Curriculum vitae

Nama : Prof. dr. Iwan Dwiprahasto, MMedSc, PhD

Riwayat pendidikan

Dokter, FK UGM tahun 1987

S-2: MMedSc (Farmakoepidemiologi), Newcastle University Australia, 1993

S-3: PhD, London School of Hygiene & Tropical Medicine, England, 2000

Jabatan:

1. Ketua Umum PB IKAFI (Ikatan Farmakologi Indonesia)
2. Ketua, Komite Pendidikan, Pelatihan, dan Pengembangan RS. Dr. Sardjito
3. Board of Governor, International Clinical Epidemiology Network (INCLEN)
4. Ketua, Komite Sistem Informasi, FK UGM
5. Editor, Berkala Ilmu Kedokteran
6. Editor, Indonesian Journal of Clinical Epidemiology and Biostatistics
7. Tim Ahli Menteri Kesehatan untuk Evaluasi Harga Obat
8. Tim Ahli untuk DPHO, PT Askes Indonesia
9. Komite Bersama Uji Kompetensi Dokter Indonesia
10. Komite Nasional (KOMNAS) DOEN (Daftar Obat Esensial Nasional)
11. Komite Nasional (KOMNAS) Penilai Obat Jadi Badan POM
12. Komite Nasional (KOMNAS) Informatorium Obat Nasional Indonesia (IONI)
13. Komite Nasional (KOMNAS) Obat Tradisional, Badan POM

EBM GUIDE TO ANTIBIOTIC USE

Iwan Dwiprahasto

Dept of Pharmacology & Therapy FK UGM

Penggunaan antibiotika

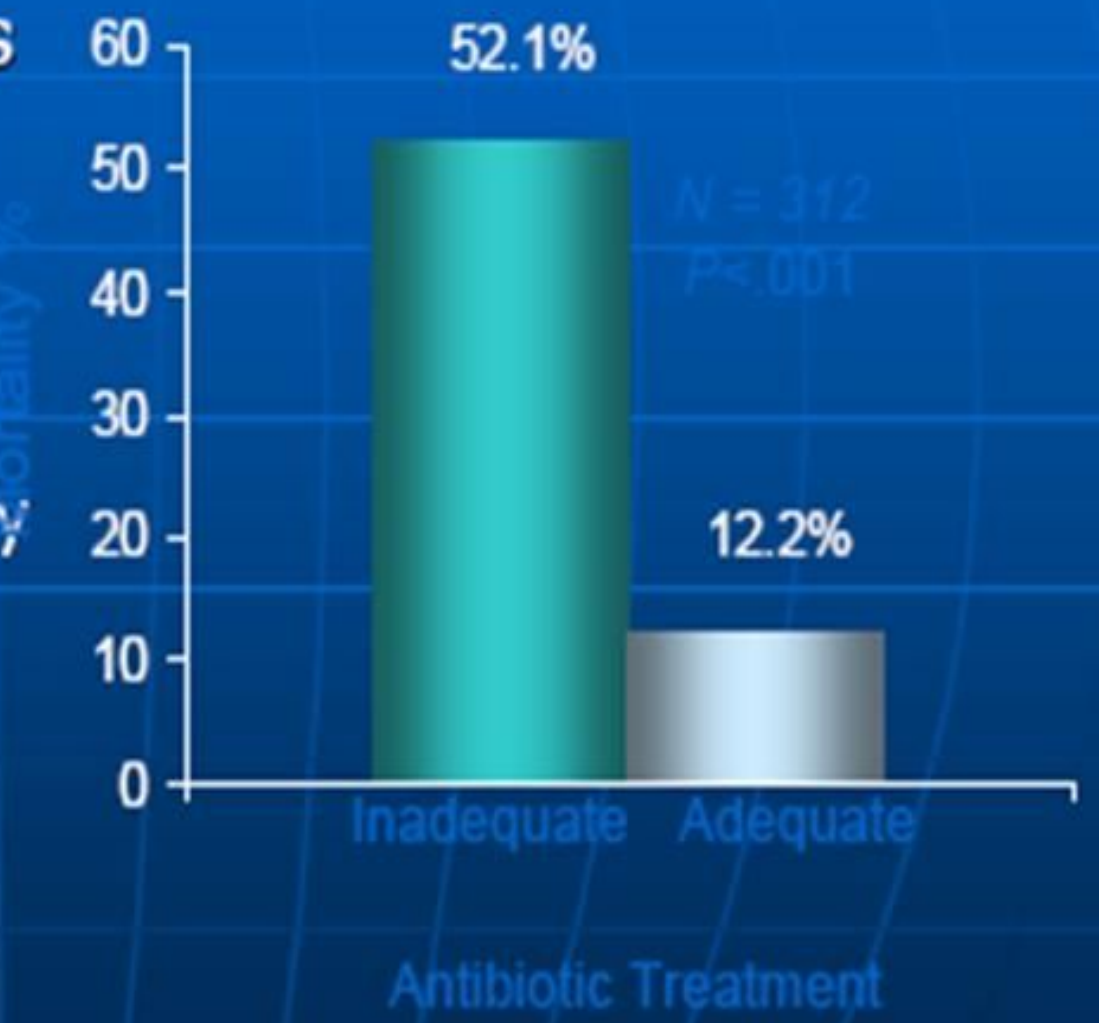
Penggunaan antibiotika	Jenis pengguna	Masalah
Human use (60%)	20% Rumah Sakit 80% Komunitas	20-50% *Unnecessary*
Agricultural use (40%)	20% Terapetic 80% Profilaktik/ growth promotion	40-80% Highly questionable

Inappropriate Antibiotic Therapy Increases Mortality

Ibrahim, et al. *Chest*. 2000;118:146–155.
Leibovici, et al. *J Intern Med*. 1998;244:379–386.
Luna, et al. *Chest*. 1997;111:676–685.
Alvarez-Lerma, et al. *Intensive Care Med*.1996;22:387–394.
Rello, et al. *AJRCCM*.1997;156:196–200.

