MANAGING ANTIBIOTIC THERAPY

ITS MORE THAN JUST ABOUT THE 'S' AND THE 'R'

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“LETS FACE IT……

WE ARE OBSESSED WITH PRESCRIBNG ANTIBIOTICS”

IN FACT, THE CDC SAYS THAT APPROXIMATELY 50%
OF HOSPITALIZED PATIENTS RECEIVE ONE ANTIBIOTIC OR ANOTHER
SOMETIME DURING THEIR STAY

AND.. EVEN THOUGH ABOUT 90% OF ALL RESPIRATORY OUTPATIENT INFECTIONS ARE CAUSED BY VIRUSES, ALMOST 70% OF PATIENTS ARE GIVEN AN ANTIBIOTIC, OFTEN BROAD SPECTRUM DRUGS
i.e. fluoroquinolones

HOWEVER..THE CDC ALSO SAYS THAT ABOUT **50%** OF THESE ANTIBIOTICS USED IN THE HOSPITAL ARE EITHER **INCORRECTLY USED** OR **UNWARRANTED**..

and **FURTHERMORE**..

The major instigating factors for the exponential rise in antimicrobial RESISTANCE is OUR OVER PRESCRIBING of this precious resource…along with their use in animal feeds…

To the point that approximately 2 Million persons become ill every year with antibiotic-resistant infections, and about 23,000 die!

EDITORIAL

THE AMERICAN JOURNAL of MEDICINE®

The Unintended Deleterious Consequences of the 'Routine' Urinalysis

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SO THEN….
HOW DID WE GET TO THIS POINT….

AND WHAT ARE WE (YOU) GOING TO DO TO CORRECT IT?

KEEP IN MIND….

THE WORLD OF MEDICINE WAS CHANGED BY

SANITATION & IMMUNIZATION

FIRST OFF…LETS ALL BE TALKING 'APPLES to APPLES'

..does it fascinate you as it does me that when one considers that the human body is comprised of approx. 10^{12} cells, and that located either within and/or on the surface of a human exists an estimated 10^{15} virions and 10^{13} bacteria (the indigenous microbiome).

..it is *astonishing* yet comforting to realize that Clinical Infectious Disease is actually an INFREQUENT EVENT!

..the question our patients should ask is..why have I not gotten more infections, rather than what we all hear.."HOW AND WHY did I get this"

……LETS KEEP THE 'APPLE' TERMS STRAIGHT

INFECTION (COLONIZATION) – A 'BUG' WTIHIN OR ON A HOST, PERSISTENT OR TRANSIENT AND CAUSES NO HARM.

INFECTIOUS DISEASE – INTERACTION WITH THE 'BUG' CAUSES HARM TO THE HOST, ALTERS PHYSIOLOGY AND LEADS TO SIGNS AND SYMPTOMS

PATHOGEN – A 'BUG' THAT HAS THE CAPACITY TO CAUSE DISEASE. ALMOST ALWAYS FROM THE ENDOGENOUS MICRO-FLORA ..so why the common question, how, why, and where did I get this infection from?

VIRULENCE – PROVIDES A QUANTITATIVE MEASURE OF A 'BUG'S' CAPACITY TO CAUSE DISEASE (i.e. Staph aureus, encapsulated Pneumococcus / Meningococcus, C dif toxins)

I CAN NOT STAND THE PHRASE…
"PERCEPTION IS REALITY"…

REALITY IS REALITY…BUT WE ALL HAVE TO LIVE WITH OUR PATIENTS PERCEPTIONS EACH AND EVERY DAY

…"JUST TELL ME I DON'T HAVE MRSA, THEY TOLD ME YOU CAN NEVER GET RID OF IT"

…"OH NO, A POSITIVE TB SKIN TEST, I THOUGHT TUBERCULOSIS WAS ONLY IN THEM"

…"ZIKA, EBOLA…WERE ALL DOOMED"

…"GIVE ME (OR HERE, TAKE) THE ANTIBIOTIC, JUST TO BE SAFE.. IT CAN'T HURT"

BUT THIS IS THE ONE MOST MISUNDERSTOOD BY PATIENTS, ADMINISTRATORS, HEALTH-CARE AGENCIES AND REGULATORY BODIES…AND FRANKLY… BY MANY OF OUR COLLEAGUES

‘SEPSIS’

…”THANK GOODNESS I DON’T HAVE ‘SEPSIS’, BUT JUST PNEUMONIA”

'*SEPSIS*' - WHAT REALLY IS THIS CONDITION ANYWAY?

EARLY 1980'S – SEPSIS IS '*ENDOTOXEMIA*', HOW DO YOU REALLY MEASURE THAT

'*SEPTICEMIA*'…THE ONGOING MISCONCEPTION OF BACTEREMIA

And then in 1991, and for 25 years thereafter..

The almost 'religious' adoption that 'sepsis' was…

'THE SYSTEMIC INFLAMMATORY RESPONSE SYNDROME (SIRS)

2 OR MORE OF: HR>90/MIN, RR>20/MIN, TEMP>100.4F or <96.8F, WBC>12,000 or <4,000 OR >10% Band forms

…BUT FINALLY IN FEBRUARY, 2016 (JAMA) WE GOT…

Clinical Review & Education

Special Communication | CARING FOR THE CRITICALLY ILL PATIENT

The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3)

.an actual **DEFINITION** of what **'SEPSIS'** actually is..no longer clinical criteria alone

"LIFE THREATENING ORGAN DYSFUNCTION caused by a DYSREGULATED HOST RESPONSE to INFECTION (proven or suspected)..based on PATHOBIOLOGY

Leads to prolonged ICU stays and a significant risk of dying,10% mortality

‘SEPSIS’ WHAT’S IN and WHAT’S OUT

OUT….SIRS and SEVERE SEPSIS…the reasons are

1- all based on clinical signs/symptoms,no definition
2- too sensitive, not specific enough
3- 50% have appropriate adaptive response, not dying
4- 1 in 8 missed organ failure and risk of death
5 – all ‘sepsis’ is severe (10% mortality), why separate term

…but lets remember that…

1- since the incorporation of SIRS, less sepsis mortality
?????? denominator increase

OUT……NO MORE, TOSSED UNDER THE BUS

Box 1. SIRS (Systemic Inflammatory Response Syndrome)

Two or more of:

- Temperature >38°C or <36°C
- Heart rate >90/min
- Respiratory rate >20/min or $PaCO_2$ <32 mm Hg (4.3 kPa)
- White blood cell count >12 000/mm^3 or <4000/mm^3 or >10% immature bands

From Bone et al.[9]

‘SEPSIS’….WHAT’S IN and WHAT’S OUT

IN…NEW CLINICAL CRITERIA, INFECTION with ORGAN DYSFUNCTION

Identified as an ACUTE CHANGE in total ‘SOFA’ SCORE ≥2

CONSEQUENT TO INFECTION

‘SOFA’

SEQUENTIAL (SEPSIS-RELATED) ORGAN FAILURE ASSESSMENT SCORE

RESPIRATION, COAGULATION, LIVER, CARDIOVASCULAR CNS, RENAL

ONLY validated for ICU PATIENTS and ALL BEGIN with SCORE = O
unless known underlying abnormalities in parameters

NEW…

Table 1. Sequential [Sepsis-Related] Organ Failure Assessment Score[a]

	Score				
System	0	1	2	3	4
Respiration					
Pao_2/Fio_2, mm Hg (kPa)	≥400 (53.3)	<400 (53.3)	<300 (40)	<200 (26.7) with respiratory support	<100 (13.3) with respiratory support
Coagulation					
Platelets, $\times 10^3/\mu L$	≥150	<150	<100	<50	<20
Liver					
Bilirubin, mg/dL (μmol/L)	<1.2 (20)	1.2-1.9 (20-32)	2.0-5.9 (33-101)	6.0-11.9 (102-204)	>12.0 (204)
Cardiovascular	MAP ≥70 mm Hg	MAP <70 mm Hg	Dopamine <5 or dobutamine (any dose)[b]	Dopamine 5.1-15 or epinephrine ≤0.1 or norepinephrine ≤0.1[b]	Dopamine >15 or epinephrine >0.1 or norepinephrine >0.1[b]
Central nervous system					
Glasgow Coma Scale score[c]	15	13-14	10-12	6-9	<6
Renal					
Creatinine, mg/dL (μmol/L)	<1.2 (110)	1.2-1.9 (110-170)	2.0-3.4 (171-299)	3.5-4.9 (300-440)	>5.0 (440)
Urine output, mL/d				<500	<200

QUICK 'SOFA'…..qSOFA

EMERGENCY DEPARTMENT and GENERAL WARD BEDSIDE EVALUATION

'HAT'……

1- **HYPOTENSION** – **SYSTOLIC BP ≤100 mm/hg**

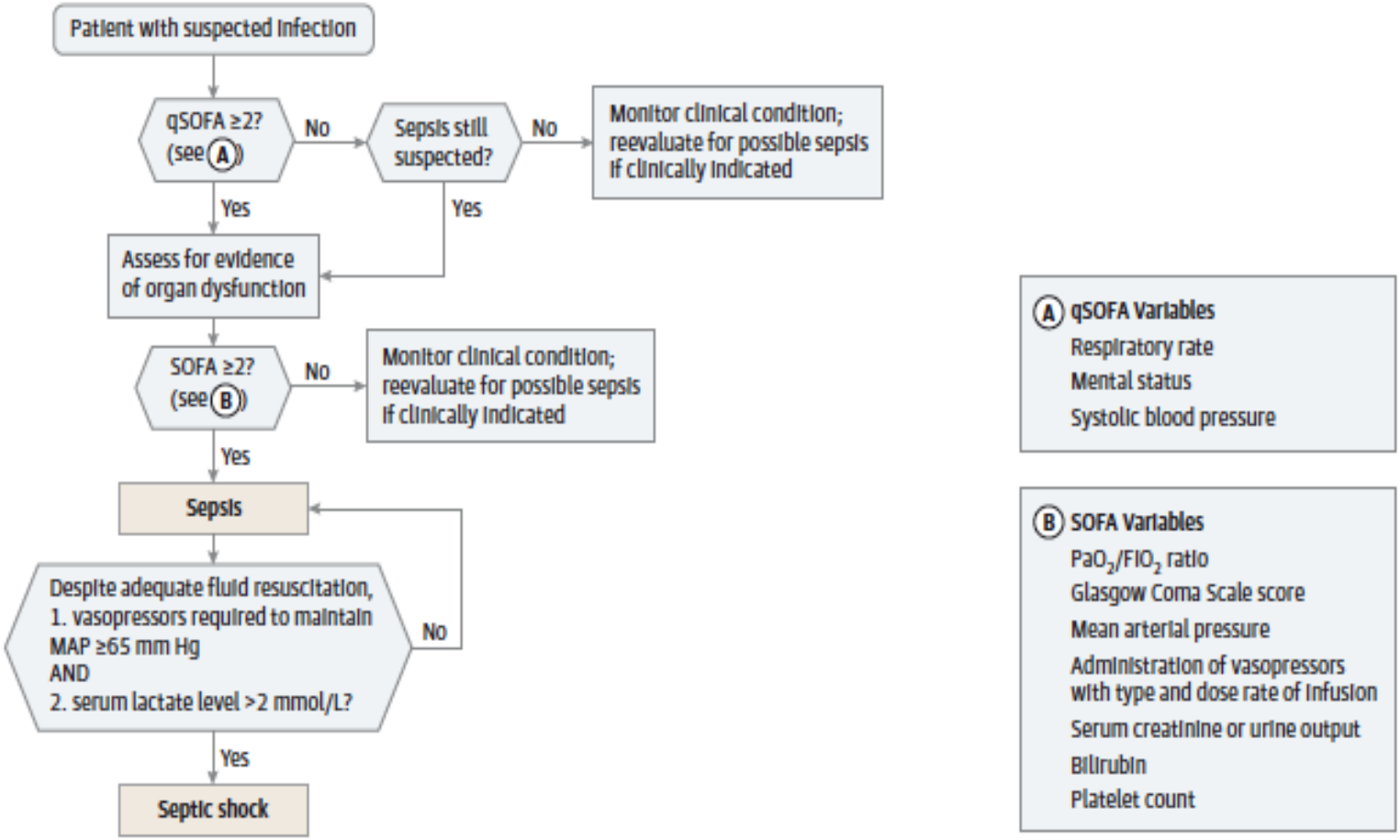
2- ALTERED MENTAL STATUS – GLASGOW COMA SCORE <15

3- TACHYPNEA – RESP RATE >22 / min

…≥2 OF THE PARAMETERS SERVE AS QUALIFIERS AND ELIMINATE THE NEED FOR LABORATORY TESTING

HERE IS THE NEW ROAD MAP….

Figure. Operationalization of Clinical Criteria Identifying Patients With Sepsis and Septic Shock



The baseline Sequential [Sepsis-related] Organ Failure Assessment (SOFA) score should be assumed to be zero unless the patient is known to have preexisting (acute or chronic) organ dysfunction before the onset of infection. qSOFA indicates quick SOFA; MAP, mean arterial pressure.

….and now ‘**SEPTIC SHOCK’** is….

..a **SUBSET OF SEPSIS**, in which **UNDERLYING CIRCULATORY** and **CELLULAR / METABOLIC ABNORMALITIES** are PROFOUND enough to **SUBSTANTIALLY INCREASE MORTALITY** (currently 42%)

….in other words…**’BAD SEPSIS’**

.....and for **'SEPTIC SHOCK'**

Having 'SEPSIS" .....and 2 THINGS

The Need for Vasopressor medications to Maintain a Mean Arterial Pressure(MAP) >65 mmHg

Serum LACTATE level >2 mmol/L

THE ISSUES WITH SEPSIS-3

1- **MAY BE TOO SENSITIVE AND LEAD TO UNWWARRANTED ANTIBIOTICS**
(or, so what else is new !!)

2- **HOW TO MEASURE A DYSREGULATED HOST REPSONSE**
(or, when does this transition from regulated and helpful to dysregulated and and harmful ??)

3- **THE WHOLE CONCEPT IS PREDICATED ON INFECTION BEING THE TRIGGER**
(they could not define infection, but relied on any patient having cultures sent and given antibiotics…how well has that worked out until now ??)

4- **REQUIRES CLINICAL PROMPTS FROM RNs, etc.**
(here comes 'code sepsis' and more telephone random orders !)

AND IT IS STILL DEFINED AND CODED DIFFERENTLY BY:

CDC

JOINT COMMISION

CMS

HOSPITAL QUALITY MEASURES

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Surviving Sepsis Campaign

Society of Critical Care Medicine
The Intensive Care Professionals

ESICM
EUROPEAN SOCIETY OF INTENSIVE CARE MEDICINE
The Intensive Connection

Surviving Sepsis Campaign

Antibiotics

- **We recommend that administration of IV antimicrobials be initiated as soon as possible after recognition and within 1 h for both sepsis and septic shock.**

(strong recommendation, moderate quality of evidence).

- **We recommend empiric broad-spectrum therapy with one or more antimicrobials to cover all likely pathogens.**

(strong recommendation, moderate quality of evidence).

Surviving Sepsis Campaign

Antibiotics

- **We suggest empiric combination therapy (using at least two antibiotics of different antimicrobial classes) aimed at the most likely bacterial pathogen(s) for the initial management of septic shock.**
  - **(Weak recommendation; low quality of evidence)**

Surviving Sepsis Campaign

Antibiotics

- **We suggest that combination therapy not be routinely used for on-going treatment of most other serious infections, including bacteremia and sepsis without shock.**
  - **(Weak recommendation; low quality of evidence).**

- **We recommend against combination therapy for the routine treatment of neutropenic sepsis/bacteremia.**
  - **(Strong recommendation; moderate quality of evidence).**

..***NOW TELL ME THIS IS NOT A COMMON EVERYDAY EVENT !***

Clinical Infectious Diseases

REVIEW ARTICLE

IDSA Infectious Diseases Society of America

hivma hiv medicine association

OXFORD

Systematic Review and Metaanalysis of Acute Kidney Injury Associated With Concomitant Vancomycin and Piperacillin/Tazobactam

Drayton A. Hammond,[1,2] Melanie N. Smith,[3] Chenghui Li,[1] Sarah M. Hayes,[4] Katherine Lusardi,[2] and P. Brandon Bookstaver[5]

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Surviving Sepsis Campaign

THE FACT IS……

- THE ADMINISTRATION OF **ADEQUATE ANTIBIOTICS** HAS BEEN THE **ONLY CLEARLY PROVEN BENEFICIAL INTERVENTION** IN LOWERING **MORTALITY** IN ‘SEPSIS’AND ‘SEPTIC SHOCK’.

Surviving Sepsis Campaign

- **SO THEN……**

HOW DO WE GET IT RIGHT?

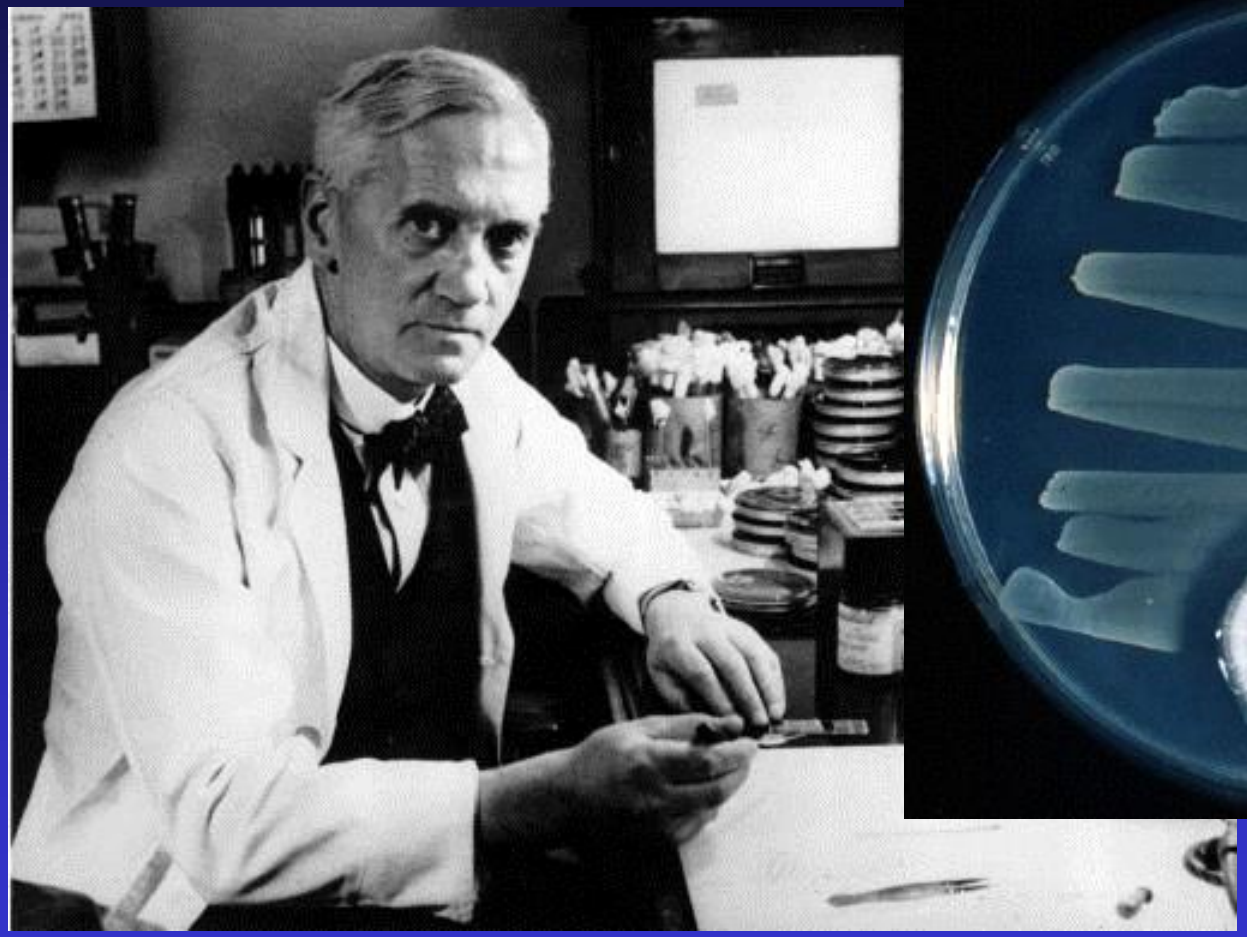
Society of Critical Care Medicine
The Intensive Care Professionals

