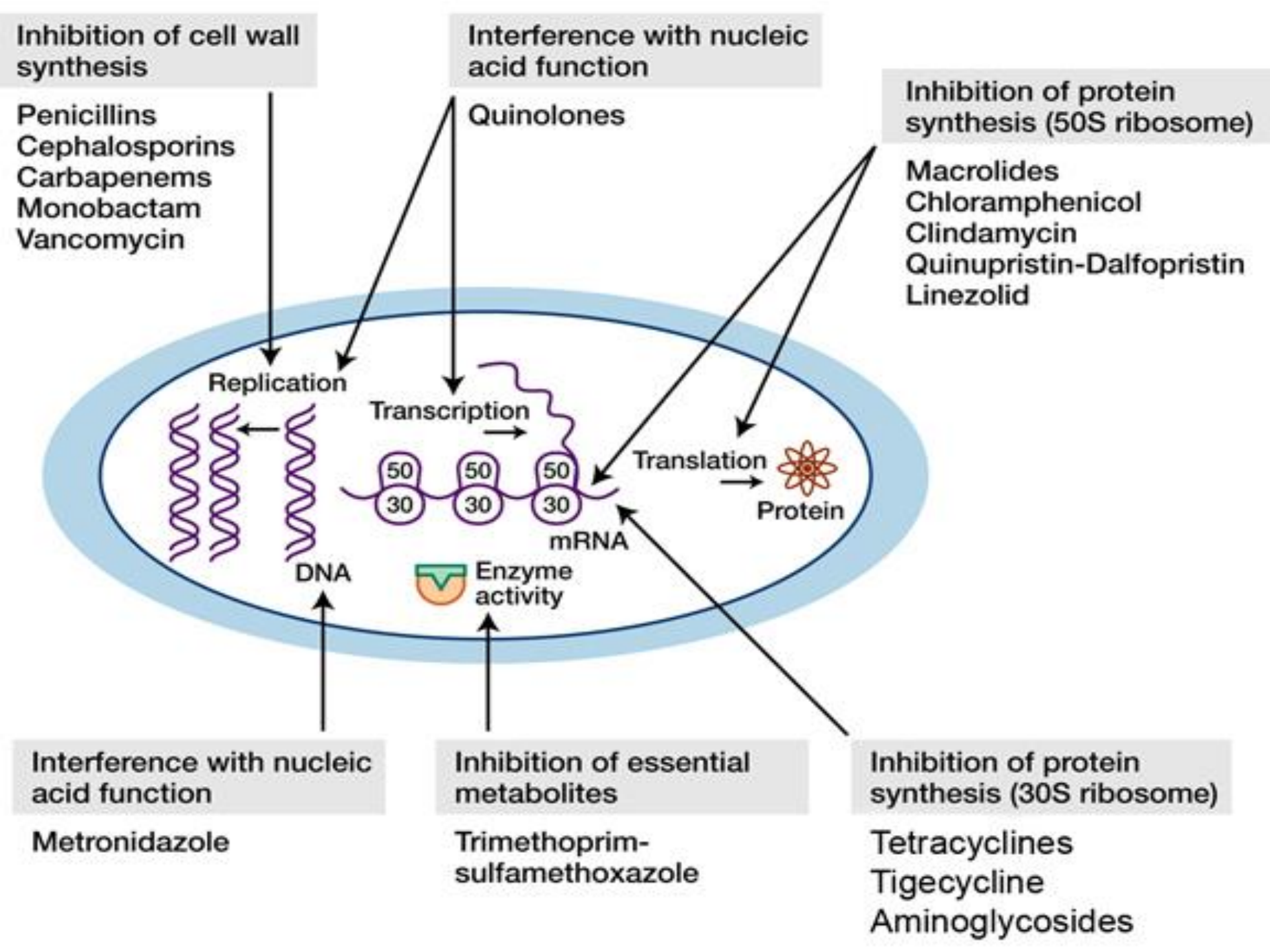
- *Pseudomonas aeruginosa*
- *Stenotrophomonas maltophilia*
- *Haemophilus influenzae*