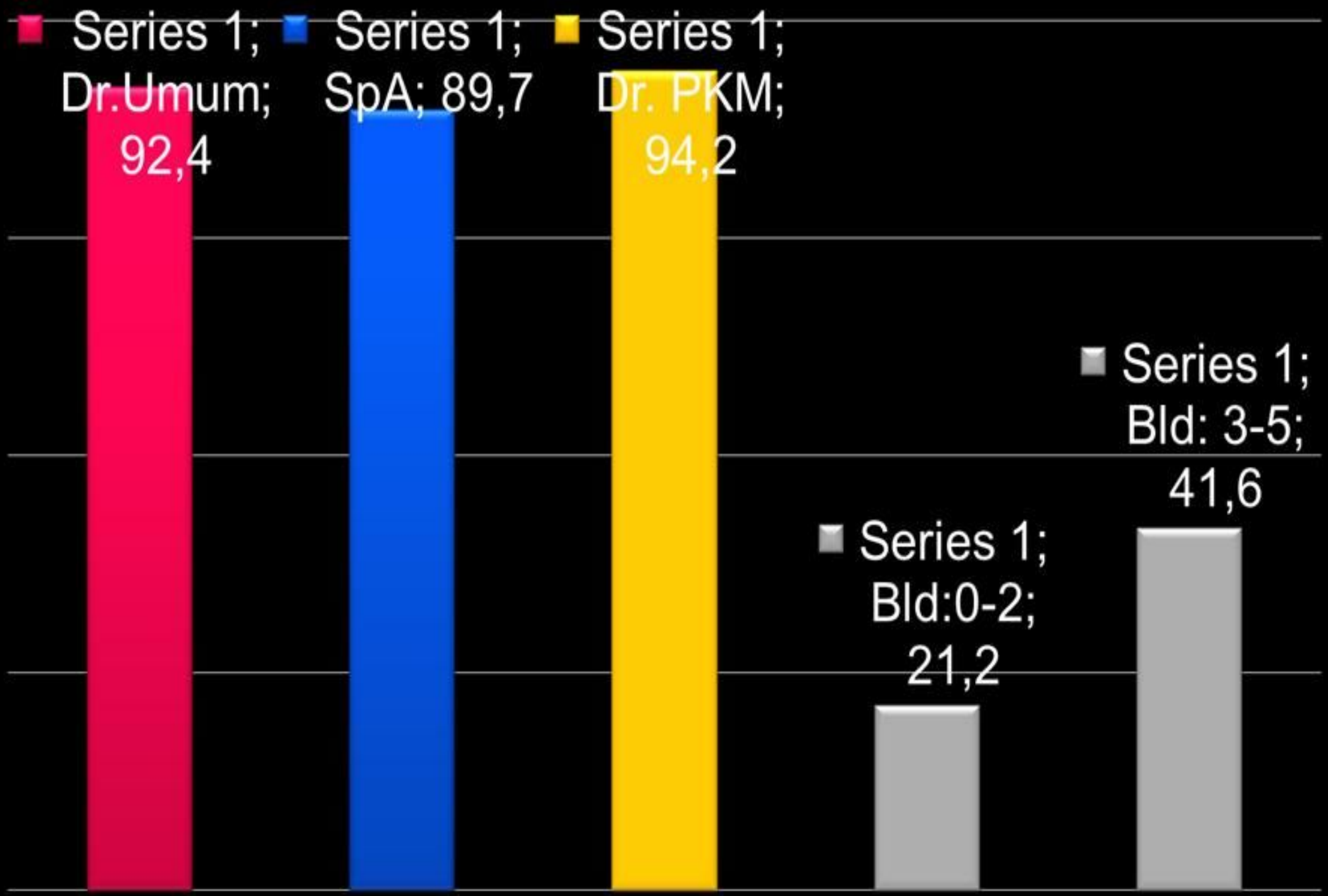
Hospital Mortality Rate of Infected Patients

- 2000 consecutive patients admitted to an MICU or SICU
- Pneumonia in 411 cases
  - 305 with adequate therapy
  - 106 with inadequate therapy