ESICM
The Intensive Connection

The Origins of Antimicrobial Drugs

- Antibiotics
  - ~ *metabolic products* of aerobic bacteria and fungi
  - ~ reduce competition for nutrients and space
  - Bacteria: *Streptomyces ,Acromyces* and *Bacillus*
  - Molds: *Penicillium* and *Cephalosporium*
  - ***Antimicrobials***
- Chemists have created new drugs by altering the structure of naturally occurring antibiotics

Flemming and Penicillin



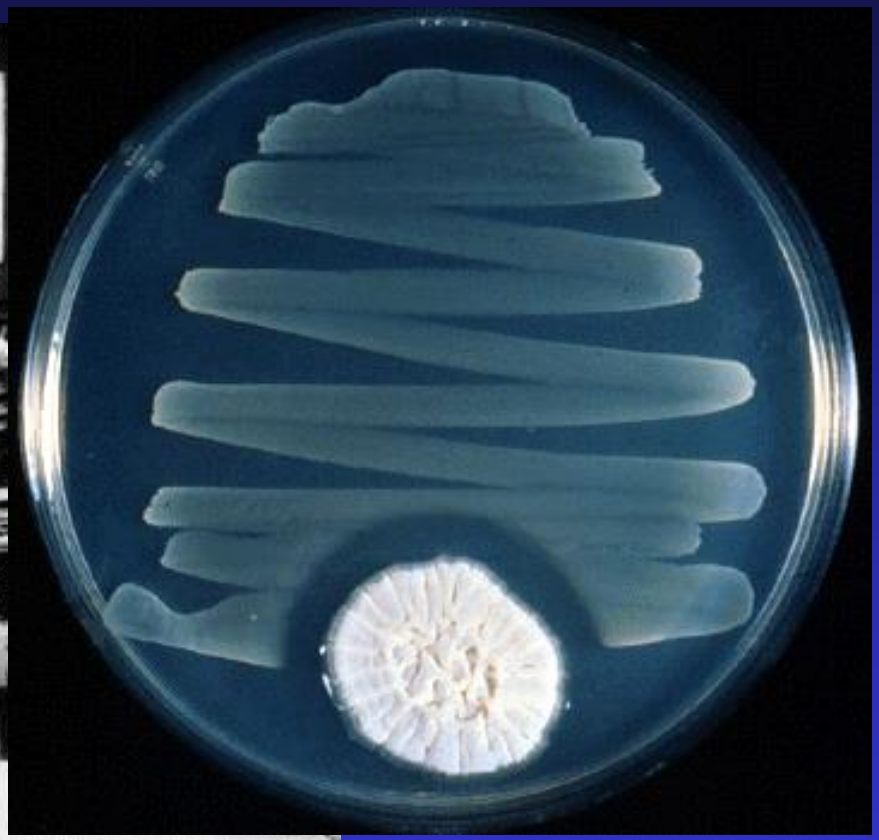


Plate of *Staphylococcus aureus* inhibited by *Penicillium notatum*

Antibiotics Revolutionized Medicine

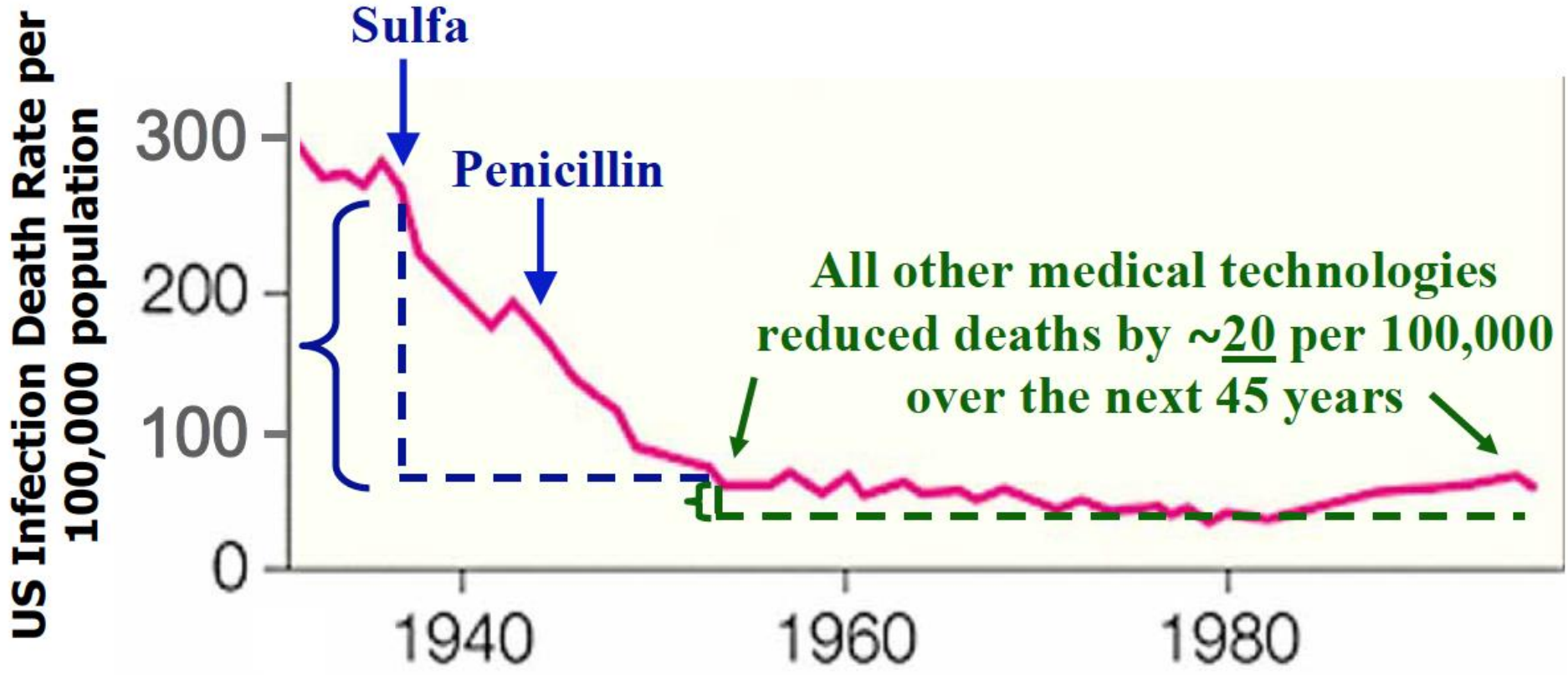
- Enable complicated surgery
- Enable cancer chemotherapy
- Enable critical care medicine
- Enable care for premature babies
- Enable organ transplantation
- Changed medicine from a diagnostic profession to a treatment profession

Early Optimism about Antimicrobials

William H. Stewart, U.S. Surgeon General 1965-1969, is purported to have said, "We have closed the book on infectious disease."

Don't Lose Forest Through the Trees

Antibiotics caused US deaths to decline by ~220 per 100,000 in 15 years



Armstrong, G. L. et al. JAMA 1999;281:61-66.

Power of Antibiotics

Disease	Pre-Antibiotic Death Rate	Death With Antibiotics	Change in Death
Community Pneumonia[1]	~35%	~10%	**-25%**
Hospital Pneumonia[2]	~60%	~30%	**-30%**
Heart Infection[3]	~100%	~25%	**-75%**
Brain Infection[4]	>80%	<20%	**-60%**
Skin Infection[5]	11%	<0.5%	**-10%**
By comparison…treatment of heart attacks with aspirin or clot busting drugs[6]			***-3%***

[1]IDSA Position Paper '08 Clin Infect Dis 47(S3):S249-65; [2]IDSA/ACCP/ATS/SCCM Position Paper '10 Clin Infect Dis In Press; [3]Kerr AJ. Subacute Bacterial Endocarditis. Springfield IL: Charles C. Thomas, 1955 & Lancet 1935 226:383-4; [4]Lancet '38 231:733-4 & Waring et al. '48 Am J Med 5:402-18; [5]Spellberg et al. '09 Clin Infect Dis 49:383-91 & Madsen '73 Infection 1:76-81; [6]'88 Lancet 2:349-60

Antibiotics Are UNIQUE

- They are the only drugs that:
  - lose efficacy over time & must be continually replaced
  - need to be used sparingly to prolong their efficacy
  - we actively discourage use of when they are approved

Antibiotic brands

- 50 penicillin's
- 71 cephalosporins
- 12 tetracycline's
- 8 aminoglycosides
- 1 monobactam
- 5 Carbapenems
- 9 macrolides
- 2 streptogramins
- 3 dihydrofolate reductase inhibitors
- 1 oxazolidinone
- 5.5 quinolones

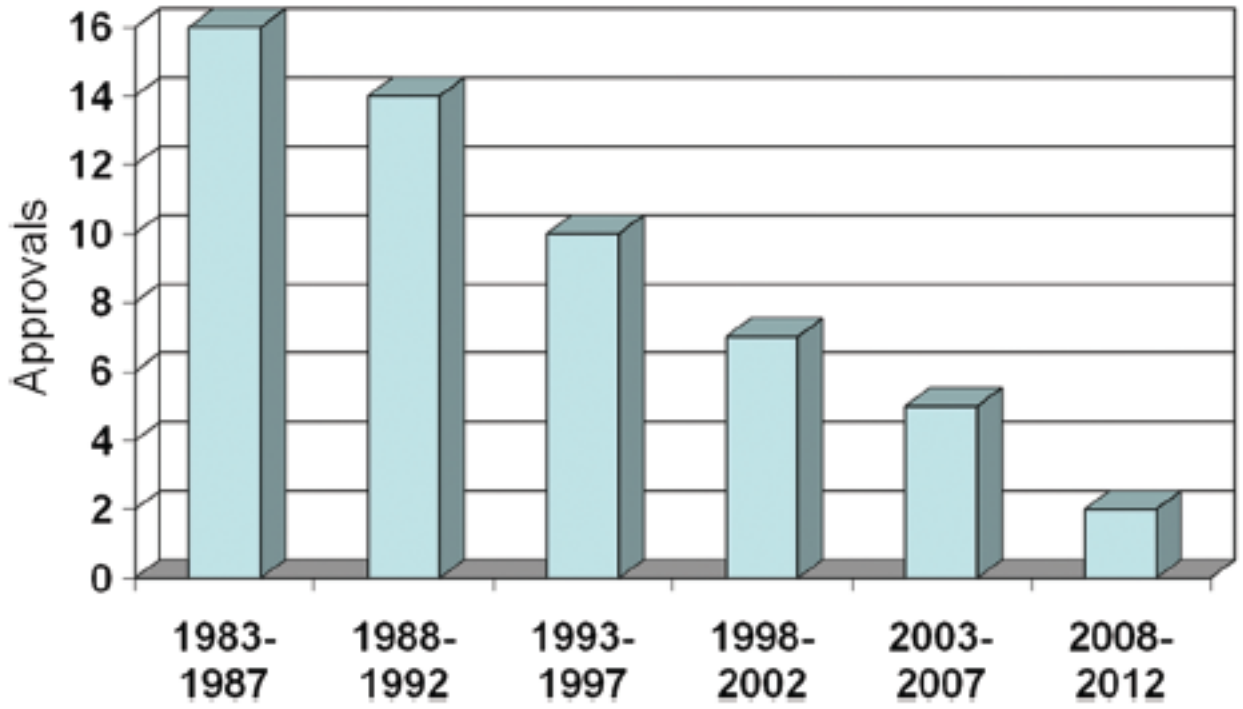
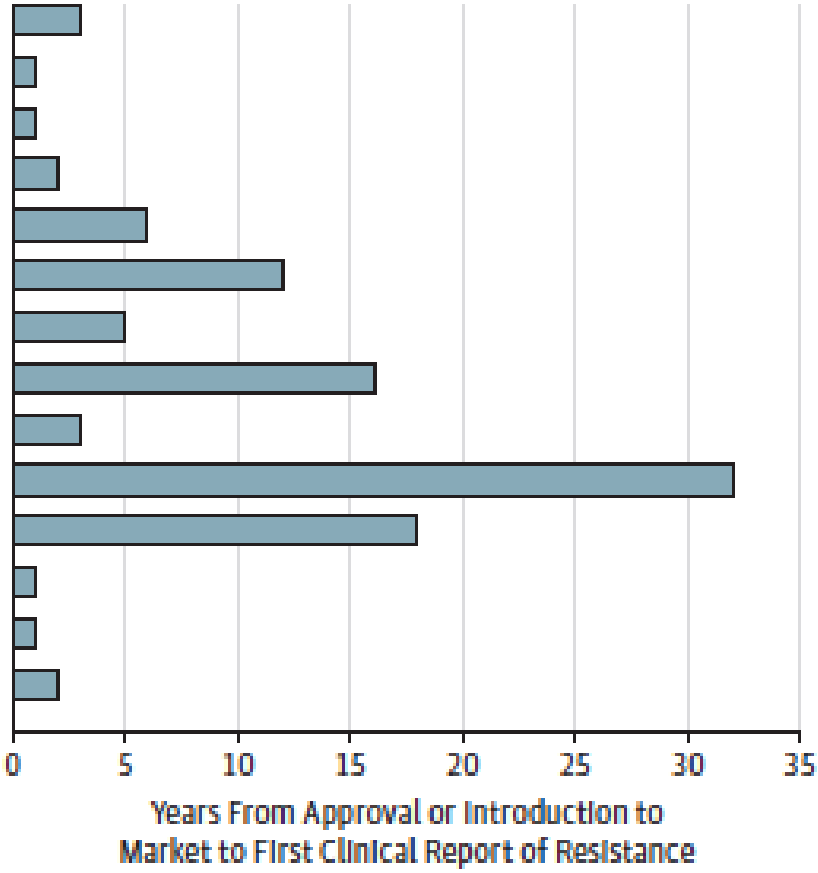


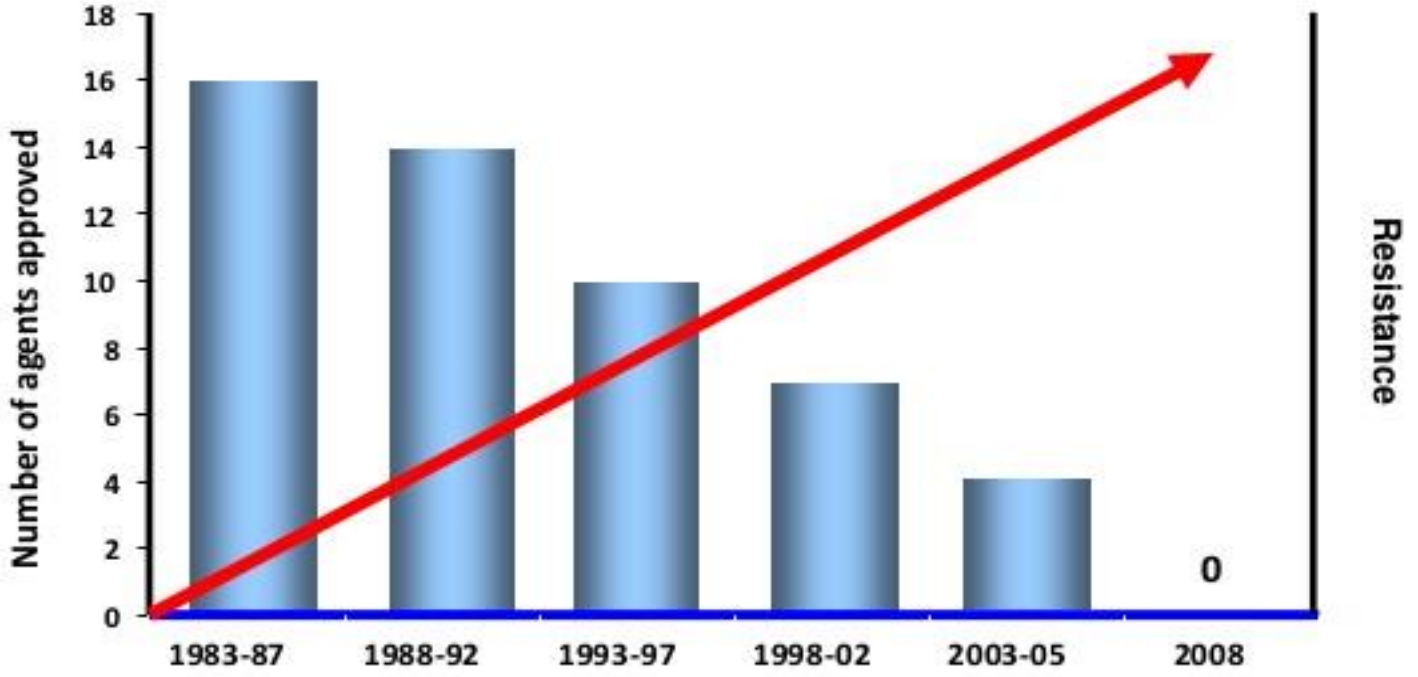
Figure 1. New systemic antibacterial agents approved by the US Food and Drug Administration per 5-year period, through 2012. Modified from Spellberg 2004 [23].

Figure 1. Time From Antibiotic Approval or Introduction to Detection of Resistance in Clinical Samples

Class	Antibiotic	Year of Approval or Introduction to Market
β-Lactams	Penicillin	1942
	Methicillin	1960
	Cephalothin	1964
	Amoxicillin-clavulanic acid	1984
Carbapenems	Imipenem-cilastatin	1985
Amphenicols	Chloramphenicol	1950
Tetracyclines	Tetracycline	1953
Aminoglycosides	Streptomycin	1946
Macrolides	Erythromycin	1952
Glycopeptides	Vancomycin	1958
Quinolones	Nalidixic acid	1964
Streptogramins	Quinupristin-dalfopristin	1999
Oxazolidinones	Linezolid	2000
Lipopeptides	Daptomycin	2003



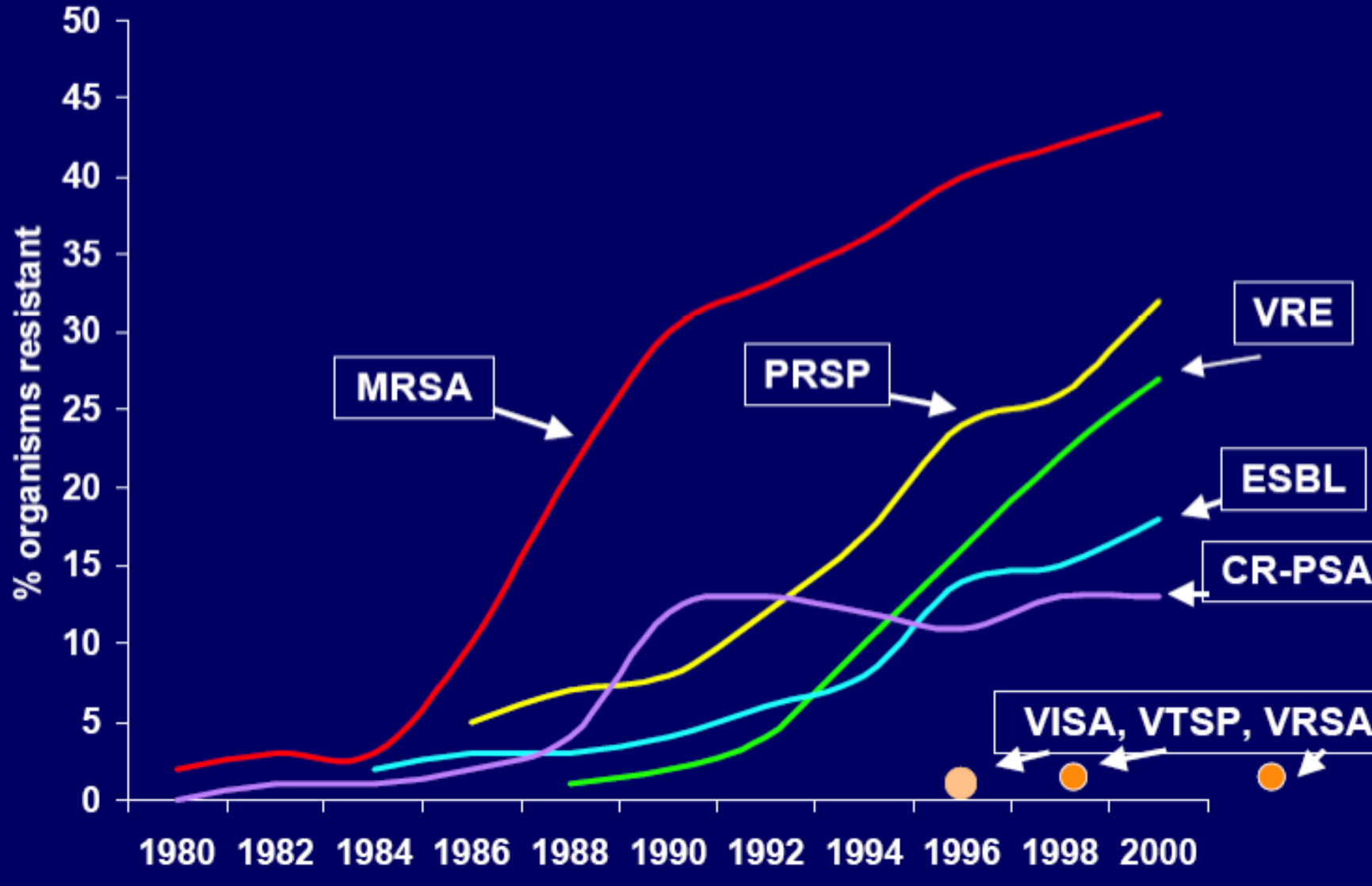
A Changing Landscape for Numbers of Approved Antibacterial Agents



Bars represent number of new antimicrobial agents approved by the FDA during the period listed.