BLOOD CULTURE BULLETS FOR ADULTS

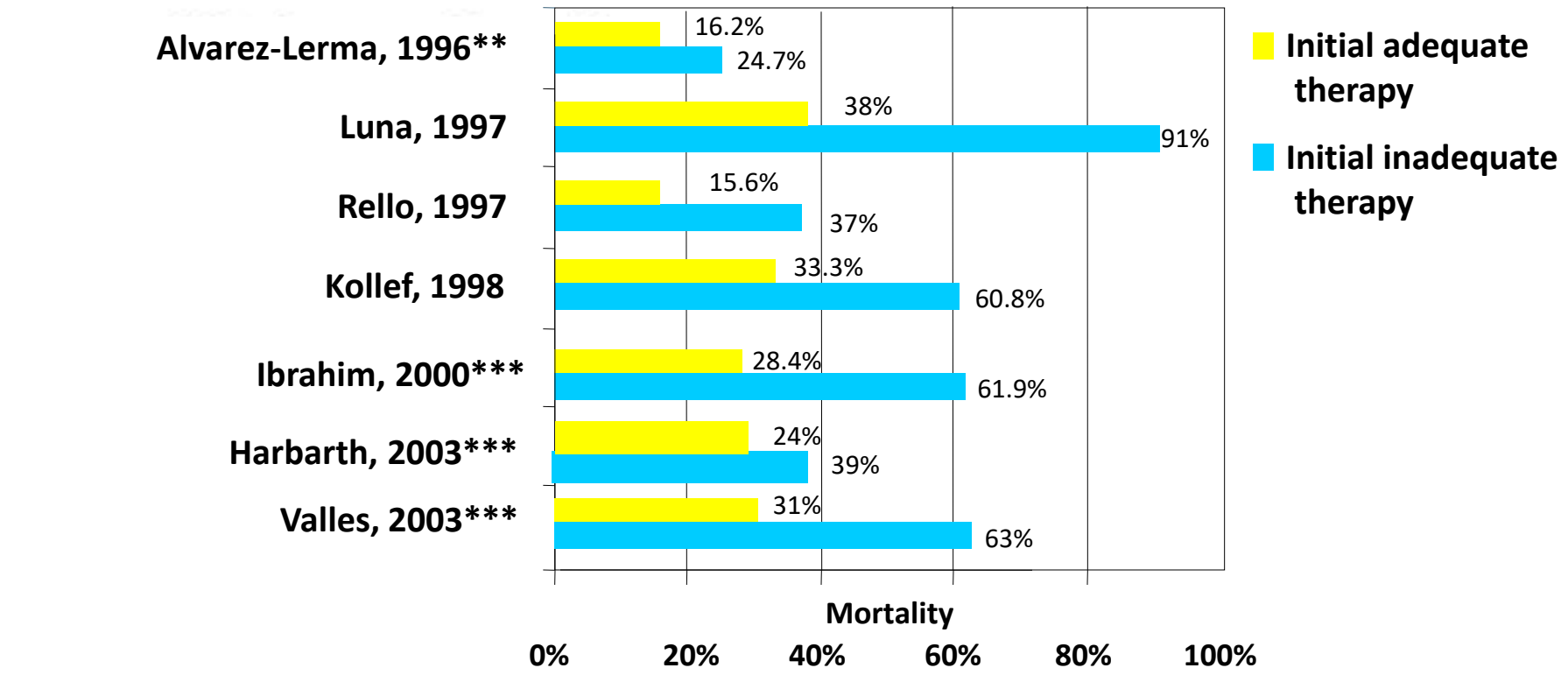
Blood cultures are most likely to be positive when an ample volume of blood is collected and if the patient is not already on antimicrobials.

Two sets of cultures (total volume each set 20 mL) should be drawn 1 hour apart, preferably from a peripheral site rather than through a central vascular catheter.

Ten mL each is inoculated into aerobic and anerobic bottles. Cultures are held at least 4 days before reported as negative.


Inhibition of cell wall synthesis
Penicillins
Cephalosporins
Carbapenems
Monobactam
Vancomycin
Interference with nucleic acid function
Quinolones
Inhibition of protein synthesis (50S ribosome)
Macrolides
Chloramphenicol
Clindamycin
Quinupristin-Dalfopristin
Linezolid
Replication
Transcription
Translation
Protein
50
30
mRNA
DNA
Enzyme activity
Interference with nucleic acid function
Metronidazole
Inhibition of essential metabolites
Trimethoprim-sulfamethoxazole
Inhibition of protein synthesis (30S ribosome)
Tetracyclines
Tigecycline
Aminoglycosides

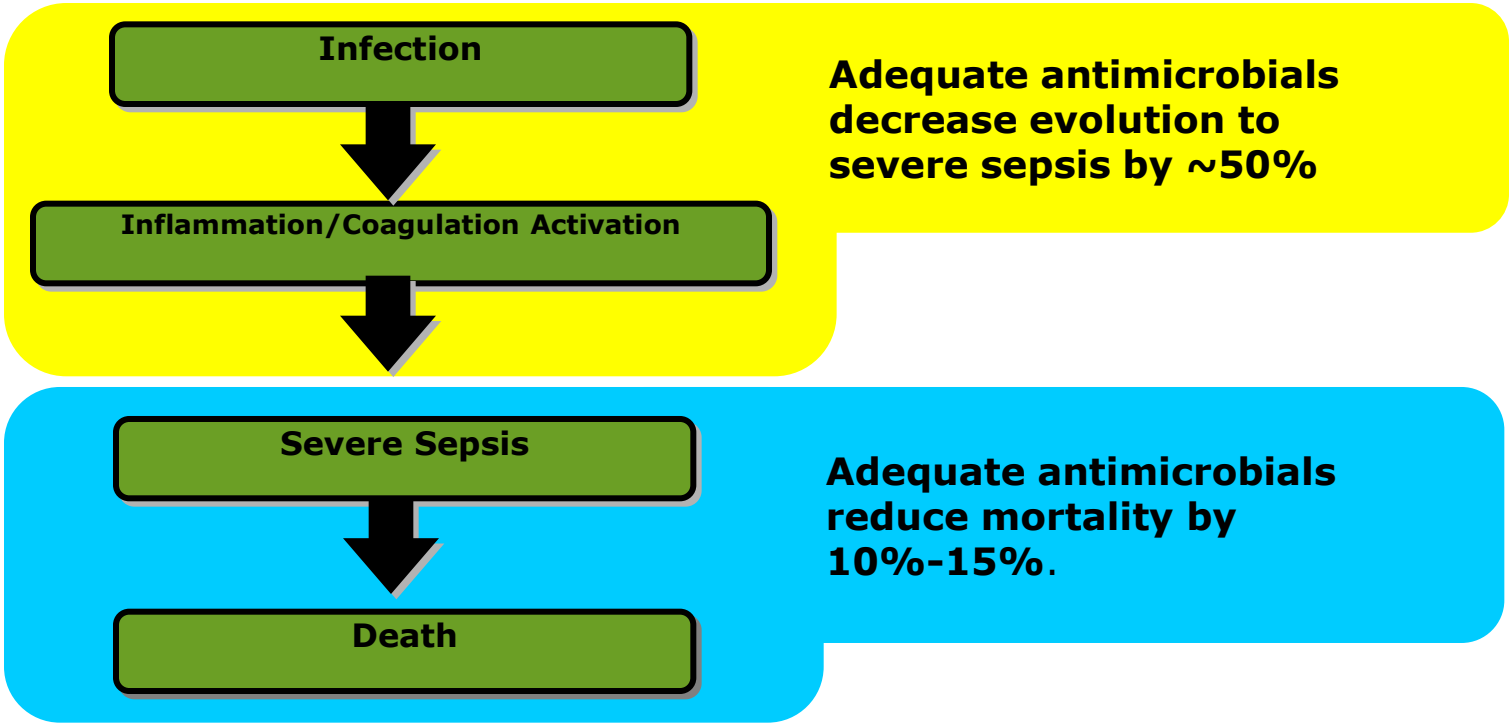
MORTALITY* ASSOCIATED WITH INITIAL INADEQUATE THERAPY IN CRITICALLY ILL ICU PATIENTS WITH HAP OR SEPSIS