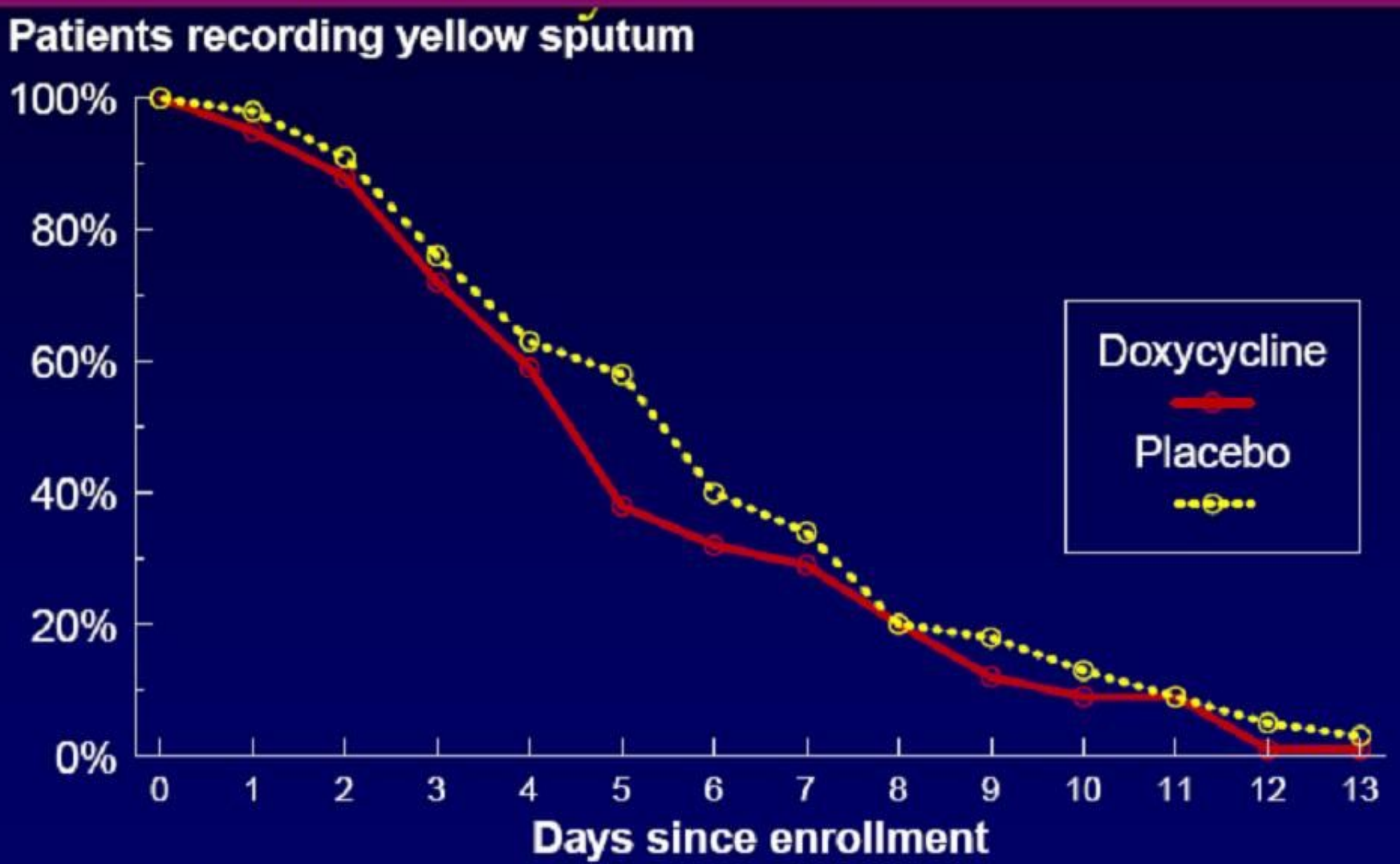


Kollef, et al. *Chest.* 1999;115:462–474.

Peresepan antibiotika untuk ISPA Non pneumonia pada anak < 10 tahun (Dwiprahasto, 2002)