Infectious Diseases Society of America. *Bad Bugs, No Drugs*. July 2004; Spellberg B et al. *Clin Infect Dis*. 2004;38:1279-1286; New antimicrobial agents. *Antimicrob Agents Chemother*. 2006;50:1912

Recent History of Antibiotic Resistance



Antibiotic Resistant Problems

Target the ESKAPE Bacteria

- *Enterococcus* (VRE)
- *S. aureus* (MRSA)
- *Klebsiella*
- *Acinetobacter*
- *Pseudomonas*

#1) R to almost all agents

- ESBL (e.g., *E. coli, Enterobacter*)

#2) R to all oral agents

Primary Unmet Medical Needs

IDSA PUBLIC POLICY

10 × ’20 Progress—Development of New Drugs Active Against Gram-Negative Bacilli: An Update From the Infectious Diseases Society of America

Helen W. Boucher,[1] George H. Talbot,[2] Daniel K. Benjamin Jr,[3,4] John Bradley,[5,6] Robert J. Guidos,[7] Ronald N. Jones,[8,9] Barbara E. Murray,[10] Robert A. Bonomo,[11,12,13,14] and David Gilbert,[15,16] for the Infectious Diseases Society of America[a]

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NONINFERIORITY TRIALS

- **How do we claim the need for new antibiotics is based on the lack of efficacy of older agents in diseases, because of resistant pathogens, and then design the trial such as to show "how much less effective" a new drug might be compared with the older drug whose effectiveness is in doubt?**

RECENTLY APPROVED NEW ANITIBACTERIAL AGENTS

DRUG	INDICATION	APPROVED
Dalbavancin (Dalvance)	Skin & Soft Tissue (MRSA)	May 2014
Oritavancin (Orbactiv)	Skin & Soft Tissue (MRSA)	August 2014
Tedizolid (Sivextro)	Skin & soft Tissue (MRSA)	June 2014
Ceftaroline (Teflaro)	SSTI (MRSA), Pneumonia	October 2010
Ceftolozane-tazobactam (Zerbaxa)	Intra-Abdominal, UTI	December 2014
Ceftazidime-Avibactam (Avycaz)	Intra-Abdominal, UTI	February 2015
Bedaquiline (Sirturo)	Drug-Resistant TB	December 2012
Obiltoxaximab (Anthim)	Inhalation Anthrax	March 2016
Bezlotoxumab (Zinplava)	Reduce C. Difficle Recurrence	October 2016

ANTIBACTERIAL AGENTS IN CLINICAL DEVELOPMENT

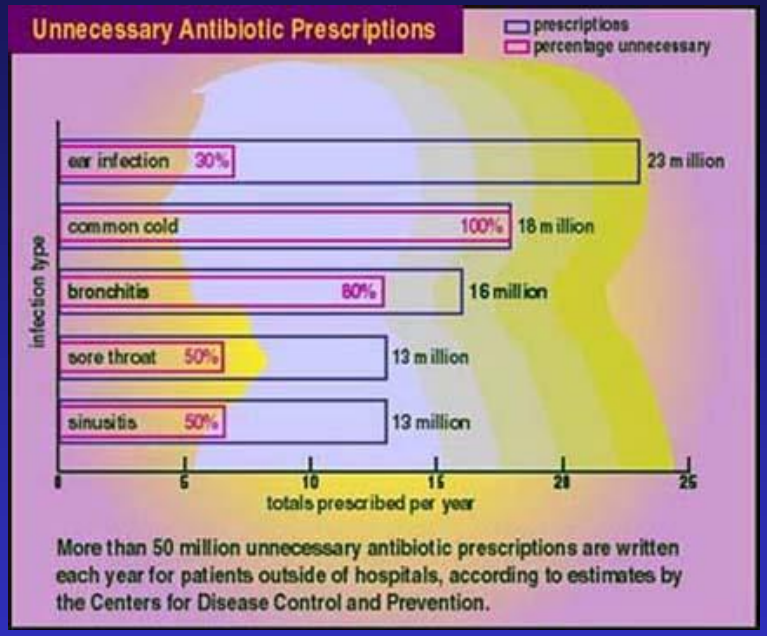
AGENT	CLASS	PHASE	INDICATION
Solithromycin (Solithera)	Macrolide	Decision Pending	Community Pneumonia
Aztreonam-Avivactam	Monobactam-Novel Beta-lactamase Inhib	Phase 2	Intra-Abdominal Infections
Fosofmycin (IV)	Epoxide	Phase 2	Complicated UTIs
S-649266	Siderophore Cephalosporin	Phase 3	HAP / VAP, Bacteremia, UTIs
Imipenem-Relebactam	Carbapenem-Beta-lactamase Inhib	Phase 3	Intra-Abdominal Infections, UTIs, HAP / VAP
Meropenem-Vaborbactam	Carbapenem-novel boronic Beta-lactamase Inhib	Phase 3	Intra-Abdomninal Infections, UTIs, Bacteremia HAP / VAP Febrile Neutropenic
Eravacycline	Tetracycline	Phase 3	Intra-Abdominal Infections, UTIs
Plazomicin	Aminoglycoside	Phase 3	UTIs, Bacteremia HAP / VAP (CREs)

?

SO WHY ALL THE RESISTANCE

Inappropriate Antimicrobial Use

- Prescription not taken correctly
- Antibiotics for viral infections
- Antibiotics sold without medical supervision
- Spread of resistant microbes in hospitals due to lack of hygiene



Open Access Full Text Article

REVIEW

Cumulative clinical experience from over a decade of use of levofloxacin in urinary tract infections: critical appraisal and role in therapy

This article was published in the following Dove Press journal:
Infection and Drug Resistance
14 October 2011
Number of times this article has been viewed

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Abstract: The treatment of urinary tract infections (UTIs) continues to evolve as common uropathogens increasingly become resistant to previously active antimicrobial agents. In addition, bacterial isolates, which were once considered to be either colonizers or contaminants, have emerged as true pathogens, likely related to the more complex array of settings where health care is now delivered. Even though the reliability of many antimicrobial agents has become less predictable, the fluoroquinolone group of agents has remained a frequent, if not the most often prescribed, antimicrobial therapy for almost all types of UTIs. Levofloxacin has taken its position at the top of the list as one of the most regularly administered fluoroquinolone agents given to patients with a suspected or proven UTI. The authors review the clinical experience of the use of levofloxacin over the past decade and suggest that the use of levofloxacin for the treatment of UTIs, although still fairly dependable, is perhaps not the best use of this important antimicrobial agent.

Keywords: fluoroquinolone, antimicrobial agent, UTI, resistance

MAJOR ARTICLE

Skin and Soft-Tissue Infections Requiring Hospitalization at an Academic Medical Center: Opportunities for Antimicrobial Stewardship

Timothy C. Jenkins,[1,4] Allison L. Sabel,[3,5] Ellen E. Sarcone,[2,4] Connie S. Price,[1,4] Philip S. Mehler,[2,3,4] and William J. Burman[1,4]

[1]Department of Medicine and Division of Infectious Diseases, [2]Department of Medicine, and [3]Department of Patient Safety and Quality, Denver Health Medical Center, and Departments of [4]Medicine and [5]Preventive Medicine and Biometry, University of Colorado Denver, Denver

(See the editorial commentary by Spellberg, on pages 904–906.)

Background. Although complicated skin and soft-tissue infections (SSTIs) are among the most common infections requiring hospitalization, their clinical spectrum, management, and outcomes have not been well described.

Methods. We report a cohort of consecutive adult patients hospitalized for SSTI from 1 January through 31 December 2007 at an academic medical center. Cases meeting inclusion criteria were reviewed and classified as cellulitis, cutaneous abscess, or SSTI with additional complicating factors.

Results. In total, 322 patients were included; 66 (20%) had cellulitis, 103 (32%) had cutaneous abscess, and 153 (48%) had SSTI with additional complicating factors. Injection drug use, diabetes mellitus, and alcohol abuse were common comorbidities. Serum inflammatory markers were routinely measured and blood cultures and imaging studies were routinely performed in each group. Of 150 patients with a positive culture result for an abscess, deep tissue, or blood, *Staphylococcus aureus* or streptococci were identified in 145 (97%). Use of antibiotics with broad aerobic gram-negative activity (61%–80% of patients) or anaerobic activity (73%–83% of patients) was frequent in each group. The median duration of therapy for cellulitis, cutaneous abscess, and SSTI with additional complicating factors was 13 (interquartile range [IQR], 10–14), 13 (IQR, 10–16), and 14 (IQR, 11–17) days, respectively. Treatment failure, recurrence, or rehospitalization due to SSTI within 30 days occurred in 12.1%, 4.9%, and 9.2% of patients, respectively.

Conclusions. Hospitalizations for SSTI were common; more than half were due to cellulitis or cutaneous abscess. Frequent use of potentially unnecessary diagnostic studies, broad-spectrum antibiotic therapy, and prolonged treatment courses in these patients suggest targets for antimicrobial stewardship programs.

MAJOR ARTICLE

Clinical Trial: Comparative Effectiveness of Cephalexin Plus Trimethoprim-Sulfamethoxazole Versus Cephalexin Alone for Treatment of Uncomplicated Cellulitis: A Randomized Controlled Trial

Daniel J. Pallin,[1,2] William D. Binder,[3] Matthew B. Allen,[1,4] Molly Lederman,[1,5] Siddharth Parmar,[1] Michael R. Filbin,[3] David C. Hooper,[6] and Carlos A. Camargo Jr[3]

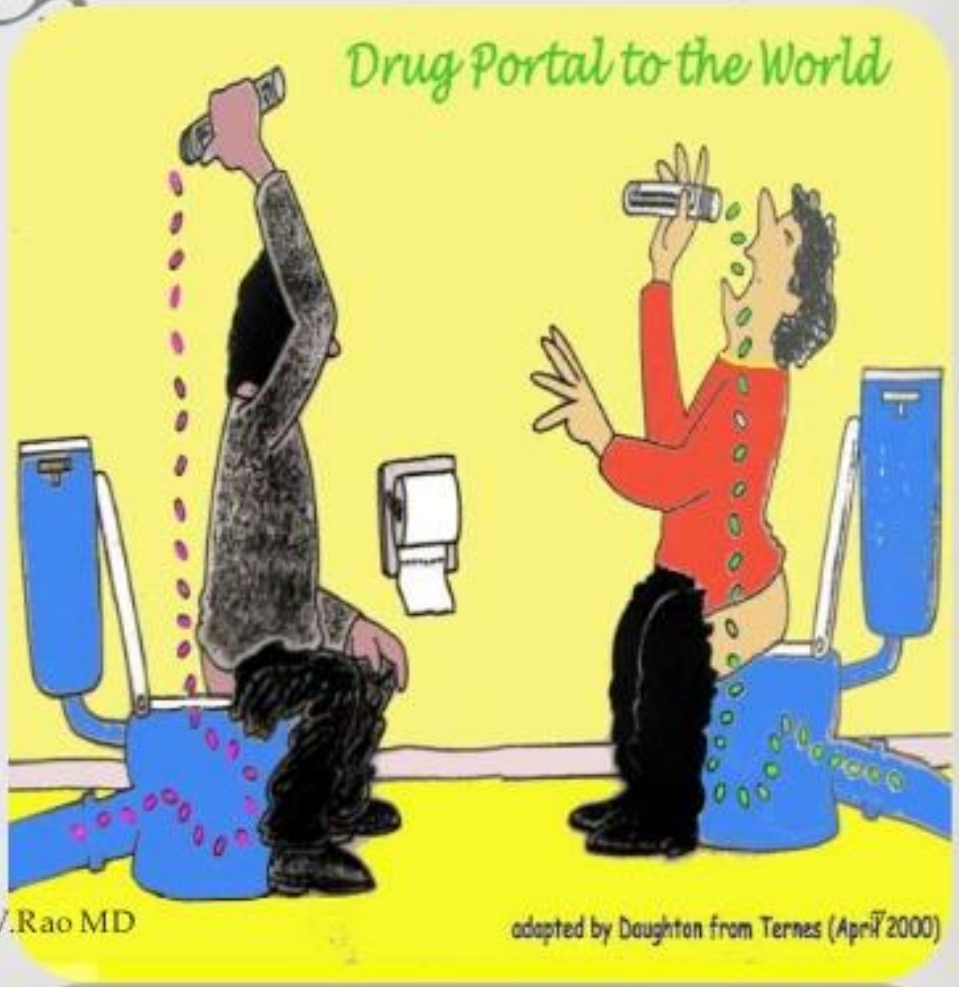
[1]Department of Emergency Medicine, Brigham and Women's Hospital, [2]Division of Emergency Medicine, Boston Children's Hospital, and [3]Department of Emergency Medicine, Massachusetts General Hospital, Boston; [4]Perelman School of Medicine at the University of Pennsylvania, Philadelphia; [5]Department of Pediatrics, and [6]Division of Infectious Diseases, Department of Medicine, Massachusetts General Hospital, Boston

(See the Editorial Commentary by Chambers on pages 1763–4.)

Background. Community-associated methicillin-resistant *S. aureus* (CA-MRSA) is the most common organism isolated from purulent skin infections. Antibiotics are usually not beneficial for skin abscess, and national guidelines do not recommend CA-MRSA coverage for cellulitis, except purulent cellulitis, which is uncommon. Despite this, antibiotics targeting CA-MRSA are prescribed commonly and increasingly for skin infections, perhaps due, in part, to lack of experimental evidence among cellulitis patients. We test the hypothesis that antibiotics targeting CA-

Drugs for Human Treatment are Excreted into Sewage

- Some drugs excreted in metabolized amounts via the urine and feces
- Some yield bioactive metabolites.
- Some excreted as conjugates



STRATEGIES TO REDUCE RESISTANCE (R)

"BLAST THEM"

antibiotic combinations never been shown to reduce emergence of 'R' in routine bacteria

"FOOL THEM"

cycling drugs only temporarily changes 'R' selection pressure

"STOP IRRITATING THEM"

Best Idea **- 3 points**

Before **Rx begins – only treat true infection**

During **– avoid combos where single agents suffice**

Tail end **– only treat as long as needed to cure the infection**

TERMS

Modern Day *"Buzz Words"*

Evidence Based Medicine

Recommendations graded (strong-very weak)
on Quality of Evidence (high-low) from studies

Consensus of Expert Opinions

Published Guidelines

Experience, Anecdotal, Random

What would seem to make Rational Scientific Sense

"APPROPRIATE" ANTIBIOTIC THERAPY

THE USE OF ANTIBIOTICS WITH GOOD

OR SUSCEPTIBLE *IN-VITRO* ACTIVITY

AGAINST THE BACTERIA AT THE

TISSUE SITE OF INFECTION

i.e. just look for the *'S, I* or *R'* on the micro sheet

"ADEQUATE" ANTIMICROBIAL THERAPY

INCLUDES APPROPRIATE *PLUS*

DESCRIBES THE OPTIMAL THERAPY

BASED UPON DOSAGE, PENETRATION

TO THE SITE OF INFECTION, ROUTE OF

ADMINISTRATION , COMBINATION THERAPY

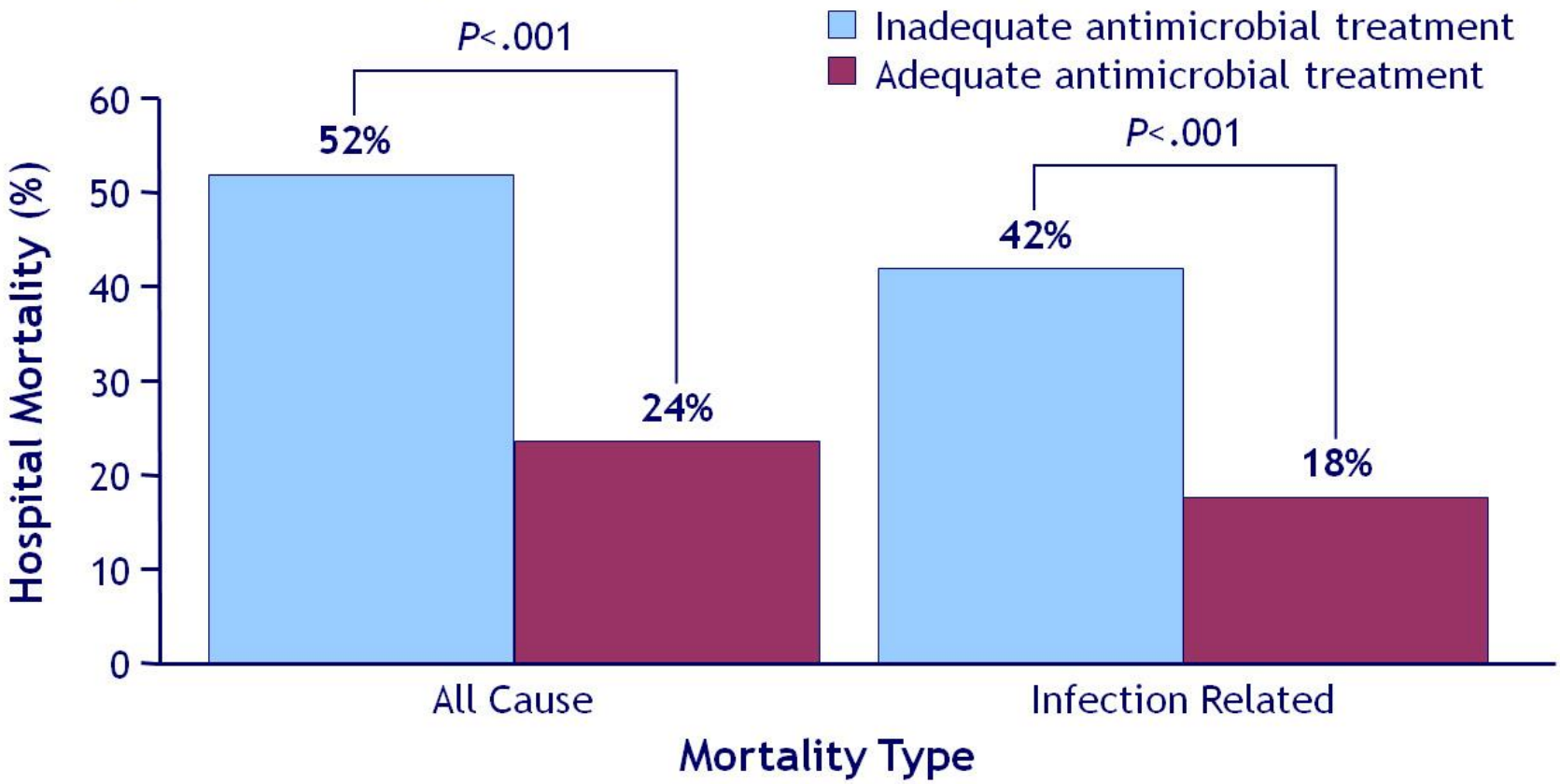
AND DURATION

i.e. you need to really understand the drug and the infection

APPROPRIATE DOES NOT EQUAL *ADEQUATE*

Higher Mortality With Inadequate Antibiotic Therapy in Infections Requiring ICU Admission[1,a]

Prospective, single-center, cohort study (1997-1998)



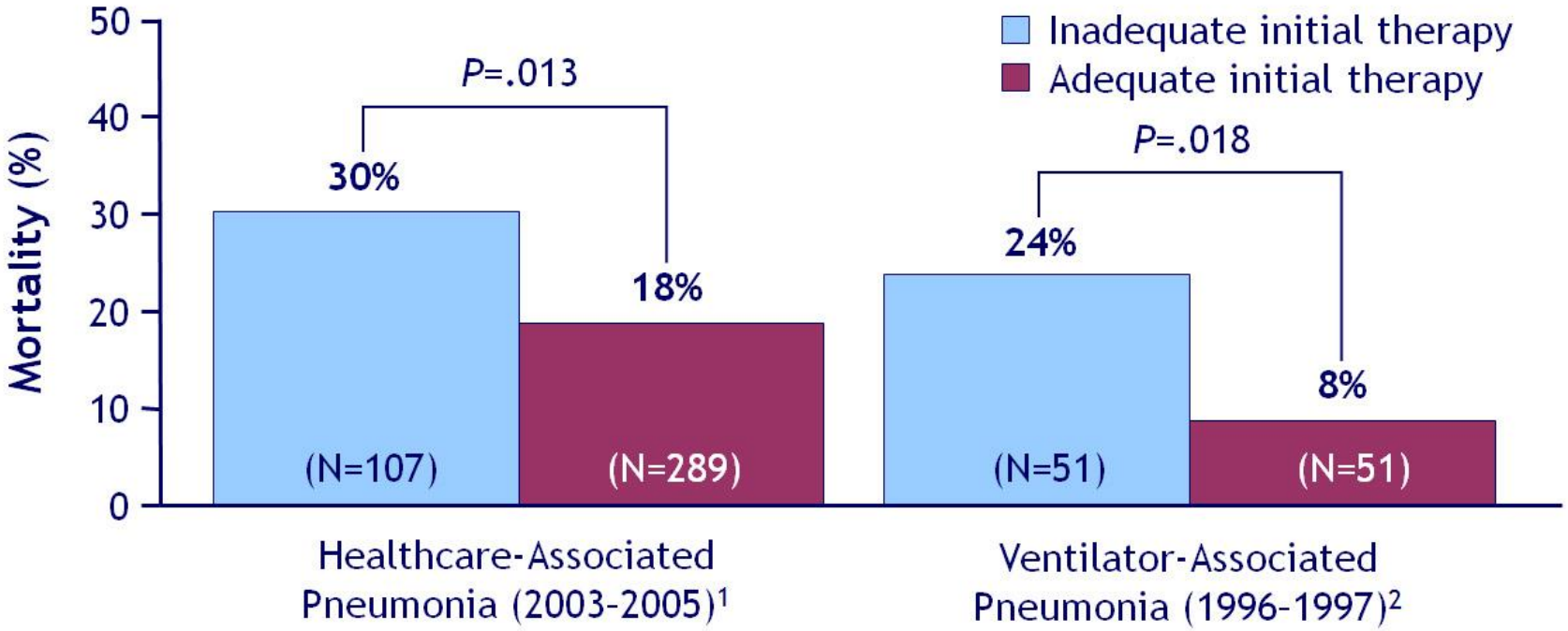
ICU=intensive care unit.