*Mortality refers to crude or infection-related mortality. **Includes patients with HAP.
***Patients had blood stream infections rather than pneumonia as in the other studies.

Alvarez-Lerma F et al. Intensive Care Med 1996;22:387-394.
Luna CM et al. Chest 1997;111:676-685.
Rello J et al. Am J Respir Crit Care Med 1997;156:196-200.
Kollef MH et al. Chest 1998;113:412-420.
Ibrahim EH at al. Chest 2000;118:146-155.
Harbarth S et al. Am J Med 2003;115:529-535.
Valles J et al. Chest 2003;123:1615-1624.

ANTIMICROBIALS AND SEPSIS



Kreger BE et al. Am J Med 1980;68:332-43.
Meehan TP et al. JAMA 1997;278:2080-4.
Opal SM et al. Crit Care Med 1997;25:1115-24.
Pittet D et al. Am J Respir Crit Care Med 1996;153:684-93.
Simon D et al. Crit Care Clin 2000;16:215-31.

De-Escalation Therapy

Choose Adequate broad-spectrum, empiric treatment regimen based on clinical symptoms and unit-specific antibiogram data and guidelines.

↓

Obtain and analyze microbiological data

↓

Modify regimen accordingly

↓

Reassess patient

Clinical Infectious Diseases 2006; 42:S72–81

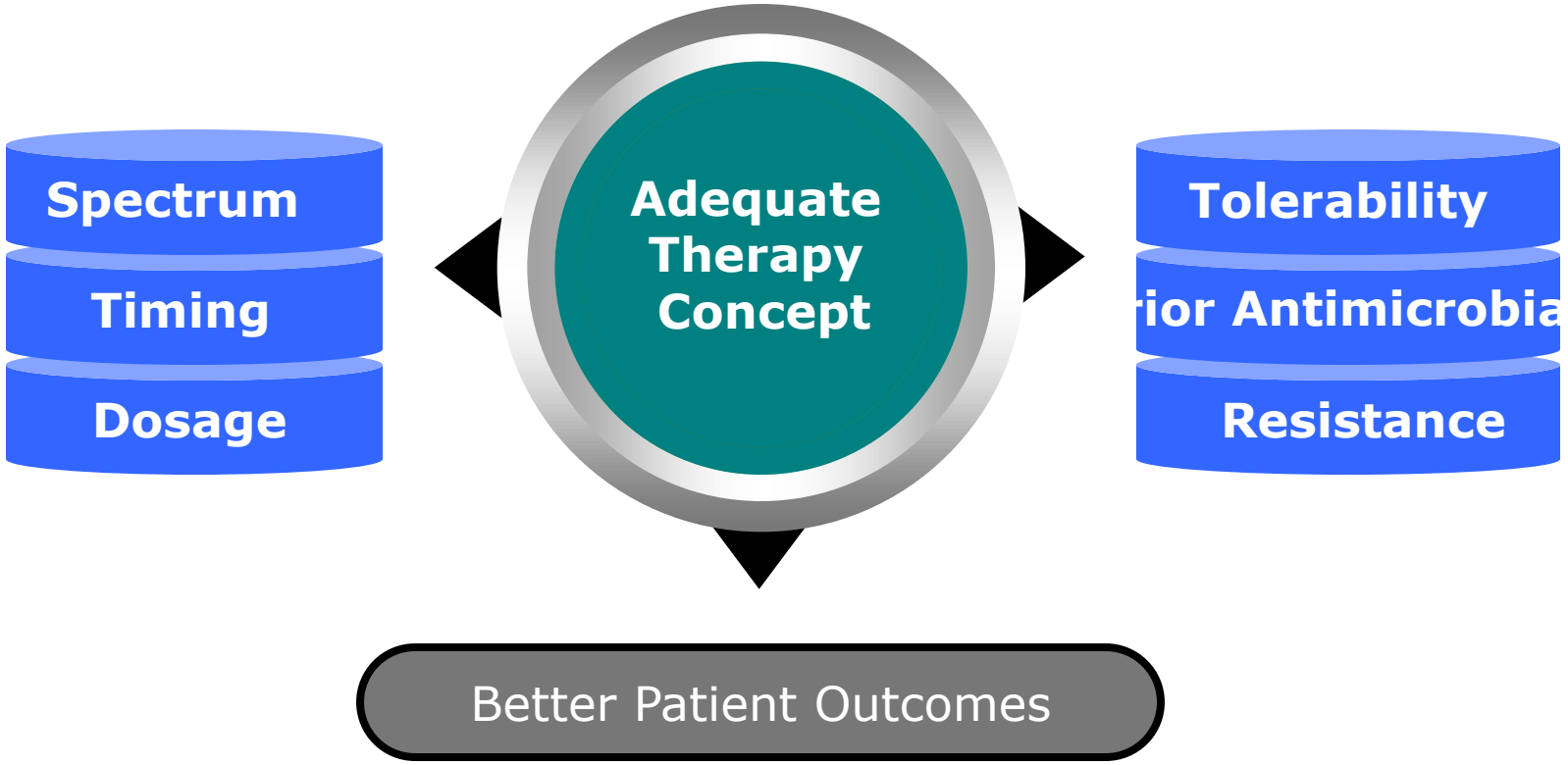
Adapted from Kollef MH,12 Kollef MH,13 Kollef MH et al,8 Niederman MS.14