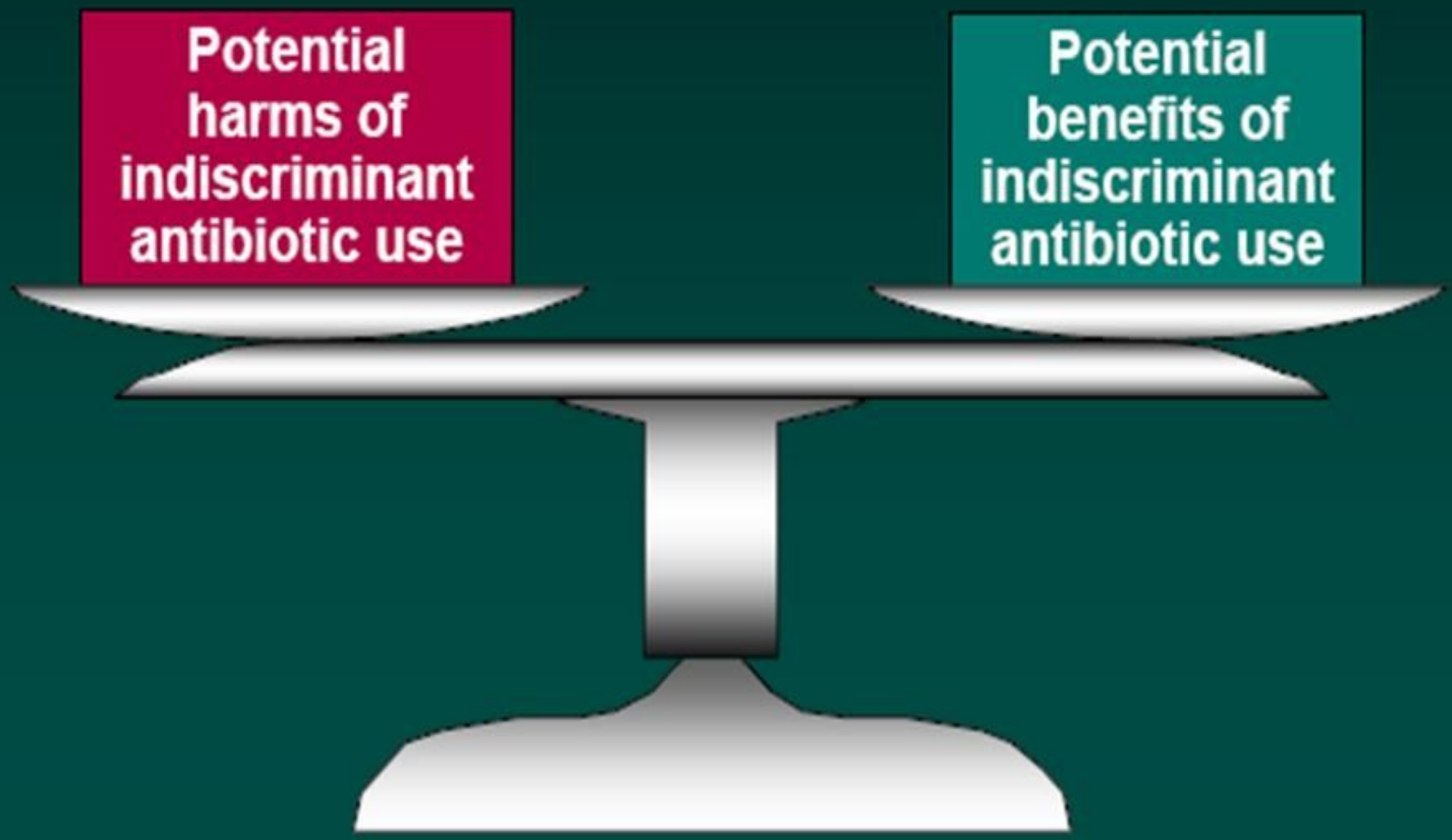


Common Cold: Apakah antibiotika bermanfaat?



Stott,BMJ 1976;2:556

Pertimbangan manfaat-risiko penggunaan antibiotika



Potential harms

Mungkin bermanfaat untuk sebagian kecil populasi

Meningkatkan kepuasan pasien

Mencegah superinfeksi

Mencegah keadaan lebih buruk

Mengurangi kunjungan ulang

Support Antibiotic Usage

Meningkatkan resistensi bakteri

Meningkatkan biaya terapi

Interaksi obat-obat

Efek samping obat

Reaksi alergi

Tidak rasional (untuk virus)

Potential benefits

Oppose Antibiotic Usage

- Meningkatkan resistensi bakteri
- Meningkatkan biaya terapi
- Interaksi obat-obat
- Efek samping obat
- Reaksi alergi
- Tidak rasional (untuk virus)

- Mungkin bermanfaat untuk sebagian kecil populasi
- Meningkatkan kepuasan pasien
- Mencegah superinfeksi
- Mencegah keadaan lebih buruk
- Mengurangi kunjungan ulang

So where is the balance?

Syarat suatu khemoterepetik dapat digunakan sebagai terapi infeksi

Memiliki selective toxicity terhadap mikroba, bukan terhadap host.

Tidak menimbulkan reaksi hypersensitivitas pada sebagian besar host

Penetrasi ke dalam jaringan secara cepat dan beberapa waktu dalam kadar yang adekuat

Microba tidak segera berubah menjadi resisten akibat pemberiannya.