[a]Site of infection includes bloodstream, lung, wound, gastrointestinal tract, urinary tract, and miscellaneous (includes peritoneal infection, meningitis, endocarditis, and infections of the skin and fascia).

1. Kollef MH. *Chest*. 1999;115:462-474.

Higher Mortality Associated With Inadequate Empirical Antibiotic Therapy in Patients With Pneumonia

Retrospective[1] and prospective,[2] single-center, cohort analyses

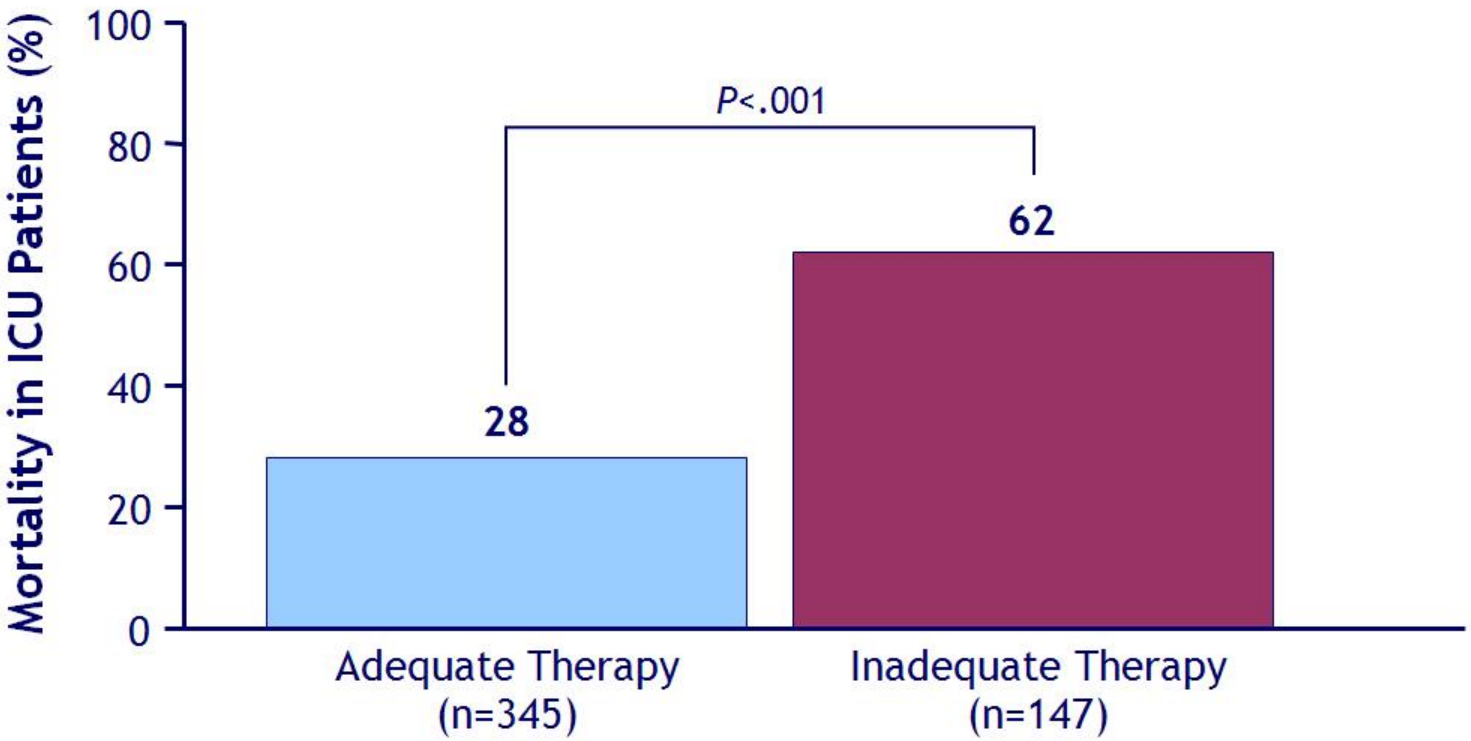


- Among patients with healthcare-associated pneumonia, subsequent escalation[a] of antibiotic therapy among patients who received inadequate initial therapy did not result in reduced risk of mortality[1]

[a]Escalation was defined as the switch to or addition of antibiotics with a broader spectrum.

1. Zilberberg MD, et al. *Chest*. 2008;134(5):963-968; 2. Kollef MH, et al. *Chest*. 1998;113:412-420.

Inadequate Therapy Increases Mortality Among Patients With Bloodstream Infections[a]



ICU=intensive care unit.

[a]Major isolates: coagulase-negative staphylococci, *Staphylococcus aureus*, and *Candida* species.

Ibrahim EH, Sherman G, Ward S, Fraser VJ, Kollef MH. The influence of inadequate antimicrobial treatment of bloodstream infections on patient outcomes in the ICU setting. *Chest*. 2000;118(1):146-155.

SO THEN HOW DOES ONE

CHOOSE

AN ADEQUATE ANTIBIOTIC ?

Many infections are self limited and lead to minimal morbidity and mortality in hosts with normal defense mechanisms

I.E. They get better in spite of our correct or incorrect antibiotic choice and usage

In seriously ill patients, because of compromised immune function, anatomic abnormalities or infection with more virulent organisms, the outcome of the infection depends on early institution and correct use of APPROPRAITE AND ADEQUATE antimicrobial therapy

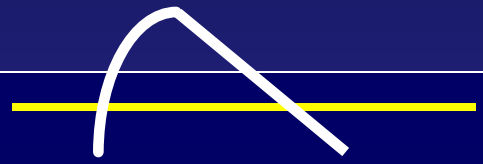
Empiric Antimicrobial Regimens are based on:

- History and Physical
- Likely site of infection
- Knowledge of pathogens commonly causing infection at that site
- Gram stain of appropriate specimen, modify regimen when pathogen(s) known

The role of antibacterials is to eradicate the causative organisms from the site of infection

The "New Science": Pharmacokinetics and Pharmacodynamics

Concept in Summary:

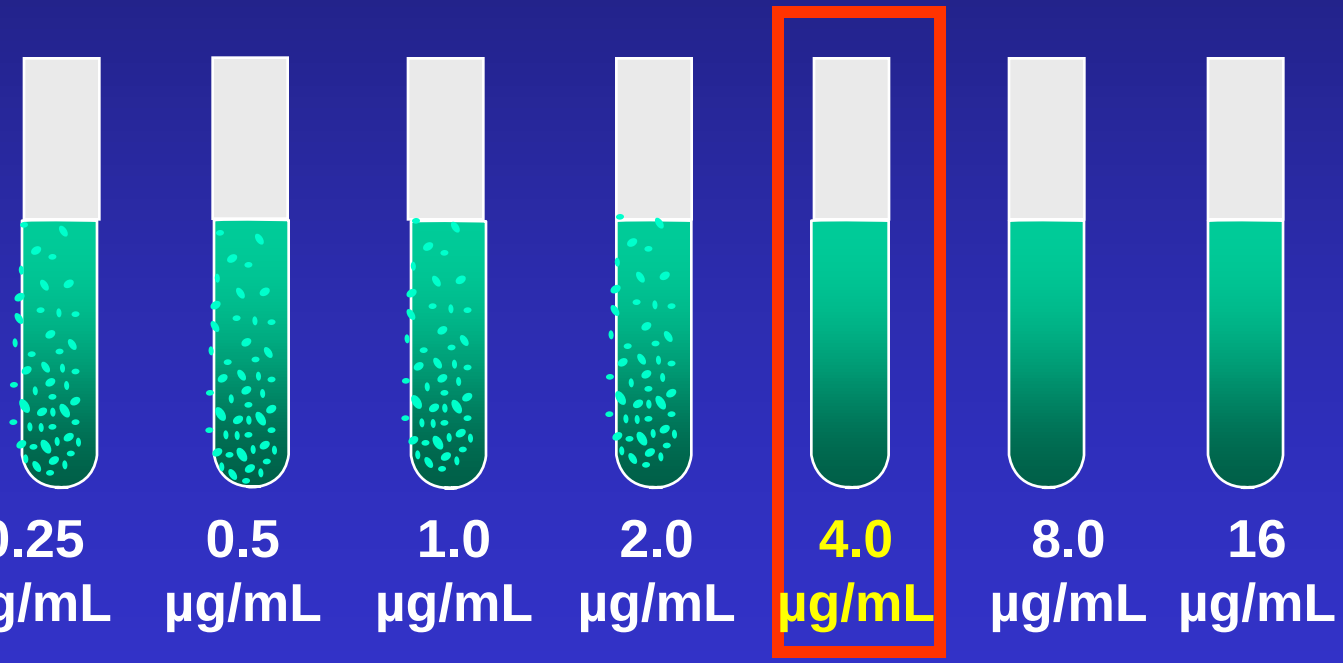


- **Is there an antibiotic level in blood that predicts bacterial eradication and clinical success?**
- **If so, what is the optimal profile to maximize bacterial kill?**
  - **↑Peak level of Abx = ↑ bacterial kill ?**
  - **↑ Length of Time that Abx level exceeds the MIC = ↑ bacterial kill ?**
- **Once PK/PD requirements are known, one can:**
  - **√ Calculate appropriate doses of new or existing agents**
  - **√ Compare antimicrobial activity of existing agents and utilize data in the development of guidelines**
  - **√ Determine susceptibility of isolated pathogens**

MIC: MINIMAL INHIBITORY CONCENTRATION

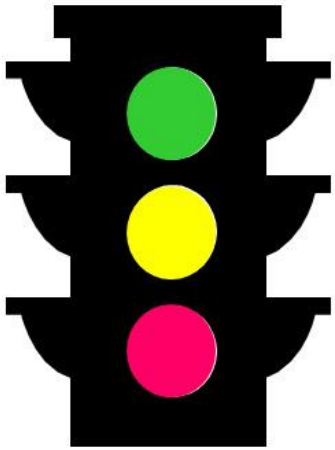
Drug potency is measured by determining lowest concentration of an antimicrobial that results in the inhibition of visible growth of a microorganism after overnight exposure

Known bacterial inoculum placed into each tube



Minimum Inhibitory Concentration[1]

- The minimum inhibitory concentration (MIC) is the lowest concentration of a particular drug that inhibits the growth of an organism
- Breakpoints for the interpretation of MIC values are defined independently by the FDA and the CLSI



Susceptible

Intermediate

Resistant

- Nonsusceptible: classification for organisms for which only a susceptible interpretive criterion has been designated because resistant strains are absent or rarely occur

FDA=Food and Drug Administration; CLSI=Clinical and Laboratory Standards Institute.

1. Clinical and Laboratory Standards Institute. *Performance Standards for Antimicrobial Susceptibility Testing*. Twentieth Informational Supplement. Wayne, PA; 2010.

RUN TIME: 1633 PCI Report
RUN USER: JRS.GC PCI User: JRS.GC Lab Database: LAB.JFK
[redacted] Sex: M [redacted]
Status: DIS IN Location: 3S
Req: [redacted]

SPEC #: [redacted] COLL: 03/28/17-1736 STATUS: COMP
RECD: 03/28/17-1925
SOURCE: Thigh ENTR: 03/28/17-1736
SPDESC: Left
ORDERED: WND/OS CALLTEST, WND CALL TEST, SURG AER/ANAER
COMMENTS: Comments: INNER THIGH ABCESS C/S (A/A,AFB, GRAM STAIN, FUNGUS)

Procedure	Result	Verified	Site
WOUND/OTHER SITE CALL TEST Final	Notification of 1+ WBC , 2+ GRAM POSITIVE COCCI PAIRS AND CLUSTERS AND 1+ GRAM VARIABLE RODS was taken and read back by:ALICIA PELLO on 03/29/17 at 0113. The call was made by BURKE,MARTHA (CL)	03/29/17-0114	CL
WND/OTHER CALL TEST Final	Notification of 1+ WBC, 2+ GRAM-POSITIVE COCCI IN PAIRS AND CLUSTERS, 1+ GRAM-VARIABLE RODS was taken and read back by: JNUREW4 on 03/29/17 at 0115. The call was made by PELO,ALICIA S	03/29/17-0119	
GRAM STAIN Final	1+ (5-10/slide) WBC(s) 2+ (1-5/O.I.F) Gram Positive Cocci in Pairs in Clusters 1+ (5-10/slide) Gram Variable Rods Wound call test ordered	03/29/17-0113	CL
SURGICAL CULTURE AER/ANAER Final		04/01/17-0006	CL
Organism 1	*Enterococcus species Moderate Mixed Anaerobic Flora Present		
BILLING INFORMATION	No Sensitivity Charge		

*Enterococcus species

	MIC mcg/ml	INTERPRETATION
AMPICILLIN	<=2	S
VANCOMYCIN	2	S
LEVOFLOXACIN	1	S

INVITED COMMENTARY

And Therein Lies the Resistance

Larry Marc Bush, MD

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Current Infectious Disease Reports 2008, **10**:1–2
Current Medicine Group LLC ISSN 1523-3847

I suppose it was in part my undergraduate studies in microbiology or perhaps my fortunate encounters during medical school clinical rotations with physicians who possessed a unique command of medical knowledge and an understanding of disease processes that kindled within me a special fascination and interest,

Available evidence indicates that acquired resistance was absent from bacteria collected prior to the antibiotic era [3], thus strongly implying that past and current antimicrobial prescribing patterns serve as the driving force behind the progressive increase in bacterial resistance we are now experiencing. Historically, resistance has been most prevalent in health care settings, particularly in intensive care units, where heavy antibiotic use has had a substantial influence on selective resistance pressures. On the other hand, the more contemporary problems of drug-resistant *Streptococcus pneumoniae*, community-acquired methicillin-resistant *Staphylococcus aureus*, and extended-spectrum β-lactamase–producing Enterobacteriaceae are directly linked to the community, the setting for 80% of current human antimicrobial use [4].

'TIME DEPENDENT ANTIBIOTICS'

TIME > MIC CORRELATES WITH CLINICAL ADEQUACY

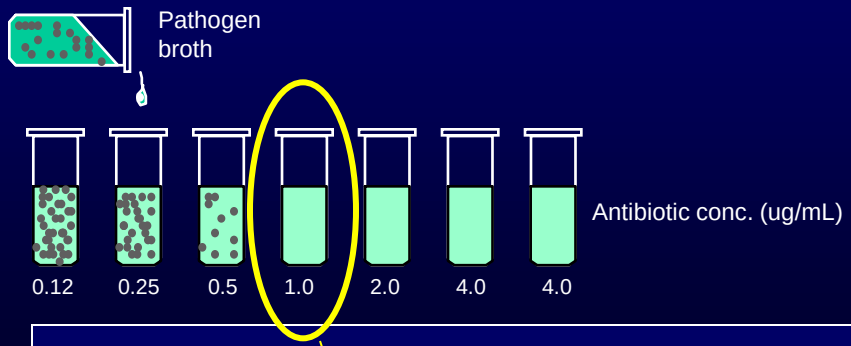
HOW MUCH TIME IS THAT ?

MORE IS NOT BETTER, JUST MORE

Pharmacokinetics and Pharmacodynamics: Required information

Step 1: Determine MIC:

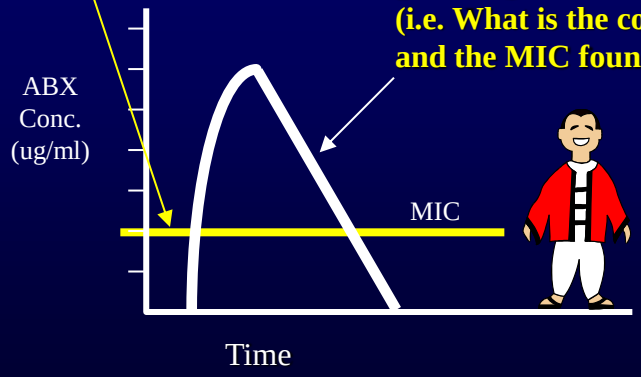
How much antibiotic is required to inhibit further growth (stasis) *in a test tube?*



Step 2: Determine Dose:

How much antibiotic is required *in the blood* to kill the pathogen at its site?

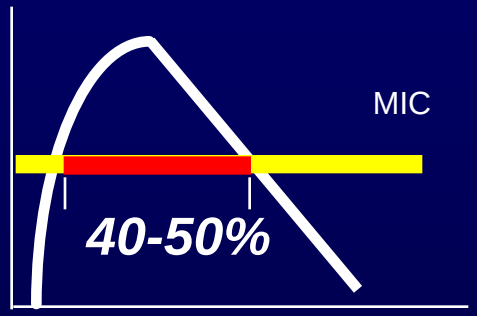
(i.e. What is the correlation between the required serum level in the body and the MIC found in the lab?)