Patients Who May Benefit from Empirical Broad-Spectrum Antimicrobial Therapy

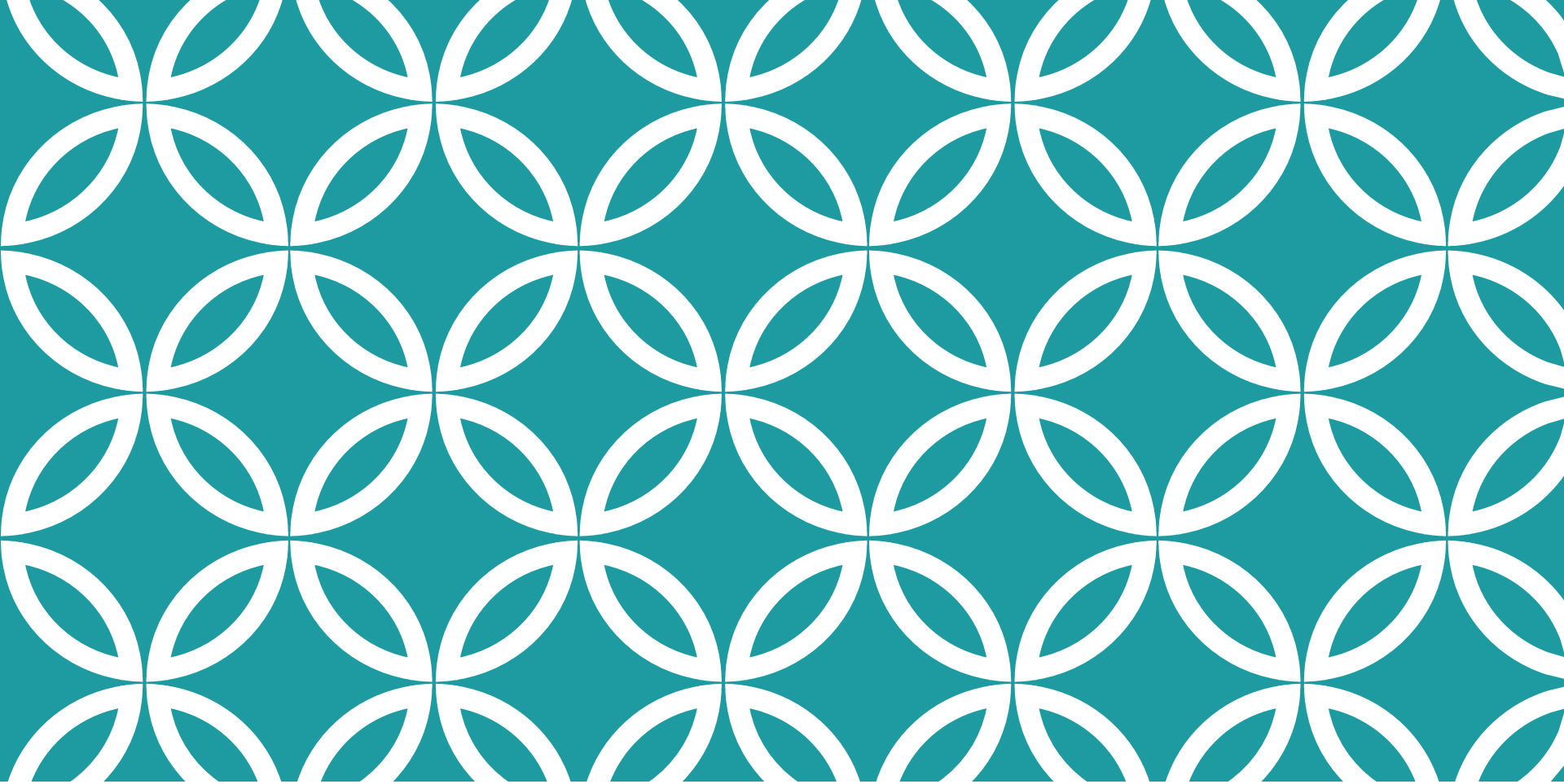
Critically ill non-neutropenic patients with serious infections, for example, patients with:

- HAP
- VAP
- Bacteremia
- Severe sepsis (including bacterial and fungal pathogens)
- Severe community-acquired pneumonia
- Burns