Penggunaan antibiotika

Profilaktik

Medical

- Paparan: HIV, N. Meningitis
- Immunocompromised: HIV dgn CD4 < 200

Prosedural

Empirik

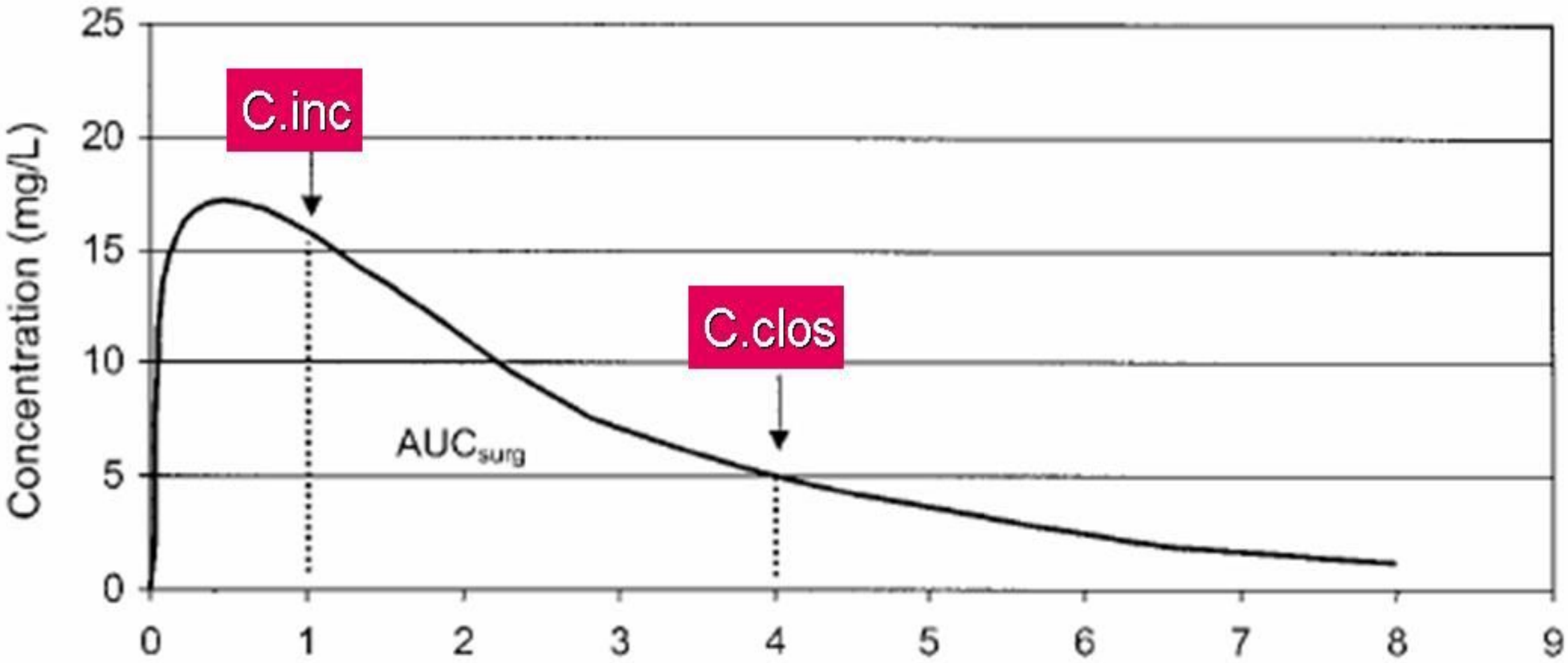
- Antibiotika diberikan segera
- Didasarkan pada: pathogens, local susceptibility trends
- Pearls: kultur di awal dan di akhir

Definitif

- Dasar: diagnosis mikrobiologi atau serologi

Farmakodinamik antibiotika profilaksi pada bedah

Antimicrob Agent Chemother, 2002;46::3026-30



Profil kadar gentamisin dalam serum vs waktu

Mencegah Surgical Site Infection

Penggunaan Antibiotika profilaksi secara tepat

Antibiotika diberikan 1 jam sebelum insisi dilakukan*

Antibiotic profilaksi: pertimbangan medik yang cermat

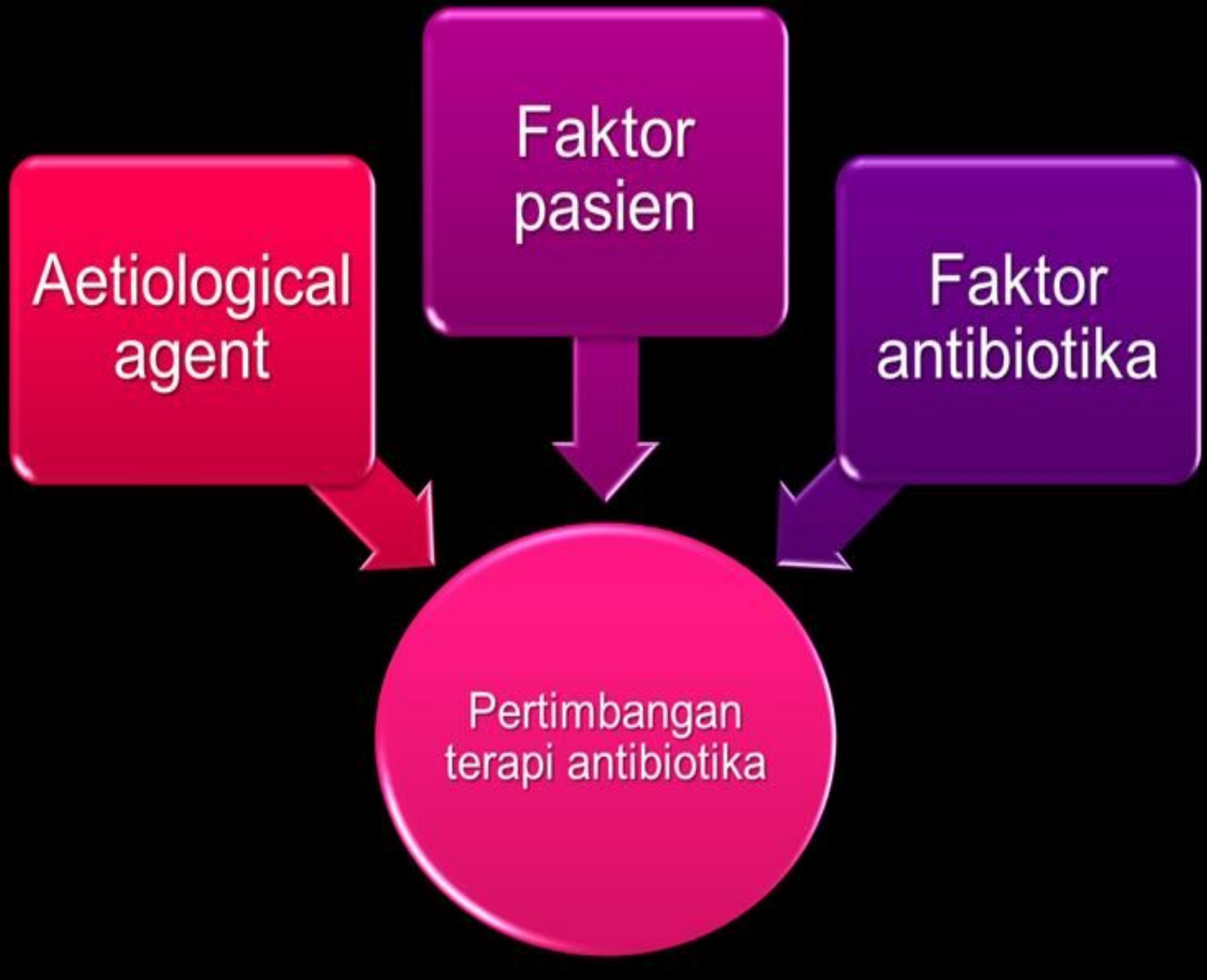
Antibiotika profilaksi dihentikan dalam 24 jam setelah operasi