- How high? (peak level vs MIC)
- How long? (time above MIC)
- How high for how long? (AUC vs MIC)

Predictors of Bacterial Eradication: Pharmacokinetic/Pharmacodynamic Profiles

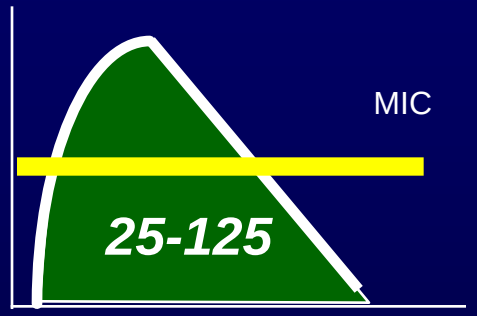
Time >MIC
(time-dependent activity)



- Penicillins
- Cephalosporins
- Erythromycin
- Clarithromycin

Optimal profile:
Antibiotic level exceeds MIC for at least 40% of dosing interval

AUC_{24}/MIC
(concentration-dependent activity)

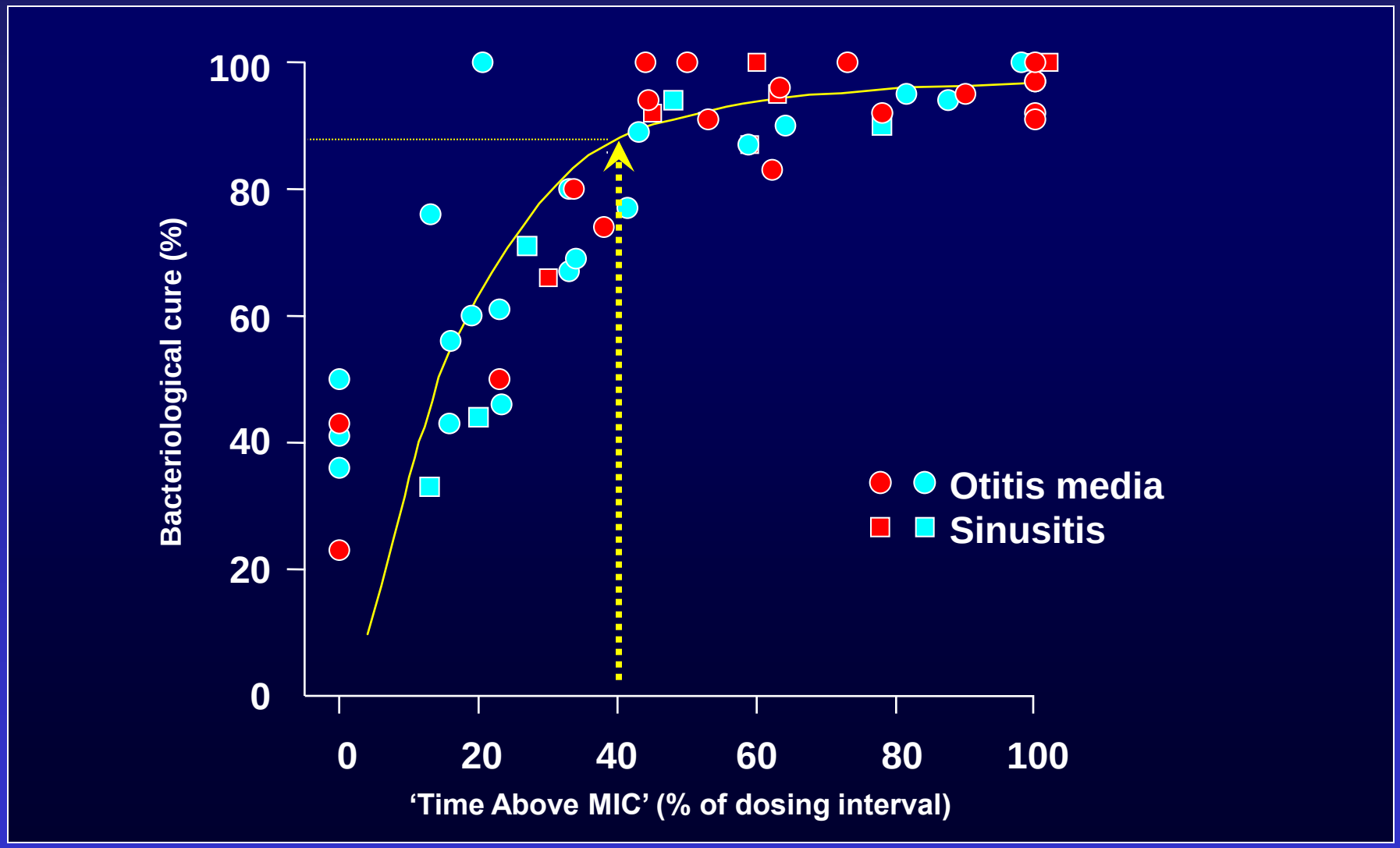


- Quinolones
- Aminoglycosides
- Azithromycin

Optimal profile:
AUC/MIC ratio at least:
25-30 (Strep., other gram-positive)
125 (gram-negative bacilli)

1. Craig WA. *Clin Infect Dis.* 1998;26:1-12.

The relationship between 'time above MIC_{90}' and bacteriological cure in *S. pneumoniae* (red) and *H. influenzae* (blue) in otitis media and sinusitis



Craig & Andes, Pediatr Infect Dis J 15;255,1996

MAJOR ARTICLE

Outcomes of Bacteremia due to *Pseudomonas aeruginosa* with Reduced Susceptibility to Piperacillin-Tazobactam: Implications on the Appropriateness of the Resistance Breakpoint

Vincent H. Tam,[1,2] Eric A. Gamez,[1] Jaye S. Weston,[2] Laura N. Gerard,[1,2] Mark T. LaRocco,[2] Juan Pablo Caeiro,[2] Layne O. Gentry,[2] and Kevin W. Garey[1,2]

[1]University of Houston College of Pharmacy and [2]St Luke's Episcopal Hospital, Houston, Texas

Background. Bacteremia due to *Pseudomonas aeruginosa* is associated with grave clinical outcomes. Recent studies have emphasized the importance of appropriate empirical therapy, but controversy arises when piperacillin-tazobactam is used against isolates with reduced susceptibility.

Methods. We performed a retrospective cohort study of pseudomonal bacteremia from 2002 to 2006. Patients were identified by the microbiology laboratory database, and pertinent clinical data (demographic characteristics, baseline Acute Physiology and Chronic Health Evaluation [APACHE] II scores, source of bacteremia, and therapy) were retrieved from the electronic medical records. All patients received appropriate empirical therapy within 24 h of positive culture results. Patients receiving piperacillin-tazobactam were compared with those receiving other agents (control subjects). The primary outcome was 30-day mortality from the first day of bacteremia.

Results. A total of 34 bacteremia episodes were identified involving isolates with reduced susceptibility to piperacillin-tazobactam (minimum inhibitory concentration, 32 or 64 mg/L, reported as susceptible); piperacillin-tazobactam was empirically given in 7 episodes. There was no significant difference in baseline characteristics between the 2 groups. Thirty-day mortality was found to be 85.7% in the piperacillin-tazobactam group and 22.2% in the control group ($P = .004$). Time to hospital mortality was also found to be shorter in the piperacillin-tazobactam group ($P < .001$). In the multivariate analysis, 30-day mortality was found to be associated with empirical piperacillin-tazobactam therapy (odds ratio, 220.5; 95% confidence interval, 3.8–12707.4; $P = .009$), after adjustment for differences in age and APACHE II score.

Conclusions. In *P. aeruginosa* bacteremia due to isolates with reduced piperacillin-tazobactam susceptibility, empirical piperacillin-tazobactam therapy was associated with increased mortality. Additional studies are warranted to examine the appropriateness of the current Clinical Laboratory Standards Institute resistance breakpoint of piperacillin-tazobactam.

INVITED ARTICLE MEDICAL MICROBIOLOGY

L. Barth Reller and Melvin P. Weinstein, Section Editors

Background and Rationale for Revised Clinical and Laboratory Standards Institute Interpretive Criteria (Breakpoints) for Enterobacteriaceae and *Pseudomonas aeruginosa:* I. Cephalosporins and Aztreonam

Michael N. Dudley,[1] Paul G. Ambrose,[2] Sujata M. Bhavnani,[2] William A. Craig,[3] Mary Jane Ferraro,[4] and Ronald N. Jones;[5] for the Antimicrobial Susceptibility Testing Subcommittee of the Clinical and Laboratory Standards Institute

[1]Rempex Pharmaceuticals, San Diego, California; [2]Institute for Clinical Pharmacodynamics, Inc, Latham, New York; [3]Department of Medicine, University of Wisconsin School of Medicine, Madison; [4]Massachusetts General Hospital and Harvard Medical School, Boston; [5]JMI Laboratories, North Liberty, Iowa

Widespread resistance in Enterobacteriaceae and *Pseudomonas aeruginosa* to cephalosporin and monobactam antibiotics due to extended-spectrum β-lactamases (ESBLs) has resulted in the need for reassessment of the interpretative criteria (breakpoints) established for these agents more than 2 decades ago. Following extensive evaluation, the Clinical and Laboratory Standards Institute recently adopted and published new breakpoints for these agents for use in clinical laboratories and provided updated recommendations for use of the ESBL screening test. This paper summarizes the background and supportive rationale for new interpretative criteria for cephalosporins and aztreonam for testing Enterobacteriaceae.

Table 1. Clinical Outcome by Minimum Inhibitory Concentration in 42 Patients With Bacteremia Due to *Escherichia coli* and *Klebsiella pneumoniae* Producing Various β-Lactamases Treated With Cephalosporin Monotherapy

MIC, mg/L	% Response	% Failure
≤1	81	19
2	67	33
4	27	73
≥8	11	89

Table 3. Revised and Pre-2010 Clinical and Laboratory Standards Institute Breakpoints for Cephalosporins and Aztreonam for Enterobacteriaceae

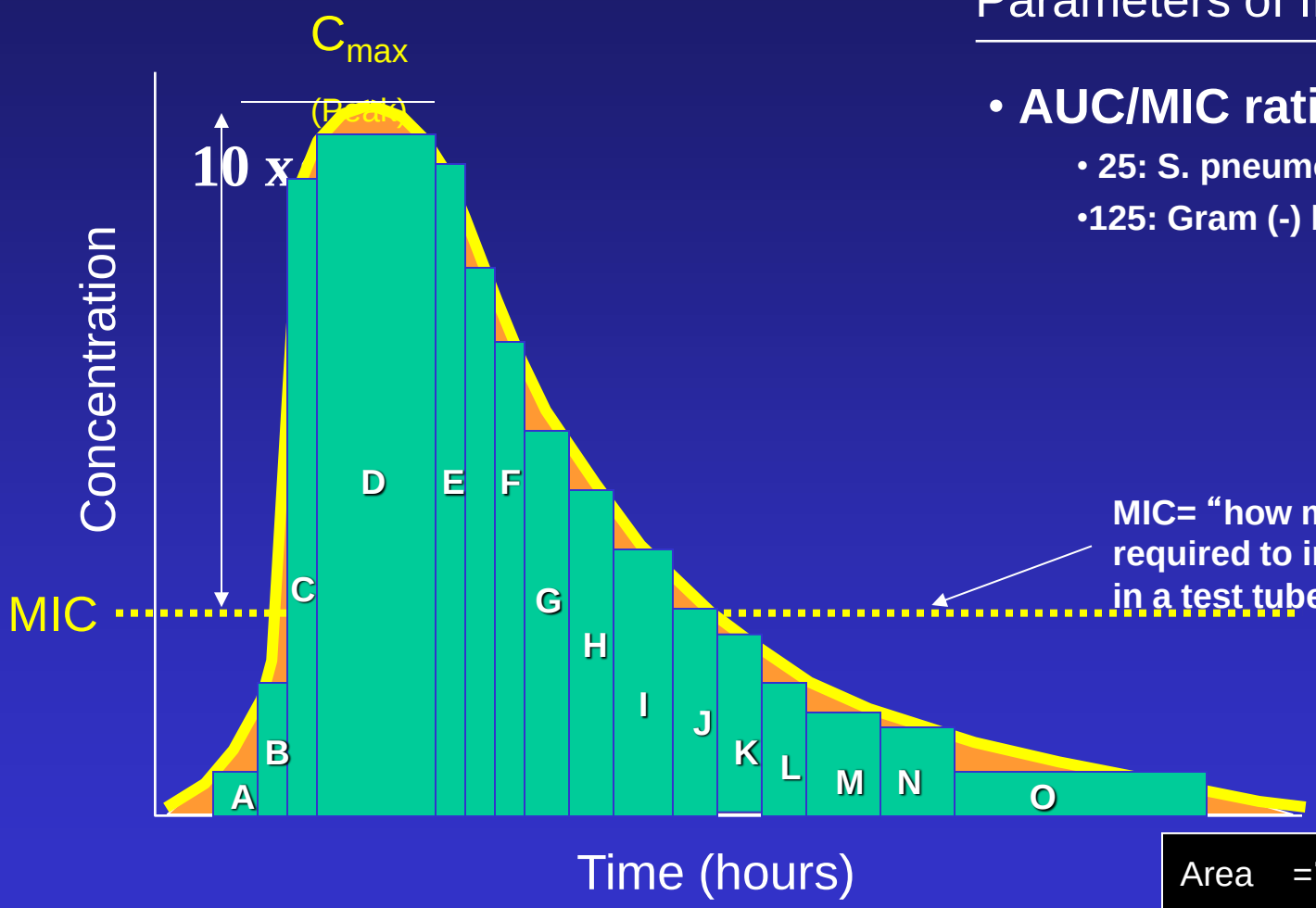
	MIC (μg/mL)						Disk (mm)					
	Revised			Pre-2010			Revised			Pre-2010		
Drug (Dosage)[a]	S	I	R	S	I	R	S	I	R	S	I	R
Aztreonam (1 g q8h)	≤4	8	≥16	≤8	16	≥32	≥21	18–20	≤17	≥22	16–21	≤15
Cefotaxime (1 g q8h)	≤1	2	≥4	≤8	16–32	≥64	≥26	23–25	≤22	≥23	15–22	≤14
Ceftazidime (1 g q8h)	≤4	8	≥16	≤8	16	≥32	≥21	18–20	≤17	≥18	15–17	≤14
Ceftizoxime (1 g q12h)	≤1	2	≥4	≤8	16–32	≥64	≥25	22–24	≤21	≥20	15–19	≤14
Ceftriaxone (1 g q24h)	≤1	2	≥4	≤8	16–32	≥64	≥23	20–22	≤19	≥21	14–20	≤13

‘CONCENTRATION DEPENDENT ANTIBIOTICS’

- **AUC / MIC CORRELATES WITH CLINICAL ADEQUACY**

MORE IS BETTER !

Pharmacokinetic/Pharmacodynamic Predictors of Efficacy



Parameters of Interest:

- **AUC/MIC ratio**
  - **25: S. pneumoniae, Gram (+)**
  - **125: Gram (-) bacilli**

MIC= "how much abx is required to inhibit growth in a test tube"

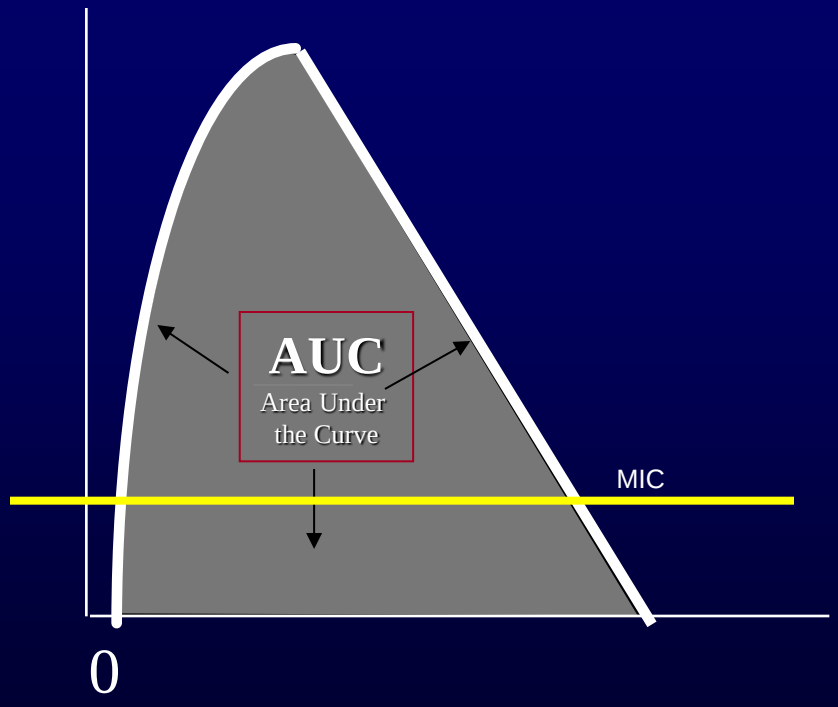
Area ="length x width"
= conc. X time
= mg/l x hr
A+B+C+E+… = AUC

Craig W. Pharmacokinetic/Pharmacodynamic Parameters: Rationale for Antibacterial Dosing of Mice and Men. *Clin Infect Dis.* 1998; 26:1-12.

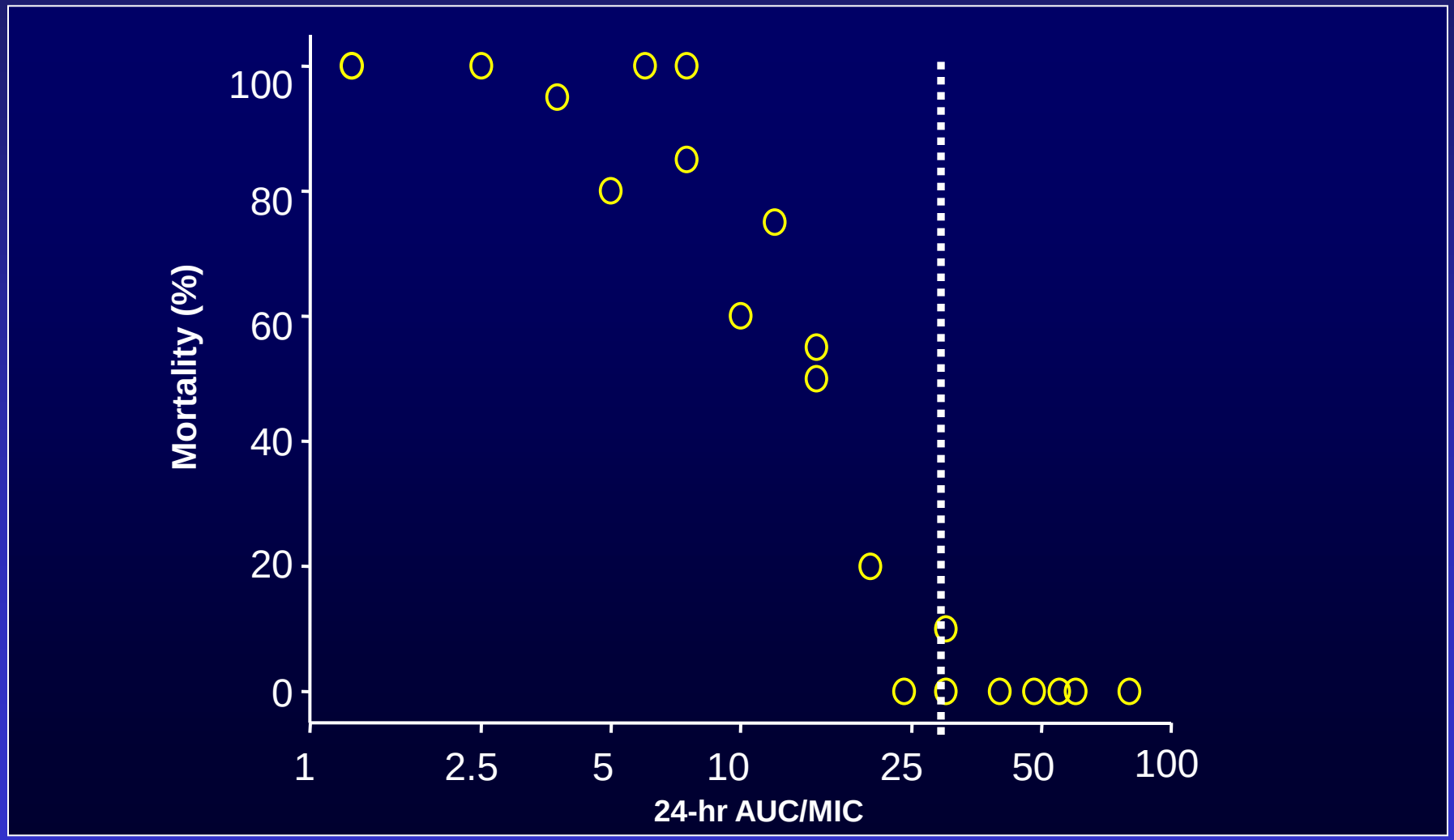
AUC:MIC ratio (area under the curve:MIC ratio):
Quinolones, Aminoglycosides and Azithromycin

Concentration-dependent killing

AUC_{24}: MIC ratio
25-30 = gm (+)
125 = gm (-)



Relationship between Antibiotic concentration (24-Hr AUC/MIC) and Mortality in Immunocompetent Animals infected with S. pneumoniae using Fluoroquinolones



Craig WA. Presented at ICAAC. 2000.