MAIN FACTORS DEFINING ADEQUATE THERAPY

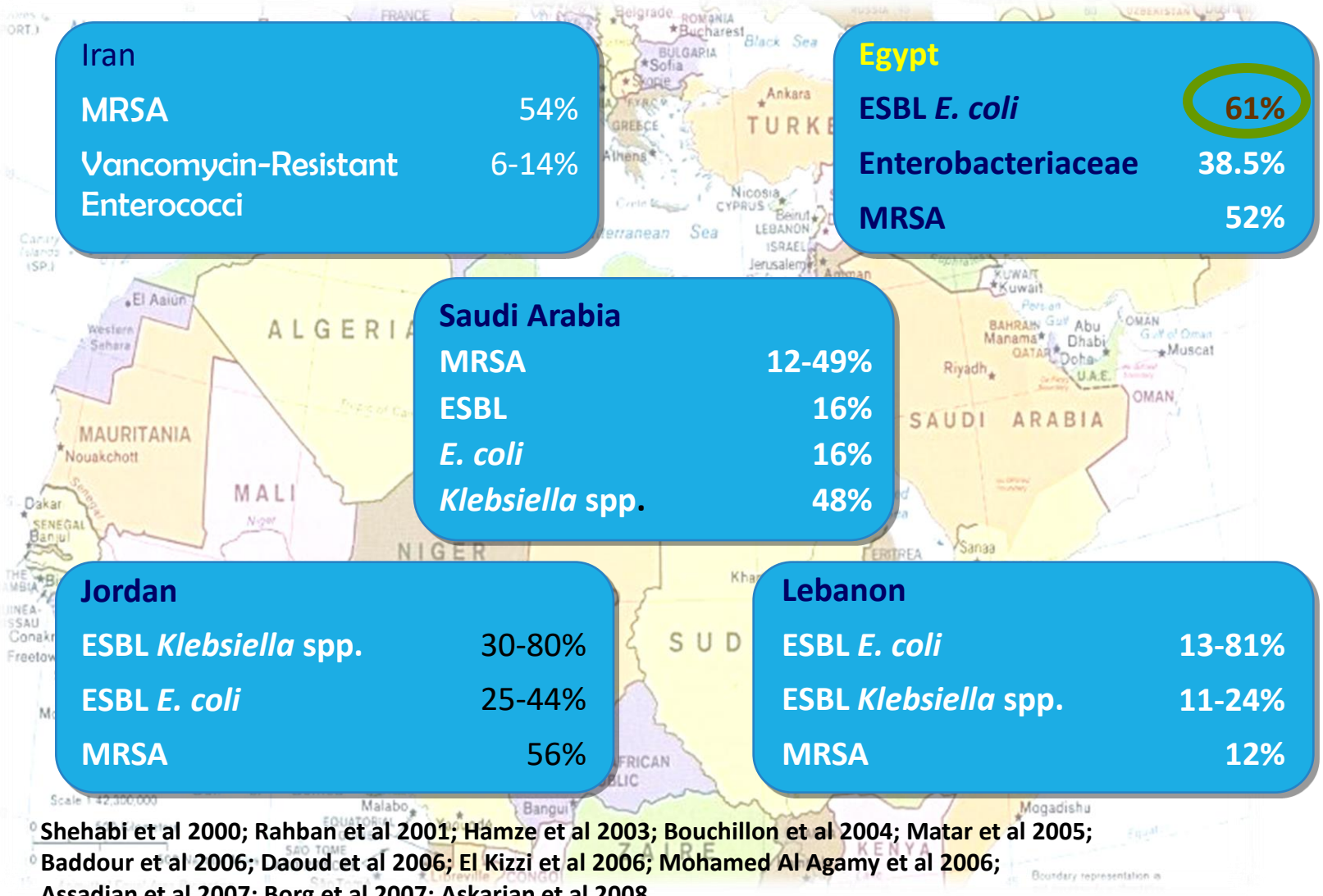


1. *Kollef MH. Clin Infect Dis 2000;31(Suppl 4):S131-S138.*
2. *Kollef MH et al. Chest 1999;115:462-474.*