*Untuk vancomycin karena waktu paruhnya panjang, dapat diberikan 2 jam sebelum insisi.

Antibiotic Classes

- Penicillins
- Cephalosporins
- Monobactam
- Carbapenem
- Glycopeptide
- Oxazolidionone
- Aminoglycosides
- Macrolides
- Tetracycline
- Sulfonamide
- Nitroimidazole
- Quinolones

Pemilihan antibiotika



Bakteri penyebab

Diagnosis klinis

Temuan klinis

- Sumber infeksi
- Bakteri penyebab

Terapi empiris

- Data universal
- Data lokal/setempat

Faktor diagnosis & faktor pasien

Diagnosis laboratorium

- Bakteri penyebab vs kolonisasi
- Yang diisolasi bukan bakteri pathogen
- Cara pengambilan spesimen keliru
- sensitivity reports

Faktor pasien

- Umur
- Fungsi fisiologis
- Factor genetik
- Kehamilan
- Site & severity of infection
- Allergy

Faktor Antibiotika

Pharmacokinetic/pharmacodynamic (PK/PD)

- absorpsi
- ekskresi
- Kadar dalam jaringan
- Kadar puncak, AUC, Time above MIC

Toksisitas dan adverse effects

Interactions obat-obat

Biaya/harga

Pertimbangan farmakokinetik dan farmakodinamik

Pharmacokinetics (PK)

- Profil kadar dalam serum
- Penetrasi ke tempat infeksi

Pharmacodynamics (PD)

- susceptibility – MIC (potency)
- concentration- vs. time-dependent killing
- persistent (post-antibiotic) effects (PAE)

Jacobs. Clin Microbiol Infect 2001;7:589–96

The ideal antibiotics

The molecule → Brilliant & clear solution → Patient's cure

The molecule → Brilliant & clear solution → No cure

Chemistry microbiology Therapy

Not always ideal

The molecule

Brilliant & clear solution

The big black box

Patient's cure

Chemistry microbiology PK/PD Therapy

Penyebab kegagalan terapi antibiotika

False failures

- Diagnosis keliru
- Underlying disease
- Inaktivasi antibiotika

Patient related failures

- Non compliance
- Inappropriate administration
- Immunosuppressed host

Penyebab kegagalan terapi antibiotika

- Dosis obat terlalu rencah
- Tidak mempertimbangkan parameter farmakodinamik

Pharmacological failures

- Keliru identifikasi bakteri
- Reistensi terjadi selama terapi
- Insuficient bactericidal activity
- Efek Inoculum