ANTIMICROBIAL AGENTS AND CHEMOTHERAPY, Mar. 2009, p. 1074–1079 Vol. 53, No. 3
0066-4804/09/$08.00+0 doi:10.1128/AAC.00580-08

Effect of Differences in MIC Values on Clinical Outcomes in Patients with Bloodstream Infections Caused by Gram-Negative Organisms Treated with Levofloxacin▽

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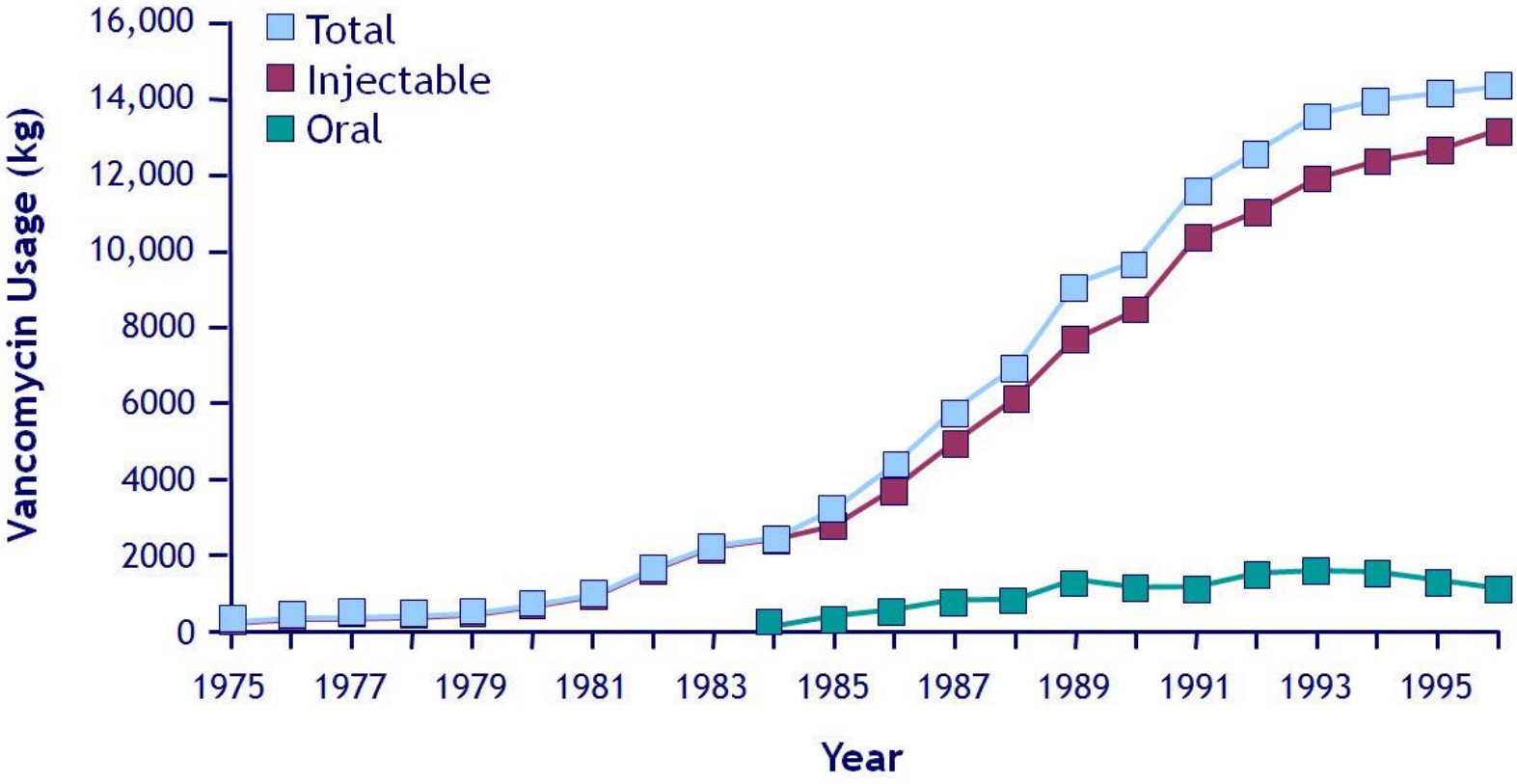
Department of Pharmacy, Northwestern Memorial Hospital, Chicago, Illinois[1]; Department of Pharmacy Practice, Chicago College of Pharmacy, Midwestern University, Downers Grove, Illinois[2]; Division of Internal Medicine, Feinberg School of Medicine, Northwestern University, Chicago, Illinois[3]; and Division of Infectious Diseases, Feinberg School of Medicine, Northwestern University, Chicago, Illinois[4]

Received 2 May 2008/Returned for modification 30 August 2008/Accepted 8 December 2008

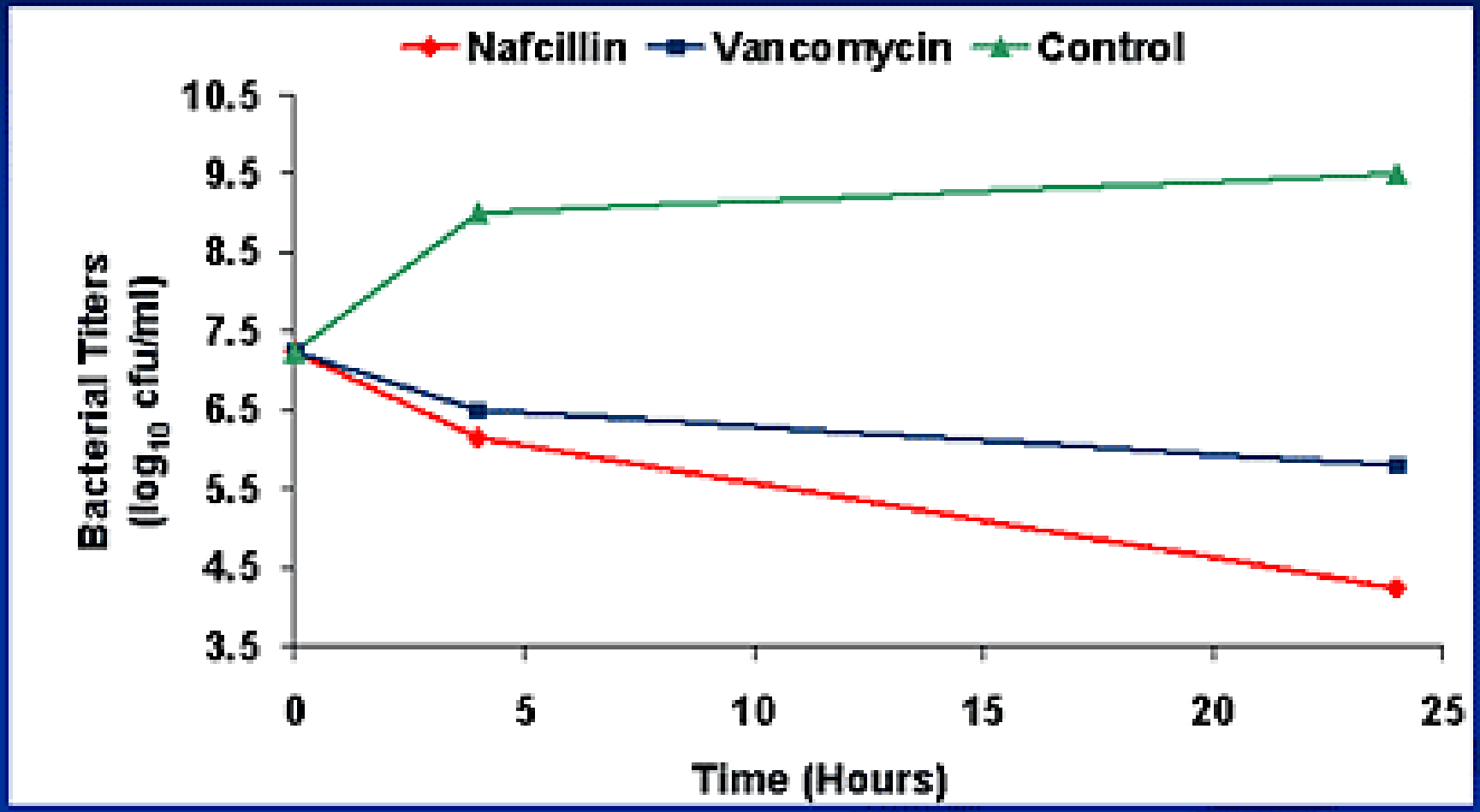
Emerging evidence suggests that current fluoroquinolone dosing strategies may be inadequate to treat bloodstream infections caused by organisms classified as sensitive. This study sought to determine if differences in MICs for levofloxacin-susceptible gram-negative organisms correlate with differences in patient outcomes. A retrospective cohort study evaluated patients treated with levofloxacin for bloodstream infections caused by susceptible gram-negative organisms. Patients infected with gram-negative organisms for which MICs indicated susceptibility were categorized into three groups: those with organisms for which MICs were low (≤0.25 mg/liter), intermediate (0.5 mg/liter), and high (1 or 2 mg/liter). Patients were evaluated for baseline similarity, all-cause mortality, and measurements of morbidity. A total of 404 patients with bloodstream infections caused by gram-negative organisms were identified. Of these patients, 312 were treated with levofloxacin and included in the analysis. No significant difference in all-cause mortality among the three groups was observed. The high-MIC group had a significantly longer average hospital stay postculture than the low- and intermediate-MIC groups (16.4 days versus 7.3 and 7.9 days; $P < 0.01$) and a significantly longer duration of infection (2.1 days versus 1.0 and 1.2 days; $P < 0.001$). Multivariate analysis adjusting for covariates revealed that a high MIC was associated with an increase of 5.67 days (95% confidence interval, 0.77 to 10.62 days; $P = 0.02$) in the mean length of stay postculture compared to the mean length of stay for the low-MIC group. Patients treated with levofloxacin for bloodstream infections caused by gram-negative organisms for which MICs were elevated, yet still in the susceptible category, had worse outcomes than similar patients infected with organisms for which MICs were lower. In vitro susceptibility classifications of fluoroquinolones for the treatment of bloodstream infections caused by gram-negative organisms require further study.

Vancomycin Utilization Over 20 Years[1]



1. Kirst HA, et al. *Antimicrob Agents Chemother*. 1998;42(5):1303-1304.

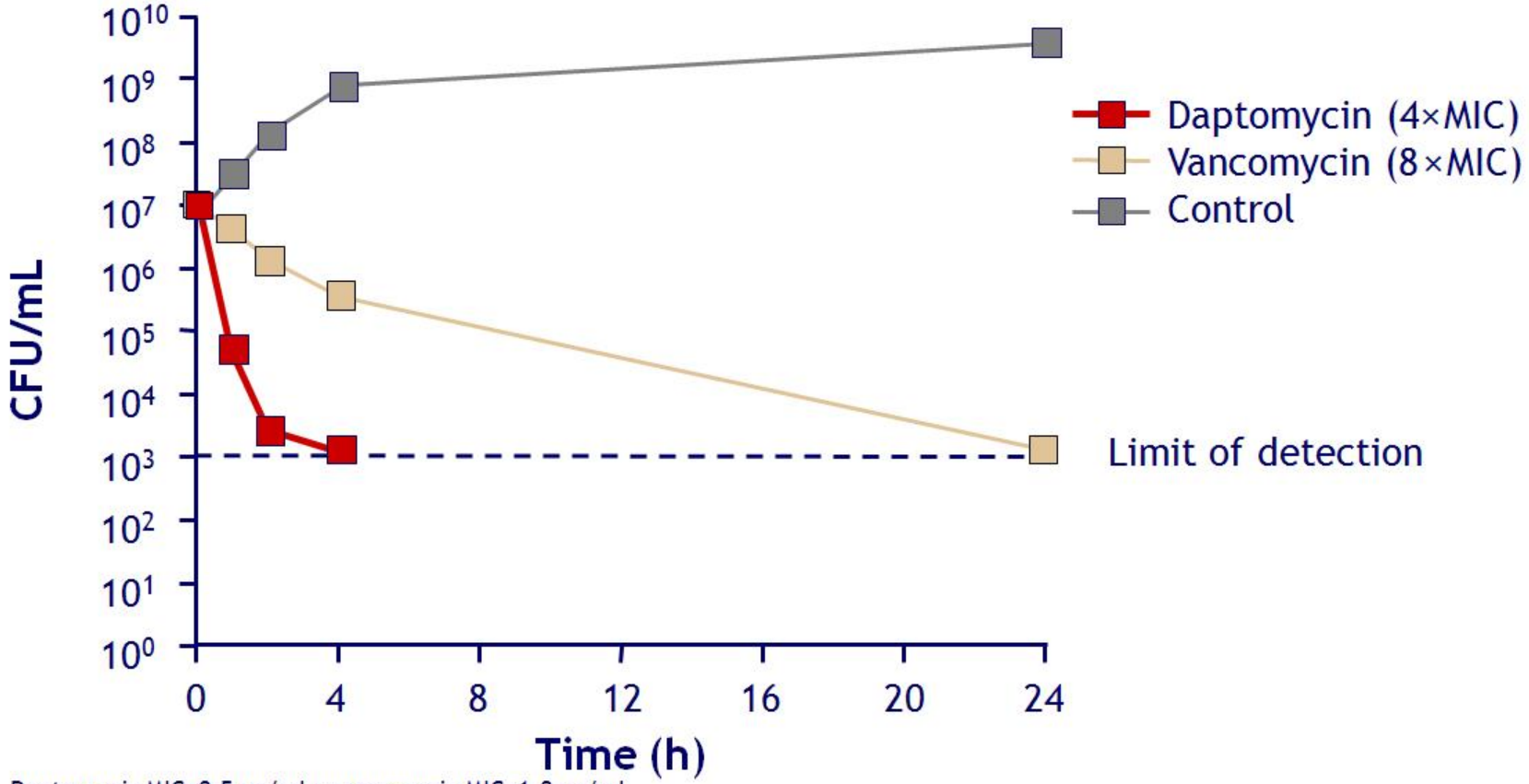
Time-Kill Curves* for Nafcillin and Vancomycin at 4 Times the MIC



*10 clinical isolates of *S aureus*

Small PM et al. *Antimicrob Agents Chemother.* 1990;34:1227-1231

Rapid *In Vitro*[a] Bactericidal Activity Against MRSA
Daptomycin vs Vancomycin



Daptomycin MIC=0.5 µg/mL; vancomycin MIC=1.0 µg/mL.

MRSA=methicillin-resistant *Staphylococcus aureus*; CFU=colony forming unit; MIC=minimum inhibitory concentration.

[a]The clinical significance of *in vitro* data has not been established.

Mortin LI, Li T, Van Praagh A, Zhang S, Zhang X-X, Alder J. Rapid bactericidal activity of daptomycin against MRSA and MSSA peritonitis in mice as demonstrated with bioluminescent bacteria. Poster presented at: 104th American Society of Microbiology General Meeting; May 23-27, 2004; New Orleans, LA. Poster O-022.

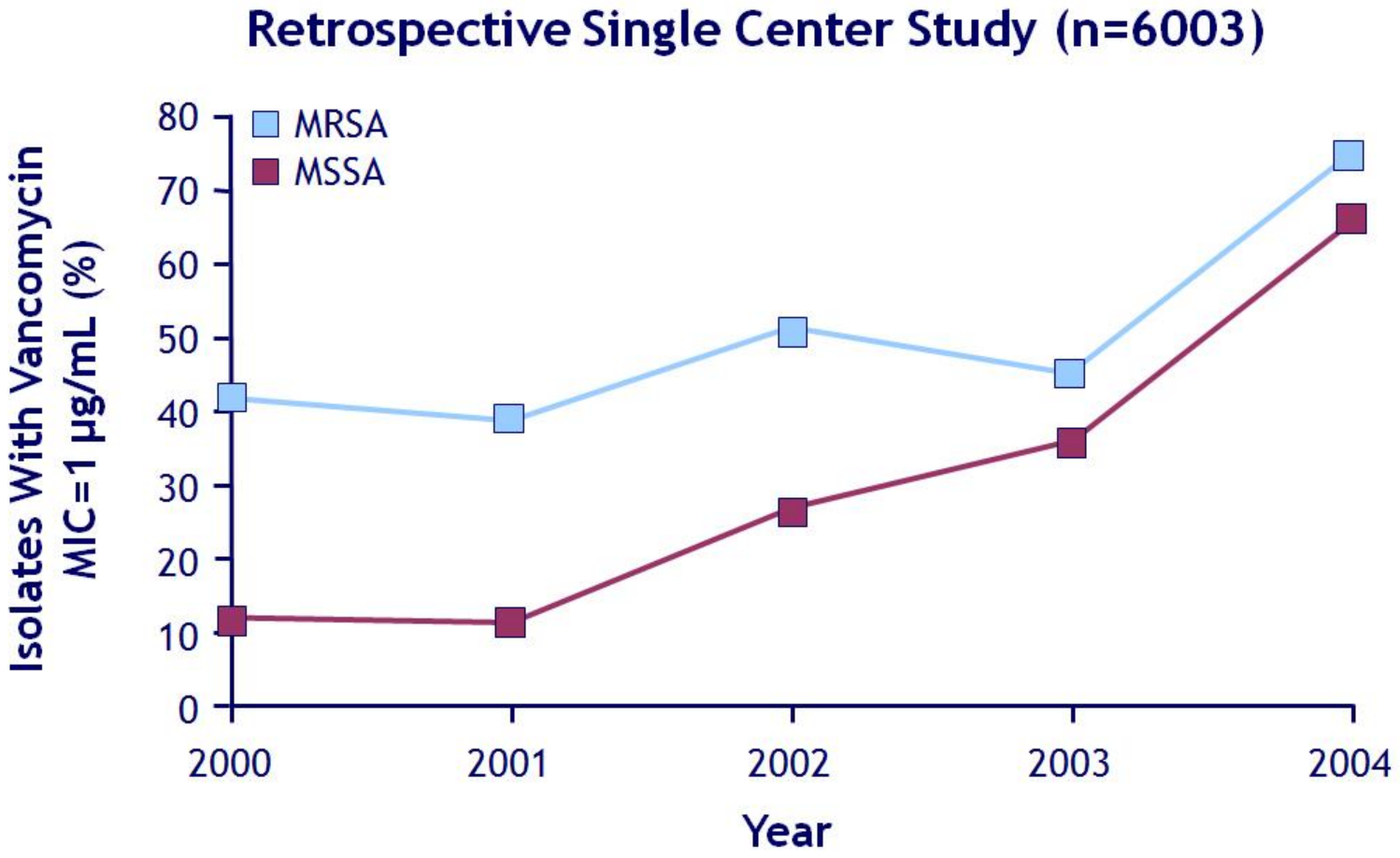
Consequences of Increasing Vancomycin Utilization

- Susceptible but higher vancomycin MICs
- Heterogeneous (heteroresistant) vancomycin-intermediate *Staphylococcus aureus* (hVISA)
- Vancomycin-intermediate *S. aureus* (VISA)
- Vancomycin-resistant *S. aureus* (VRSA)

MICs=minimum inhibitory concentrations.

Marr KA. *Staphylococcus aureus* bacteremia in patients undergoing hemodialysis. *Semin Dial*. 2000;13(1):23-29; Jones RN. Microbiological features of vancomycin in the 21st century: minimum inhibitory concentration creep, bactericidal/static activity, and applied breakpoints to predict clinical outcomes or detect resistant strains. *Clin Infect Dis*. 2006;42(suppl 1):S13-S24; Liu C, Chambers HF. *Staphylococcus aureus* with heterogeneous resistance to vancomycin: epidemiology, clinical significance, and critical assessment of diagnostic methods. *Antimicrob Agents Chemother*. 2003;47(10):3040-3045.