RESISTANCE PROBLEM

ESBLS



Iran

MRSA	54%
Vancomycin-Resistant Enterococci	6-14%

Egypt

ESBL *E. coli*	61%
Enterobacteriaceae	38.5%
MRSA	52%

Saudi Arabia

MRSA	12-49%
ESBL	16%
E. coli	16%
Klebsiella spp.	48%

Jordan

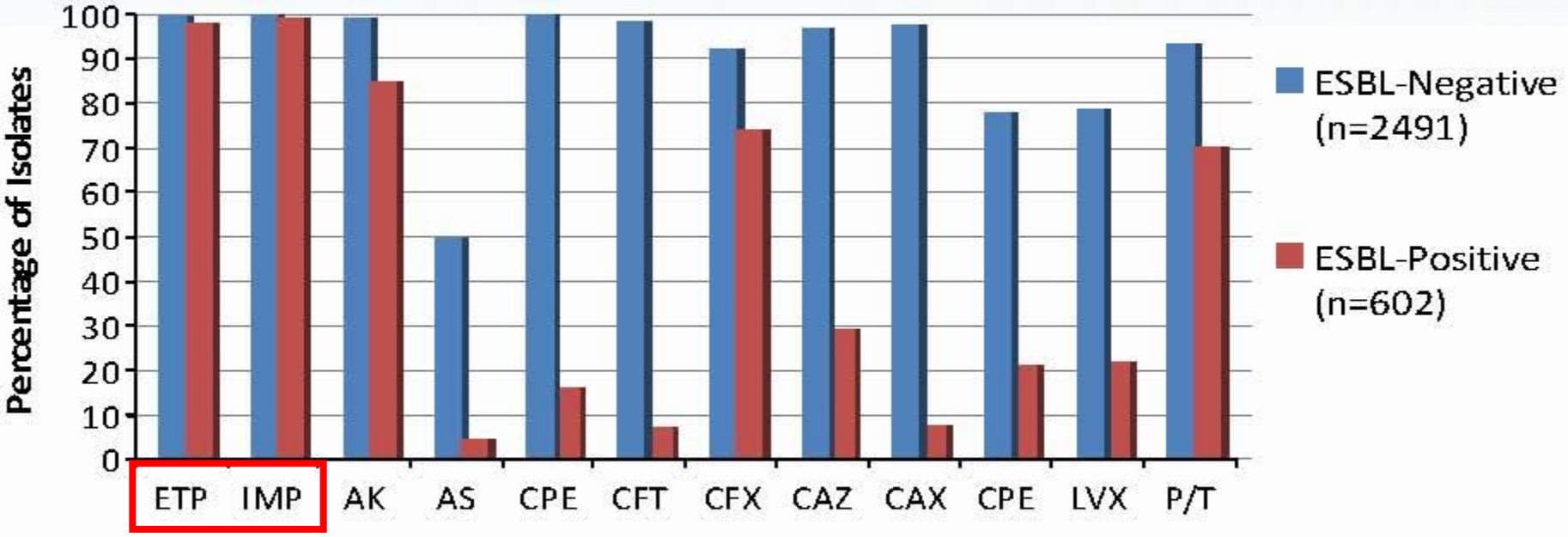
ESBL *Klebsiella* spp.	30-80%
ESBL *E. coli*	25-44%
MRSA	56%

Lebanon

ESBL *E. coli*	13-81%
ESBL *Klebsiella* spp.	11-24%
MRSA	12%

Shehabi et al 2000; Rahban et al 2001; Hamze et al 2003; Bouchillon et al 2004; Matar et al 2005; Baddour et al 2006; Daoud et al 2006; El Kizzi et al 2006; Mohamed Al Agamy et al 2006; Assadian et al 2007; Borg et al 2007; Askarian et al 2008

SMART Study: Worldwide Susceptibility of ESBL-Positive and ESBL-Negative *E coli* IAIs, 2008[1]



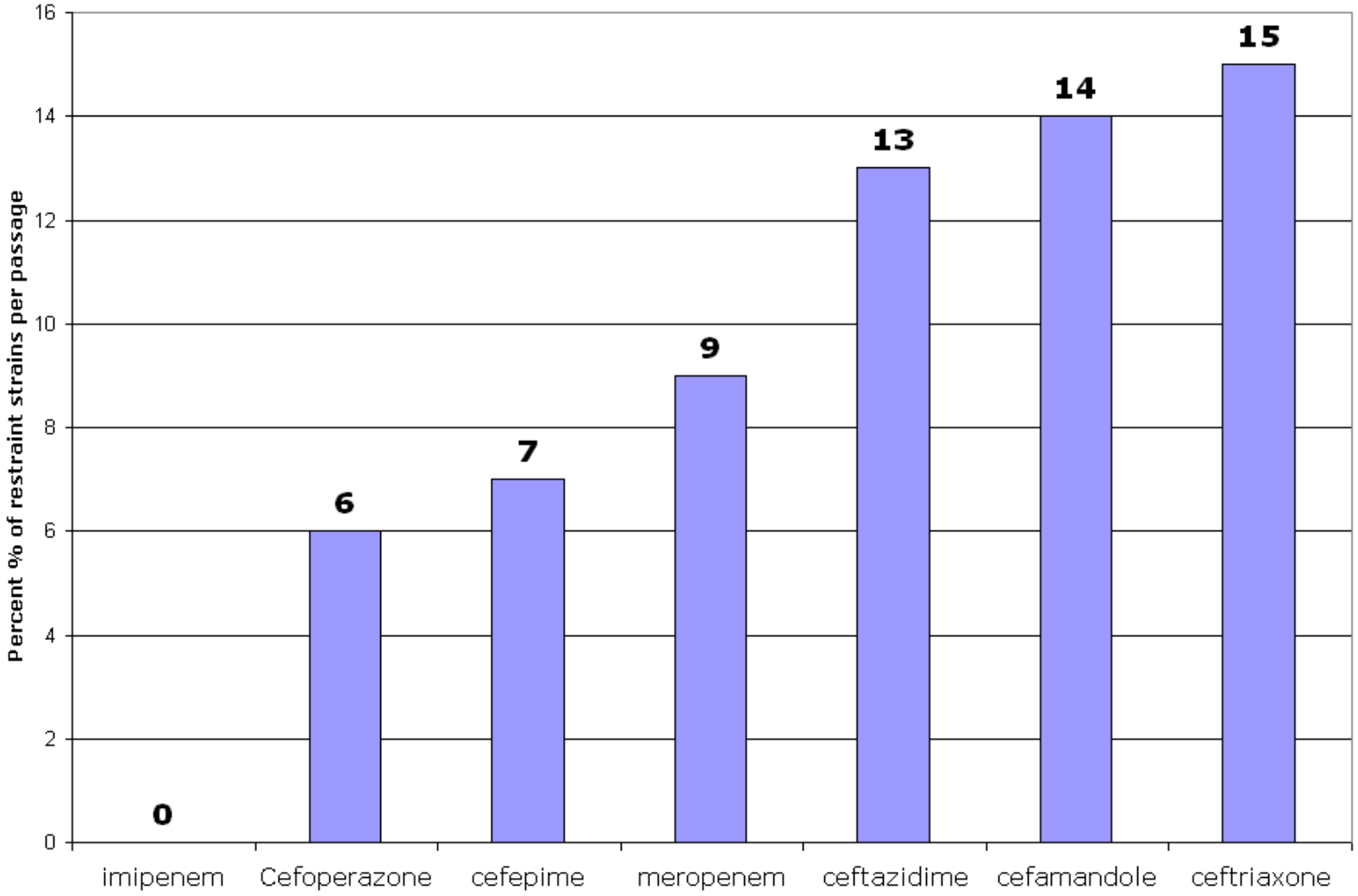
IAI=intra-abdominal infection.