Microorganism related failures

Dosage & elimination

Serum concentration varying over time

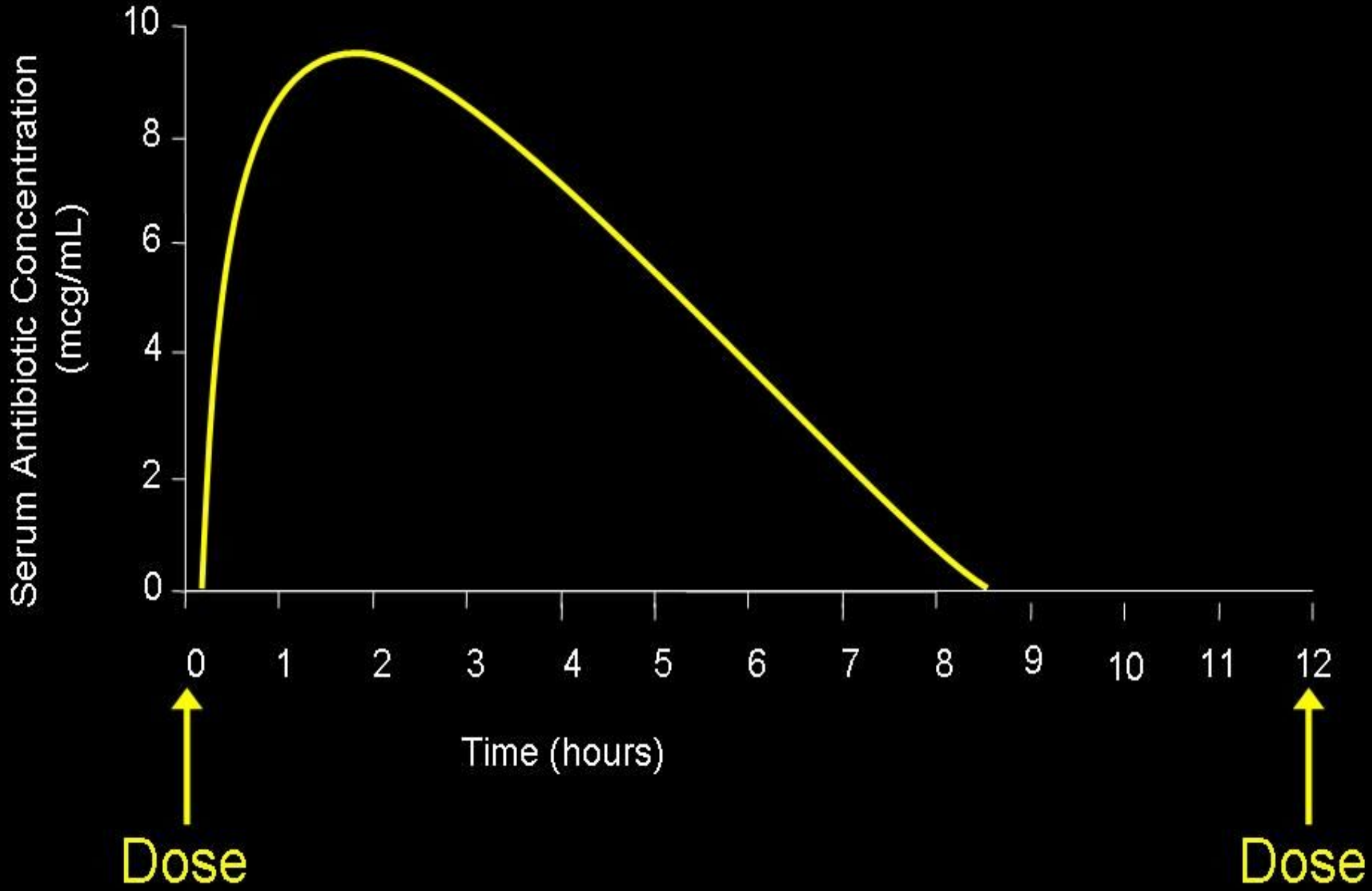
Concentration in non target tissues

Toxic effect

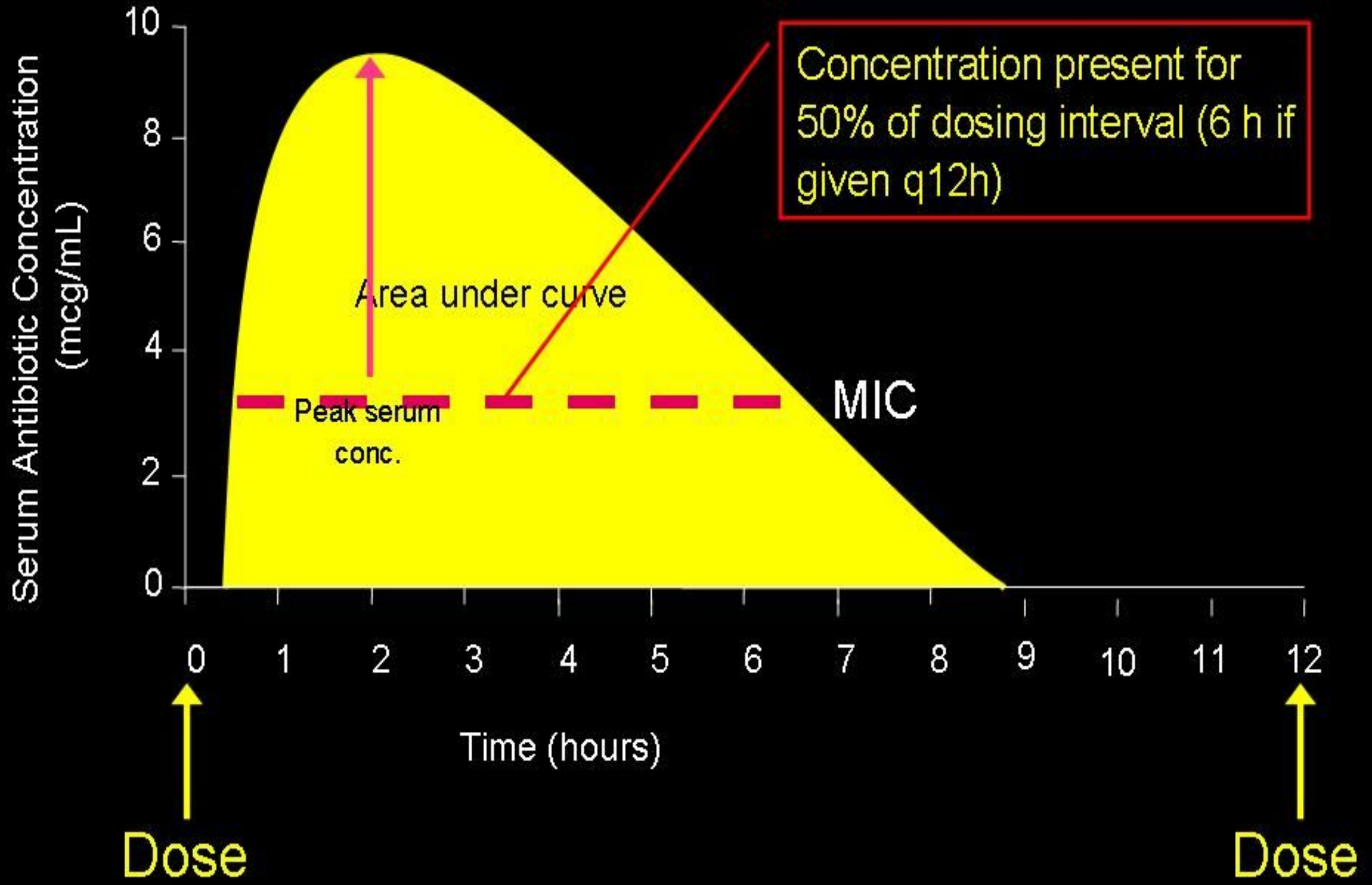
Concentration at the site of infection

Therapeu -tic effect

Drug Pharmacokinetics in blood



Pharmacokinetic Parameters



Pola aktivitas antibakterial

Time-dependent killing & minimal to moderate persistent effects	• Time above MIC (T>MIC)
Time-dependent killing and prolonged persistent Effects	• AUC/MIC ratio