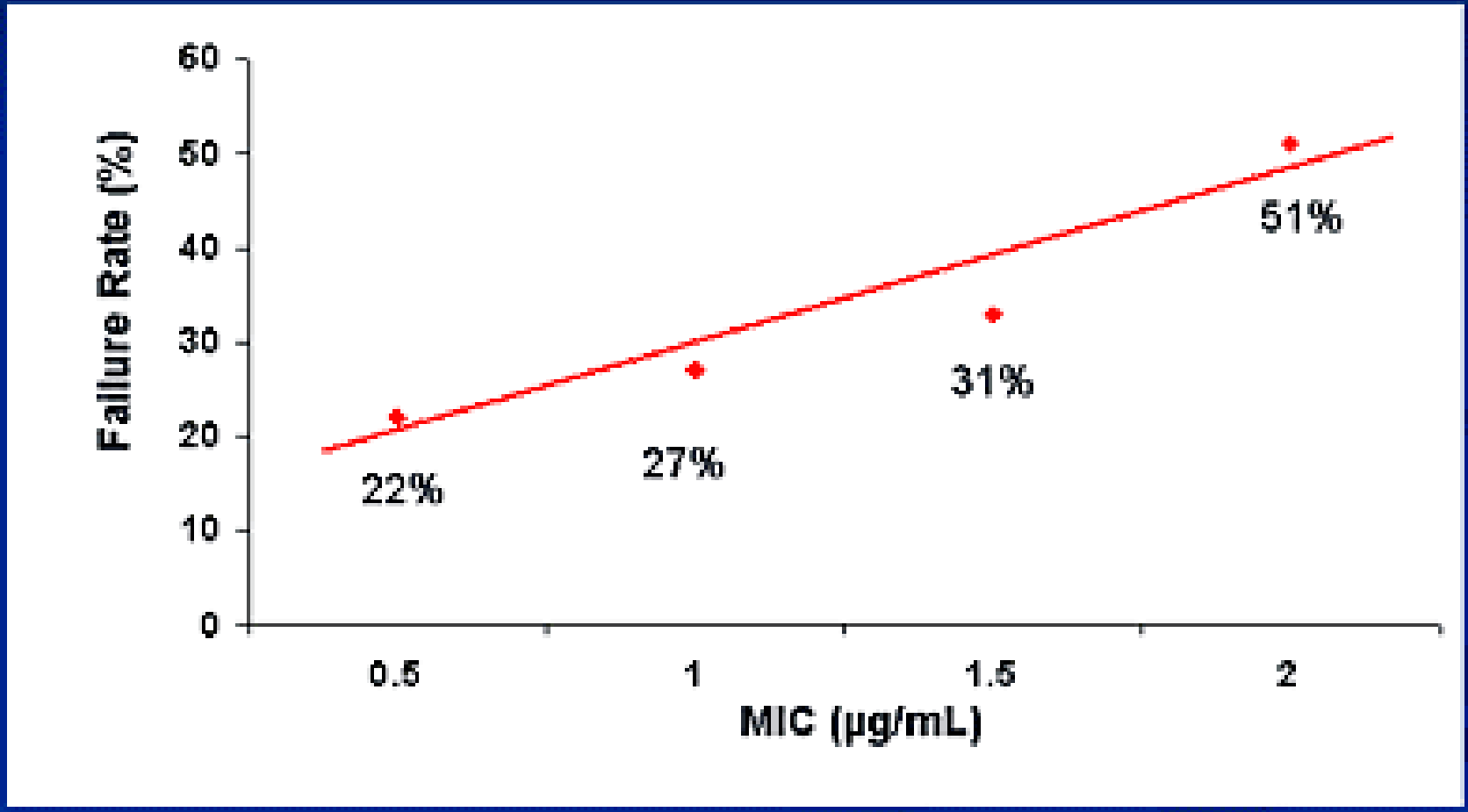
Increasing Prevalence of Vancomycin MIC of 1 µg/mL Among *Staphylococcus aureus* Isolates



MIC=minimum inhibitory concentration; MRSA=methicillin-resistant *S. aureus*; MSSA=methicillin-susceptible *S. aureus*.

Wang G, Hindler JF, Ward KW, Bruckner DA. Increased vancomycin MICs for *Staphylococcus aureus* clinical isolates from a university hospital during a 5-year period. *J Clin Microbiol*. 2006;44(11):3883-3886.

Relationship of MIC to Vancomycin Treatment Failures in MRSA Infections

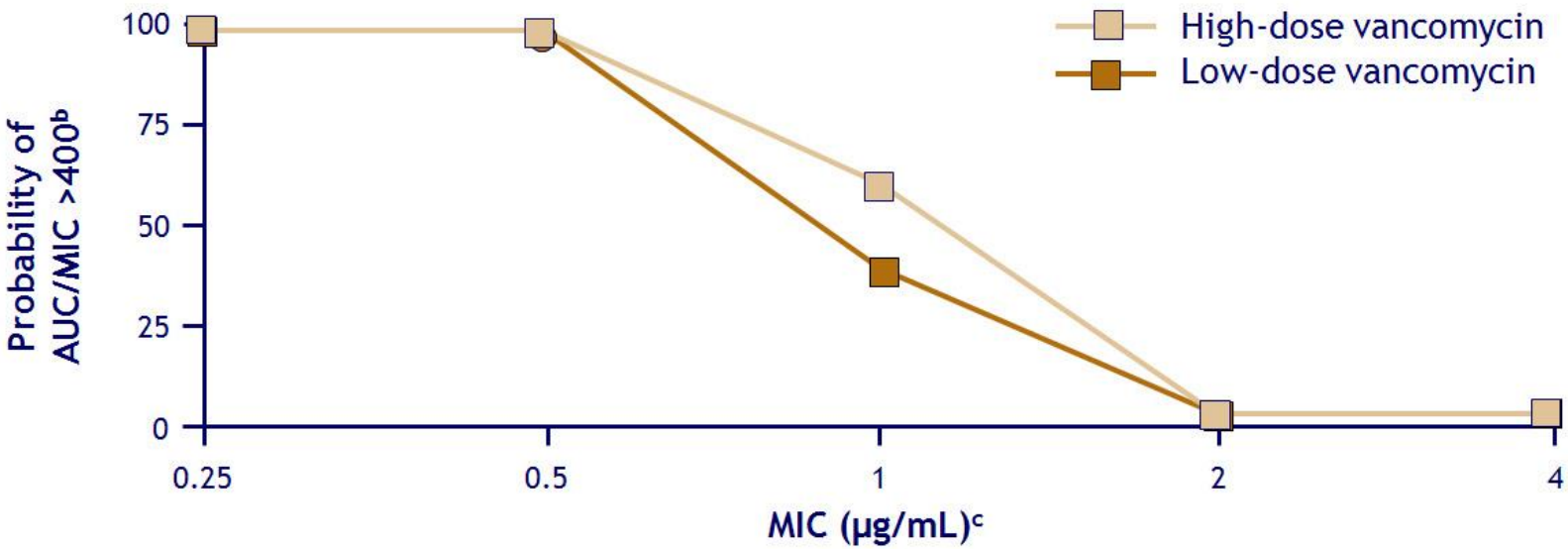


Moise-Broder PA et al. *Clin Infect Dis.* 2004;38:1700-1705.

Probability of Achieving an AUC/MIC >400 With High- and Low-Dose Vancomycin[1,2]

Vancomycin pharmacokinetic parameters

	Mean Trough	Mean AUC
Low dose (troughs <15 µg/mL) (n=68)	9.4±3.2[a]	318±111[a]
High dose (troughs ≥15 µg/mL) (n=34)	20.4±3.2[a]	418±152[a]

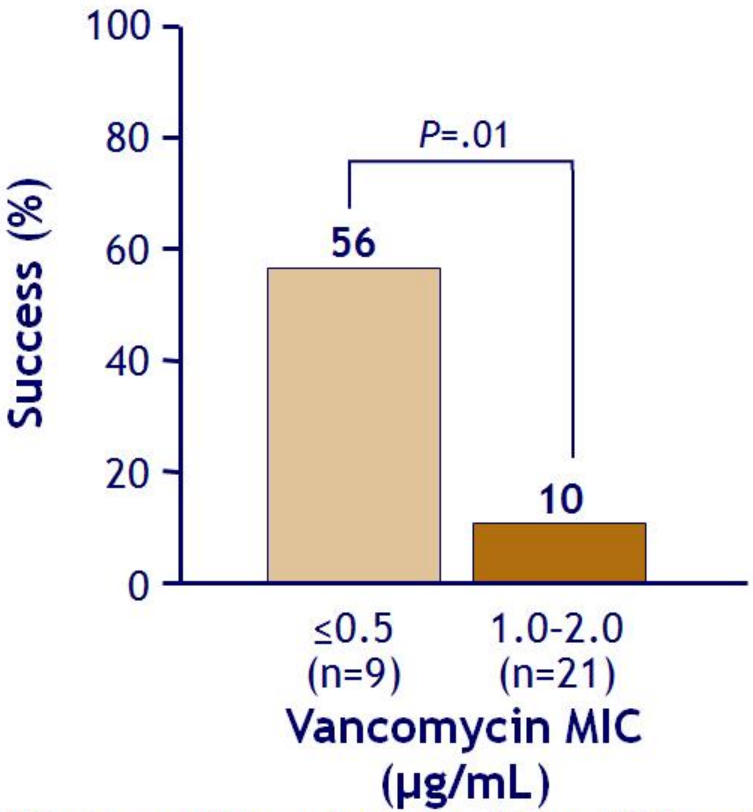


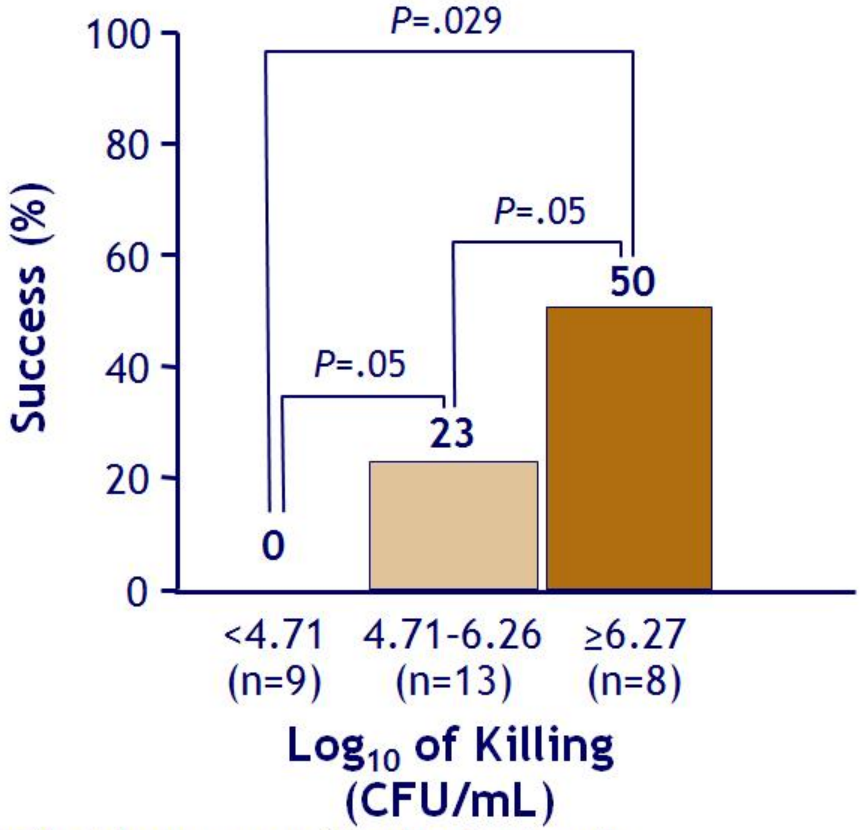
[a]$P<.001$; [b]By Monte Carlo simulation; [c]Determined by Clinical and Laboratory Standards Institute Kirby-Bauer disk diffusion methods. AUC=area under the curve; MIC=minimum inhibitory concentration.

1. Jeffres MN, et al. *Chest*. 2006;130(4):947-955; 2. Mohr JF, et al. *Clin Infect Dis*. 2007;44(12):1536-1542.

Therapeutic Efficacy of Vancomycin in Relation to MIC and Bactericidal Activity

Vancomycin in MRSA Bacteremia

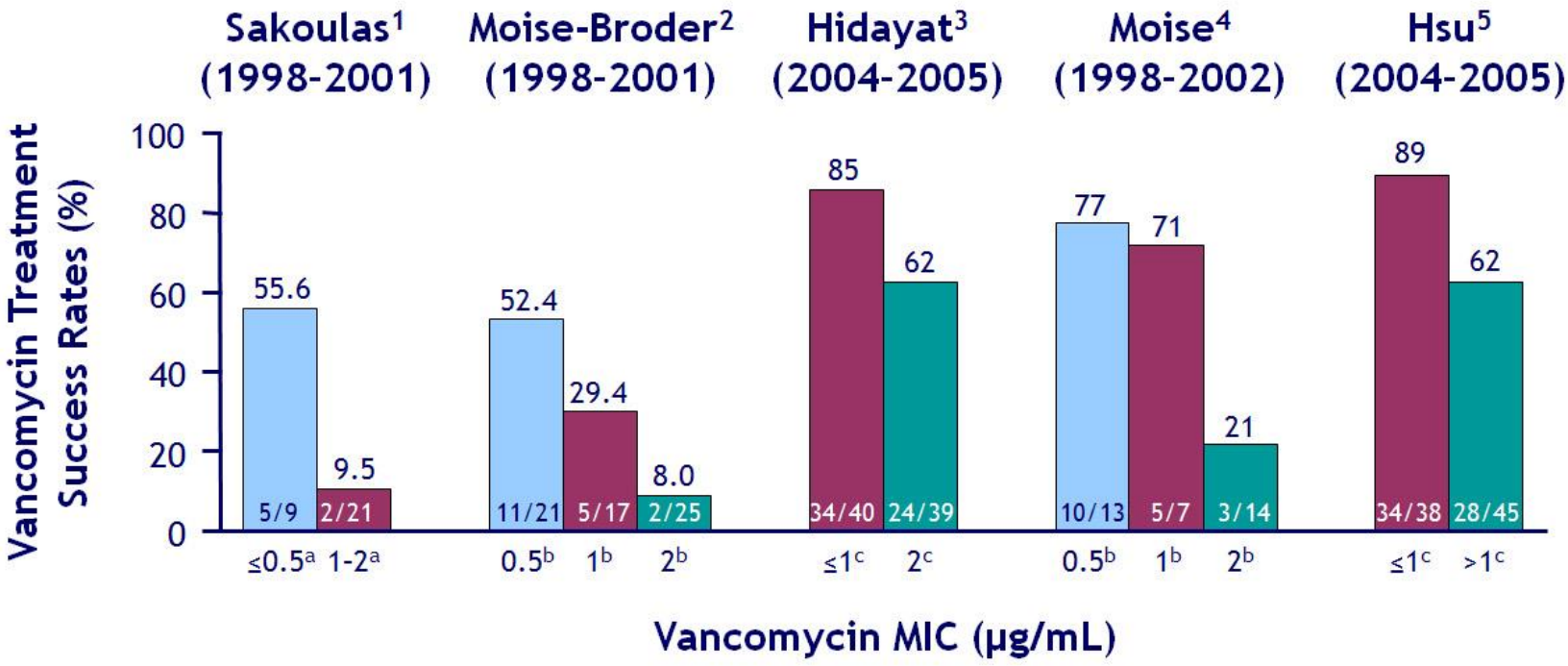




MIC=minimum inhibitory concentration; MRSA=methicillin-resistant *Staphylococcus aureus*; CFU=colony forming units.

Sakoulas G, Moise-Broder PA, Schentag J, Forrest A, Moellering RC Jr, Eliopoulos GM. Relationship of MIC and bactericidal activity to efficacy of vancomycin for treatment of methicillin-resistant *Staphylococcus aureus* bacteremia. *J Clin Microbiol*. 2004;42(6):2398-2402.

Vancomycin Treatment Response by Vancomycin MIC



[a]Determined by agar dilution; [b]Determined by broth dilution; [c]Determined by Etest®.

MRSA=methicillin-resistant *Staphylococcus aureus*; MIC=minimum inhibitory concentration.

1. Sakoulas G, et al. *J Clin Microbiol*. 2004;42:2398-2402; **2.** Moise-Broder PA, et al. *Clin Infect Dis*. 2004;38:1700-1705; **3.** Hidayat LK, et al. *Arch Intern Med*. 2006;166:2138-2144; **4.** Moise PA, et al. *Antimicrob Agents Chemother*. 2007;51:2582-2586; **5.** Hsu DI, et al. *Int J Antimicrob Agents*. 2008;32:378-385.

The Clinical Significance of Vancomycin Minimum Inhibitory Concentration in *Staphylococcus aureus* Infections: A Systematic Review and Meta-analysis

S. J. van Hal,[1,2] T. P. Lodise,[3] and D. L. Paterson[4]

[1]Department of Microbiology and Infectious Diseases, Sydney South West Pathology Services–Liverpool, South Western Sydney Local Health Network, New South Wales; [2]Antibiotic Resistance and Mobile Elements Group, Microbiology and Infectious Diseases Unit, School of Medicine, University of Western Sydney, Australia; [3]Albany College of Pharmacy and Health Sciences, New York; and [4]University of Queensland Centre for Clinical Research, Royal Brisbane and Womens Hospital Campus, Australia.

(See the Editorial Commentary by Deresinski, on pages 772–4.)

Background. Emerging data suggest that vancomycin may be less effective against serious methicillin-resistant *Staphylococcus aureus* (MRSA) infections with minimum inhibitory concentration (MIC) values at the higher end of the susceptibility range. The purpose of this review is to examine the strength of these associations.

Methods. All relevant studies pertaining to treatment outcomes or mortality associated with vancomycin MIC were retrieved from the medical literature from January 1996 through August 2011 and analyzed according to Cochrane guidelines.

Results. Of the 270 studies identified, 48 studies were reviewed, with 22 studies included in the final meta-analysis. Vancomycin MIC was significantly associated with mortality for MRSA infection irrespective of the source of infection or MIC methodology (odds ratio [OR], 1.64; 95% confidence interval [CI], 1.14–2.37; $P < .01$). This mortality association was predominantly driven by bloodstream infections (BSIs; OR, 1.58; 95% CI, 1.06–2.37; $P = .03$) and isolates with a vancomycin MIC of 2 μg/mL by Etest (OR, 1.72; 95% CI, 1.34–2.21; $P < .01$). Vancomycin MIC was significantly associated with treatment failure irrespective of source of infection or MIC methodology (OR, 2.69; 95% CI, 1.60–4.51; $P < .01$).

Conclusion. High vancomycin MIC was associated with a higher mortality rate in MRSA BSI. Thus, institutions should consider conducting Etest MICs on all MRSA BSI isolates. Although these data highlight concerns about vancomycin, currently, there are no data to support better survival rates with alternative antibiotics. Data are sorely needed to determine whether other agents can remedy these outcomes observed with vancomycin for MRSA infections with elevated vancomycin MIC values.

Infections caused by methicillin-resistant *Staphylococcus aureus* (MRSA) are a major public concern. Hospital-acquired MRSA infection rates have steadily increased over the past 25 years, and the bacterial strain is making inroads to the community [1–6]. Vancomycin is currently the cornerstone of therapy for serious infections caused by this pathogen. Although vancomycin has been widely used in the treatment of MRSA infection for the past 2 decades [7], the majority of MRSA strains have remained susceptible to vancomycin at the current minimum inhibitory concentration (MIC) susceptibility breakpoint designated by the Clinical Laboratory Standards Institute (CLSI) [2]. It has taken approximately 40 years for the first isolates with reduced susceptibility to glycopeptides to emerge.

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Clinical Infectious Diseases 2012;54(6):755–71

DOI: 10.1093/cid/cir905

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INVITED ARTICLE CLINICAL PRACTICE

Ellie J. C. Goldstein, Section Editor

Is It Time to Replace Vancomycin in the Treatment of Methicillin-Resistant *Staphylococcus aureus* Infections?