ETP=ertapenem; IMP=imipenem; AK=amikacin; A/S=ampicillin/sulbactam; CPE=cefepime; CFT= cefotaxime; CFX=cefoxitin; CAZ=ceftazidime; CAX=ceftriaxone; CP=ciprofloxacin; LVX=levofloxacin; P/T=piperacillin/tazobactam.

1. Badal R, et al. Global susceptibility patterns of *E coli* from intra-abdominal infections to ertapenem and comparators—SMART 2008. Poster presented at: 49th Annual Interscience Conference on Antimicrobial Agents and Chemotherapy (ICAAC); 12–15 September 2009; San Francisco, CA.

SMART

SELECTION FOR RESISTANT STRAINS



METHODS FOR PREVENTION

- De- escalation.
- Antimicrobial rotation.
- Limiting Duration.
- Antimicrobial stewardship programs.

DURATION OF THERAPY

- Role of biomarkers.
- Source control.
- Infection control.

BASIS OF ANTIMICROBIAL SELECTION

- Comparative efficacy.
- Adverse effect profile.
- Individual patient drug allergy.
- Potential for resistance.
- Cost effectiveness.

CDC 2013

ANTIBIOTIC STEWARDSHIP

IN YOUR FACILITY WILL

DECREASE

- ANTIBIOTIC RESISTANCE
- C. DIFFICILE INFECTIONS
- COSTS

INCREASE

- GOOD PATIENT OUTCOMES

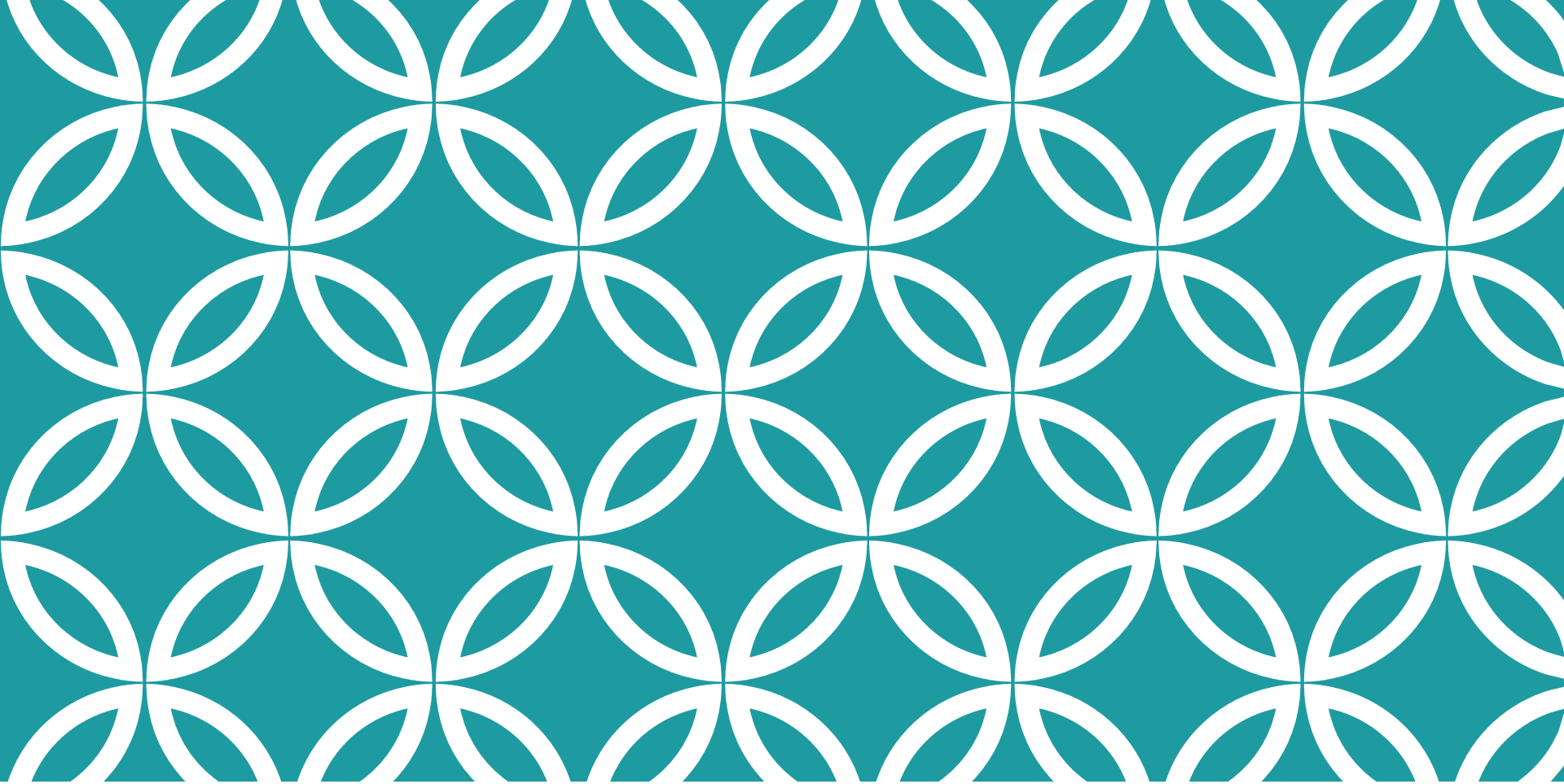
PROMOTE ANTIBIOTIC BEST PRACTICES— A FIRST STEP IN ANTIBIOTIC STEWARDSHIP

- ENSURE ALL ORDERS HAVE DOSE, DURATION, AND INDICATIONS
- GET CULTURES BEFORE STARTING ANTIBIOTICS
- TAKE AN "ANTIBIOTIC TIMEOUT" REASSESSING ANTIBIOTICS AFTER 48–72 HOURS

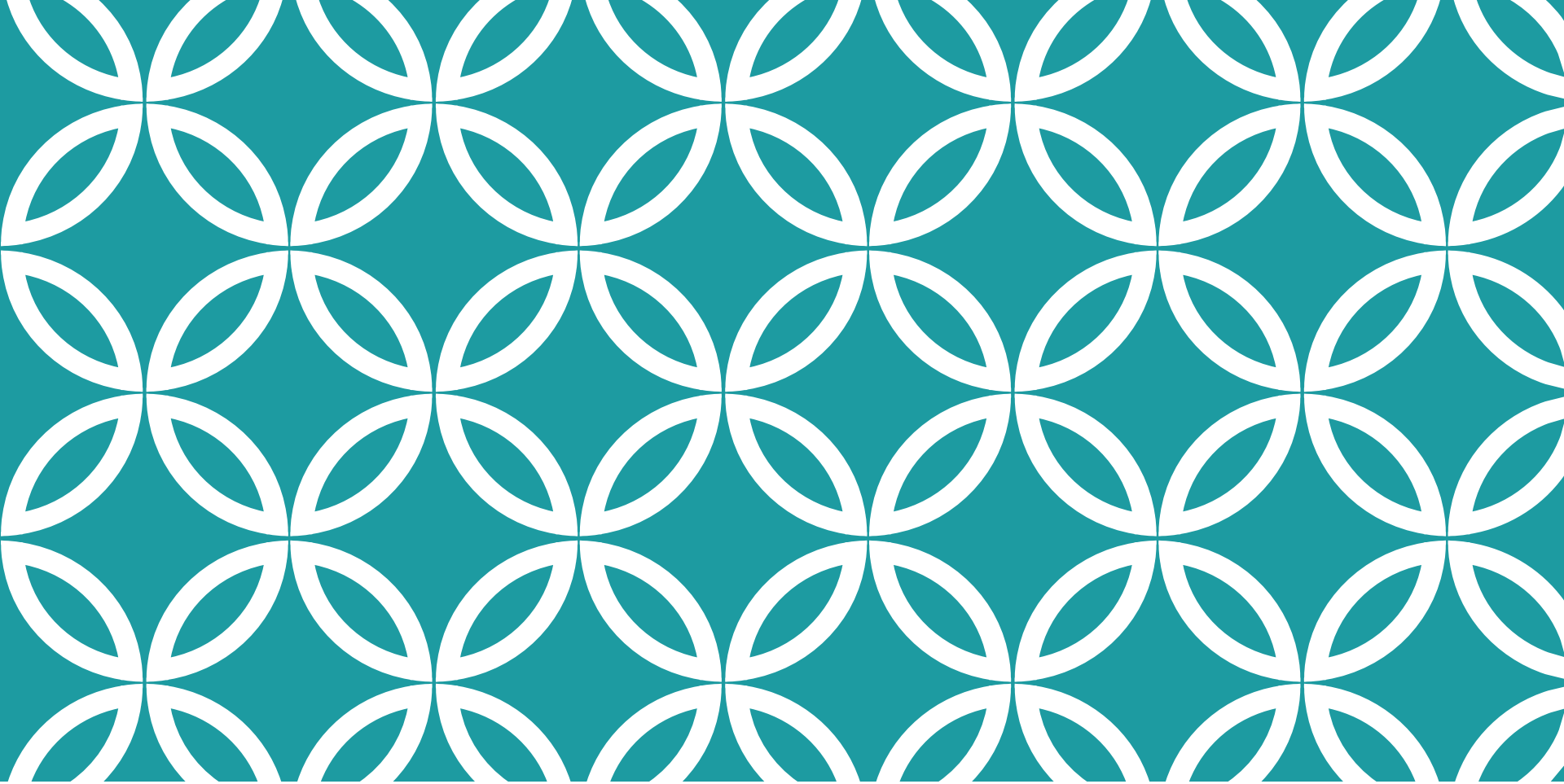
ANTIBIOTIC STEWARDSHIP PROGRAMS ARE A "WIN-WIN" FOR ALL INVOLVED

A UNIVERSITY OF MARYLAND STUDY SHOWED ONE ANTIBIOTIC STEWARDSHIP PROGRAM **SAVED A TOTAL OF $17 MILLION** OVER EIGHT YEARS

ANTIBIOTIC STEWARDSHIP HELPS **IMPROVE PATIENT CARE AND SHORTEN HOSPTIAL STAYS,** THUS **BENEFITING PATIENTS AS WELL AS HOSPITALS**



THERAPEUTIC USE



THANK YOU