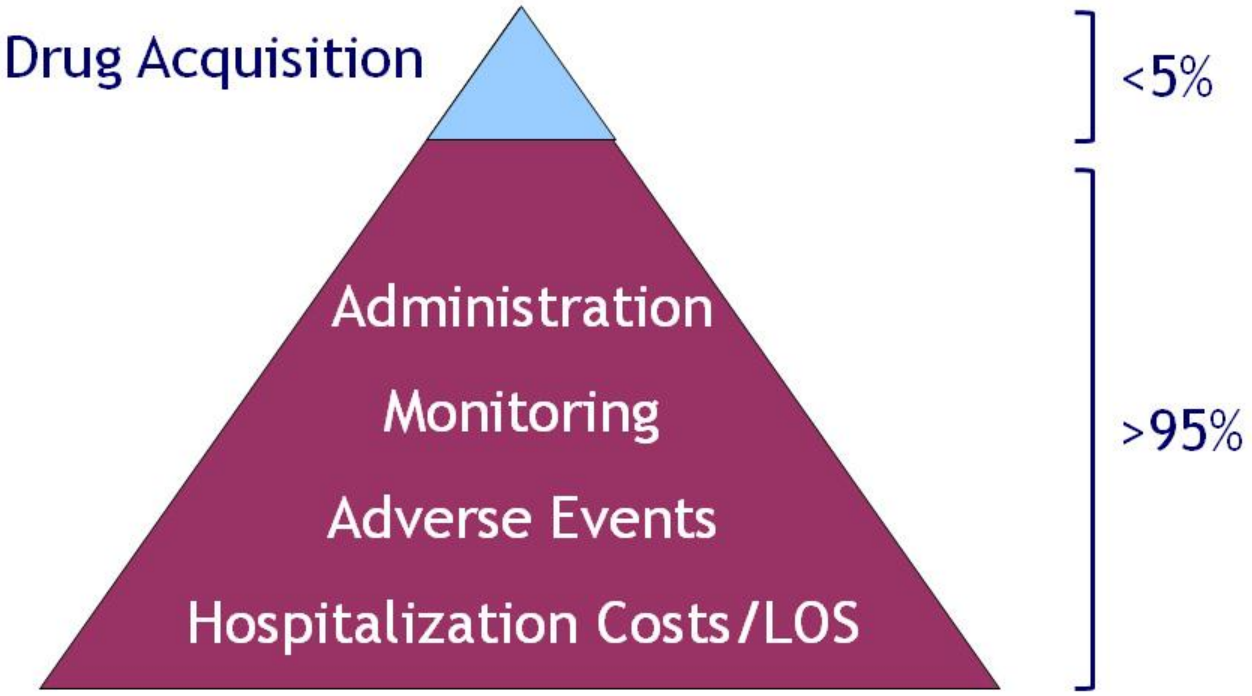
Sebastiaan J. van Hal[1,2] and Vance G. Fowler Jr[3,4]

[1]Department of Microbiology and Infectious Diseases, Royal Prince Alfred Hospital, Camperdown, Sydney, and [2]Antibiotic Resistance and Mobile Elements Group, Microbiology and Infectious Diseases Unit, School of Medicine, University of Western Sydney, Australia; [3]Duke University Medical Center, and [4]Duke Clinical Research Institute, Durham, North Carolina

For more than 4 decades, vancomycin has been the antibiotic of choice for methicillin-resistant *Staphylococcus aureus* (MRSA) infections. Recently, infections due to isolates with high but susceptible vancomycin minimum inhibitory concentrations have been associated with additional treatment failures and patient mortality. These poorer outcomes may in part be explained by the inability of attaining appropriate vancomycin levels in these patients. However, assumptions that these poor outcomes are solely due to failure to achieve optimal serum levels of vancomycin are premature. The availability of effective alternatives further erodes the position of vancomycin as first-line therapy. The emergence of resistance and cost considerations, however, favor a more measured approach when using alternative antimicrobials. Collectively, the current available data suggest that the optimal therapy for MRSA infections remains unclear. In the absence of further data, the Infectious Diseases Society of America guidelines remain relevant and inform clinicians of best practice for treating patients with MRSA infections.

Drug Acquisition vs Total Costs

Drug acquisition costs are <5% of overall treatment costs for hospitalized MRSA patients[1,2]



LOS=length of stay; MRSA=methicillin-resistant *S. aureus*.

1. Kim T, et al. *Infect Control Hosp Epidemiol*. 2001;22(2):99-104; 2. Shah NP, et al. *Curr Med Res Opin*. 2004;20(6):779-790.

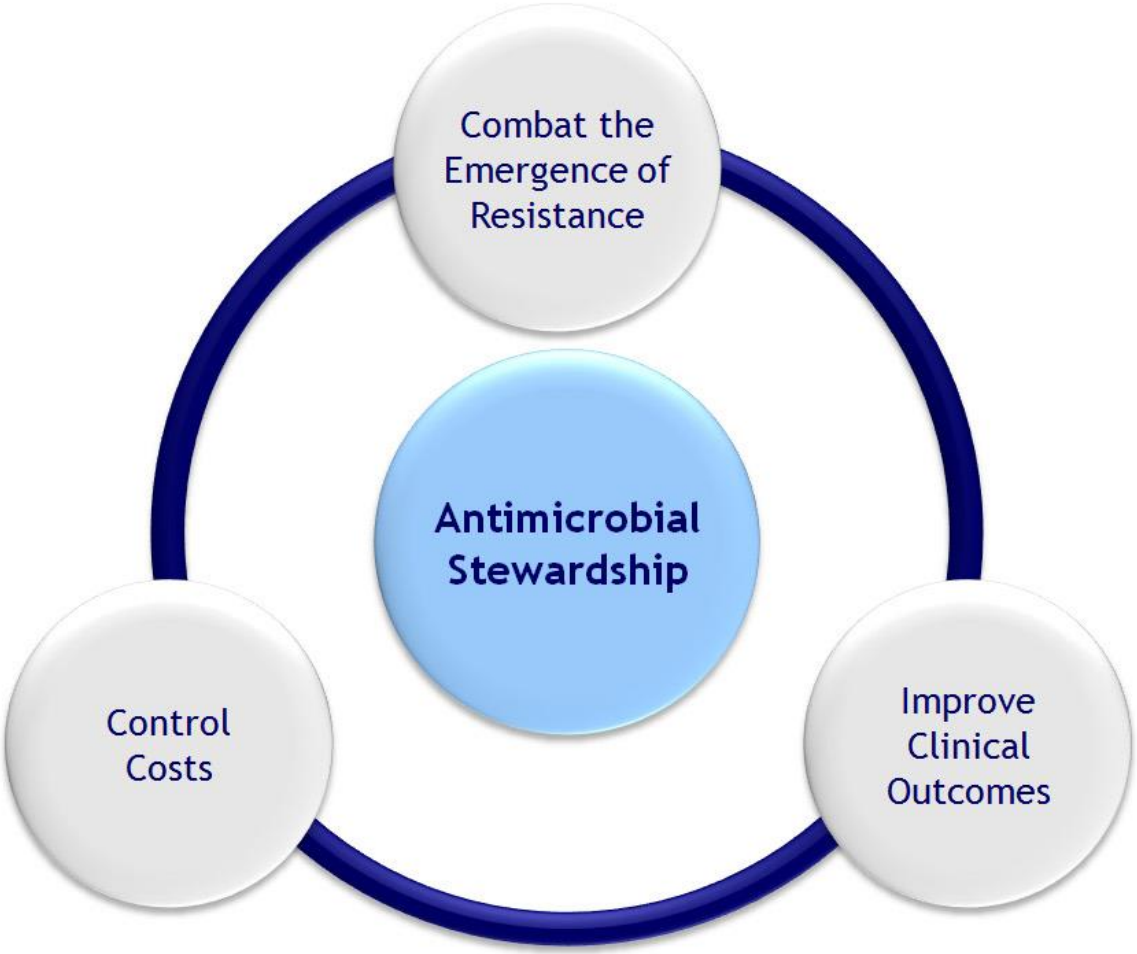
Best Alternative to Vancomycin for Serious Methicillin-Resistant *Staphylococcus aureus* Infections: Let's Just Say It

To the Editor—The recently published articles by Patel et al [1], Kullar et al [2], and Lubin et al [3] persuasively bolster the growing consensus opinion that the gold-standard antimicrobial agent for treatment

opinion as to what actually is, or likely would be, the *best* alternative anti-MRSA agent.

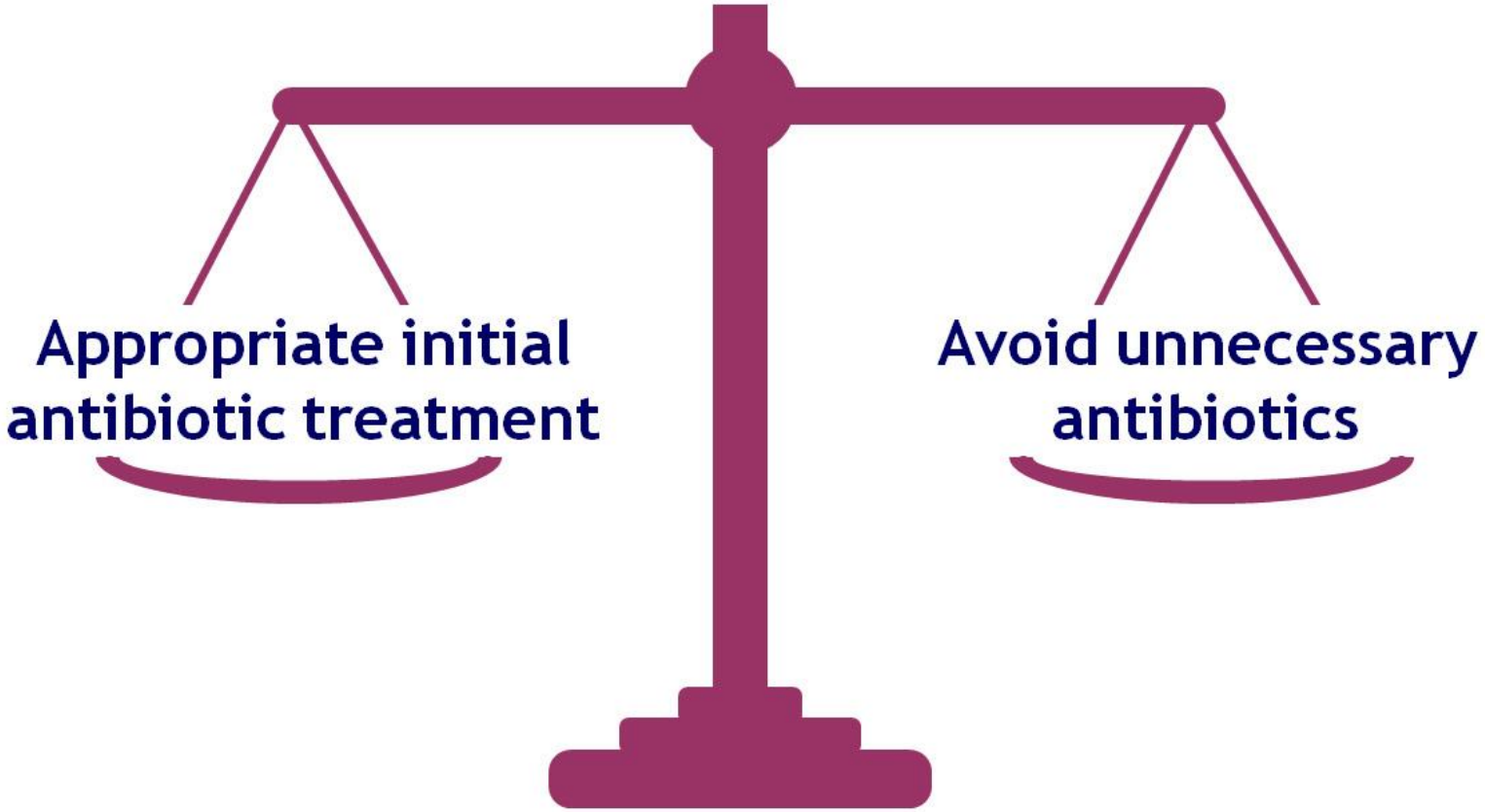
Acknowledging the absence of evidence from any head-to-head clinical trials among the relatively new antimicrobial agents with approved MRSA treatment indications (eg, quinupristin–dalfopristin, linezolid, daptomycin, tigecycline, telavancin, and ceftaroline),

Goals of Antimicrobial Stewardship[1]



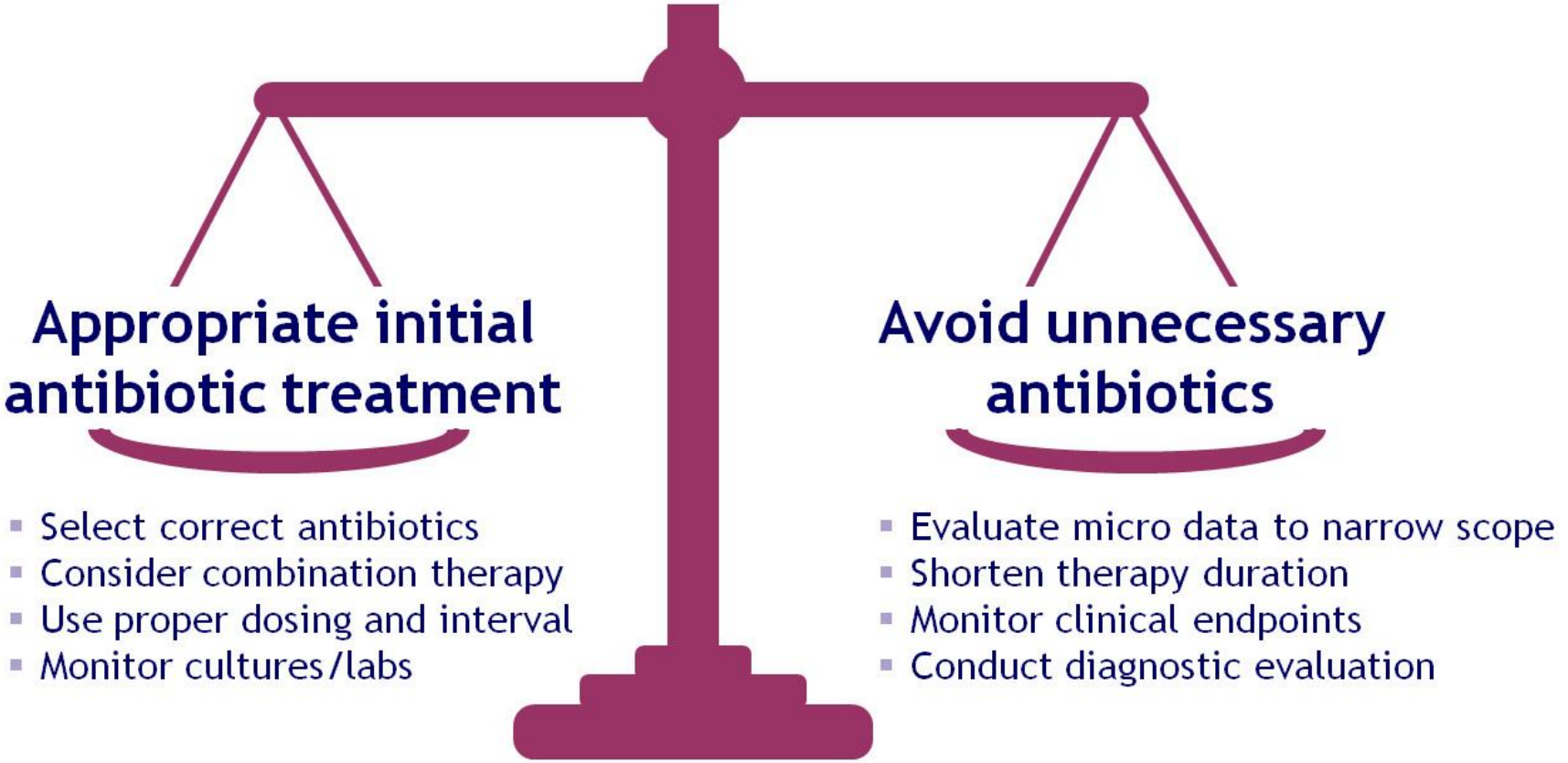
1. Lawrence KL, Kollef MH. *Am J Respir Crit Care Med*. 2009;179:434-438.

Antimicrobial Stewardship—A Balancing Act[1]



1. Kollef MH. *Drugs*. 2003;63(20):2157-2168.

De-Escalation—A Balancing Act[1]



1. Kollef MH. *Drugs*. 2003;63(20):2157-2168.

…this HAS BEEN TAKING PLACE FOR YEARS……

Clinical Infectious Diseases

INVITED ARTICLE

IDSA Infectious Diseases Society of America

hivma hiv medicine association

OXFORD

CLINICAL PRACTICE: Ellie J. C. Goldstein, Section Editor

Eight Habits of Highly Effective Antimicrobial Stewardship Programs to Meet the Joint Commission Standards for Hospitals

Debra A. Goff,[1] Ravina Kullar,[2] Karri A. Bauer,[2] and Thomas M. File Jr[3]

[1]The Ohio State University Wexner Medical Center, The Ohio State University College of Pharmacy, Columbus, Ohio; [2]MRL, Merck & Co., Inc.,Kenilworth, New Jersey; and [3]Division of Infectious Disease, Northeast Ohio Medical University, and Summa Health, Akron, Ohio

“ asking physicians to do a better job at prescribing antibiotics has and does not work and will require a behavior change.”

AREN’T WE REALLY TALKING KNOWLEDGE AND UNDERSTANDING ?

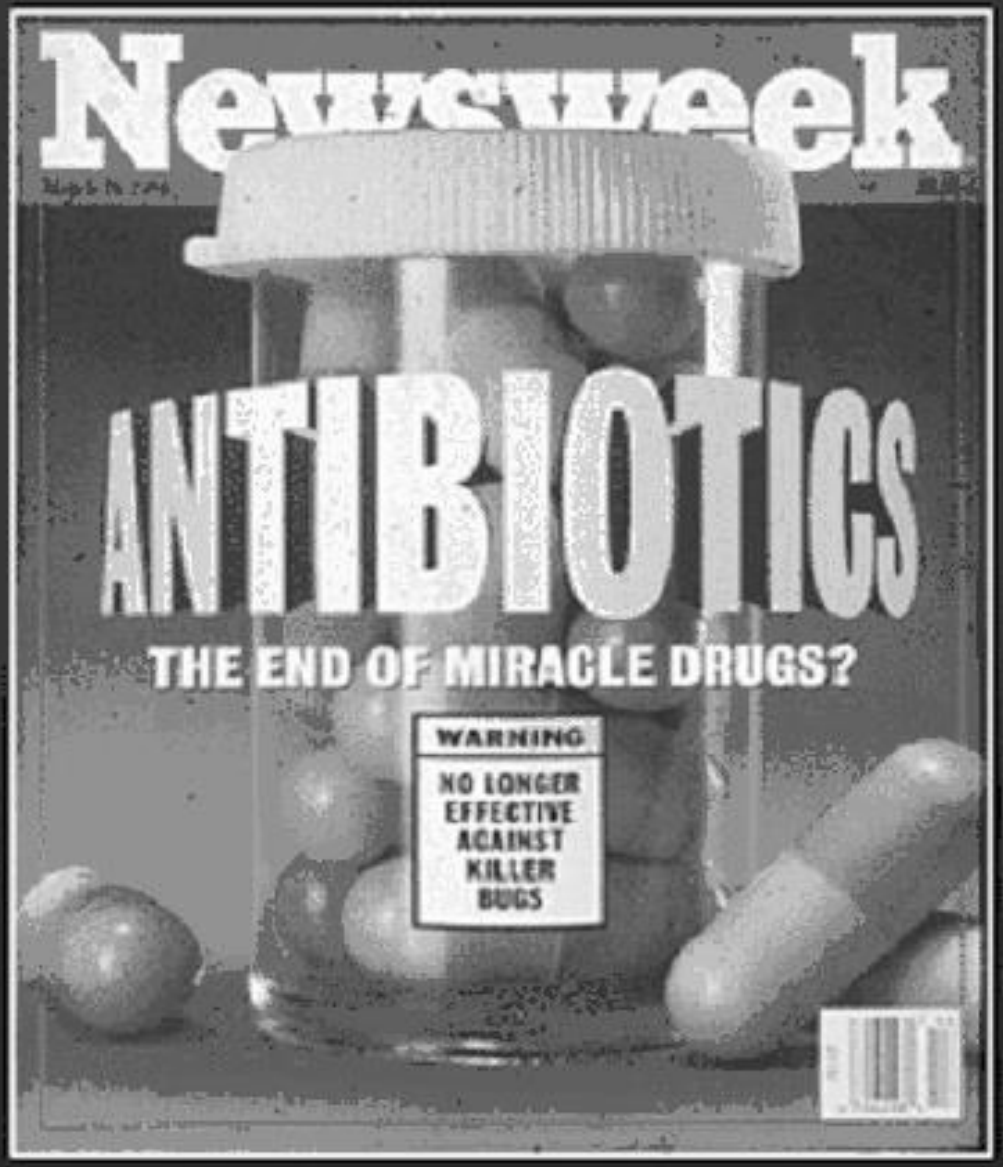
EYE ON ID

/kickers Content Bundle Image or Slug /Content Bundle Image or Slug

ASPs: Job of a steward, or time for a pilot?

Infectious Disease News, May 2016

Larry M. Bush, MD, FACP; Donald Kaye, MD, MACP


Newsweek
ANTIBIOTICS
THE END OF MIRACLE DRUGS?
WARNING
NO LONGER EFFECTIVE AGAINST KILLER BUGS

…"the risks of action are far less serious than those posed by comfortable status quo and inaction"

JFK..circa 1962

NOW, PERHAPS MORE THAN EVER…

TIME TO GET IT RIGHT !

THANK YOU