Concentration-dependent killing and prolonged persistent effects	• AUC/MIC ratio or Peak/MIC ratio

Jacobs. Clin Microbiol Infect 2001;7:589–96

Time Above MIC: β-Lactams

T>MIC (% dosing interval) yang diperlukan untuk membunuh sebagian besar bakteri

penisilin: 25-35%;

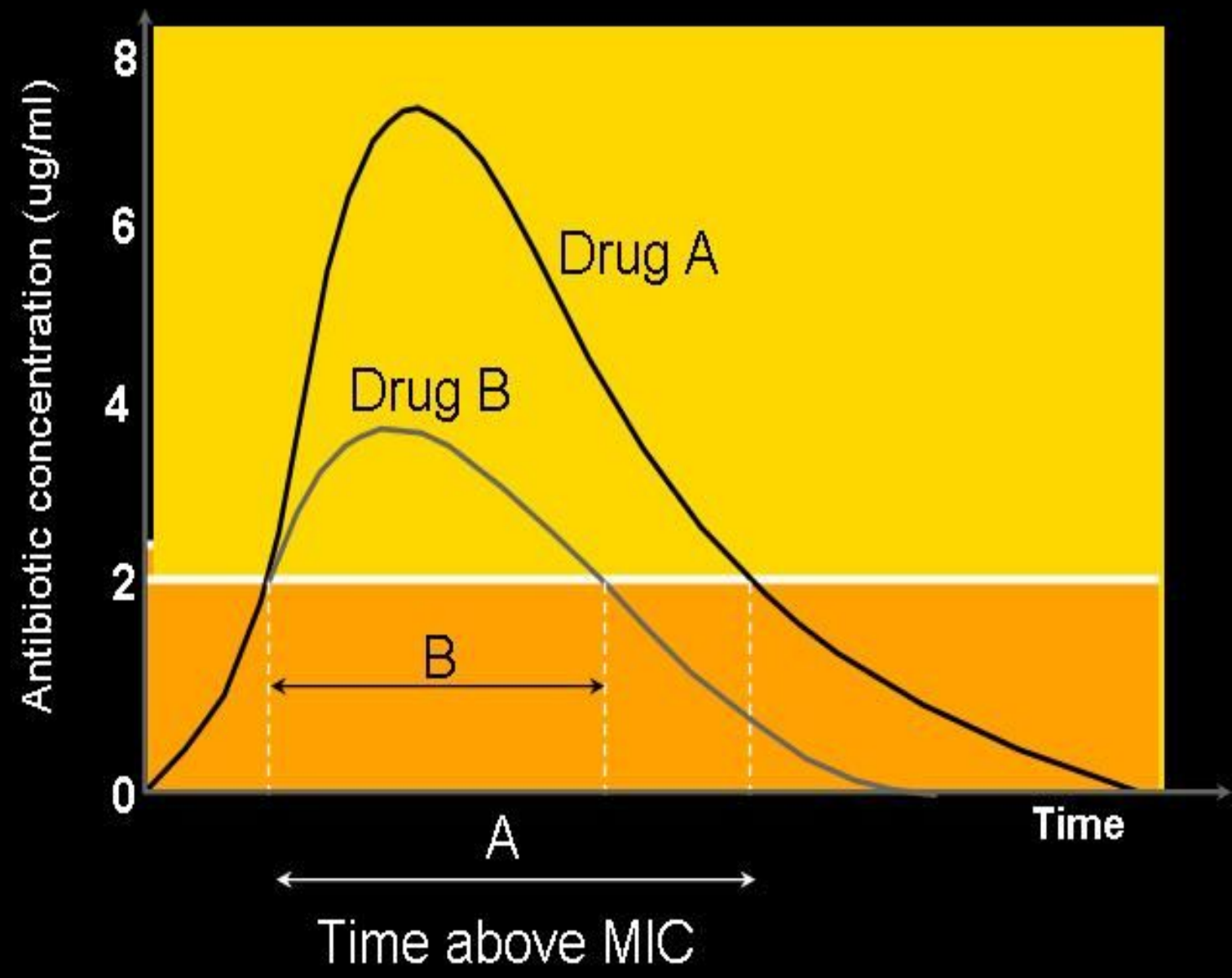
cephalosporin 30-45%

Kadar obat bebas penicillins & cephalosporins harus di atas MIC untuk 35-50% dosing interval untuk menghasilkan efek maksimal

Important PK/PD Parameters

Time above MIC :

Proporsi interval pemberian ketika kadar obat melampaui MIC



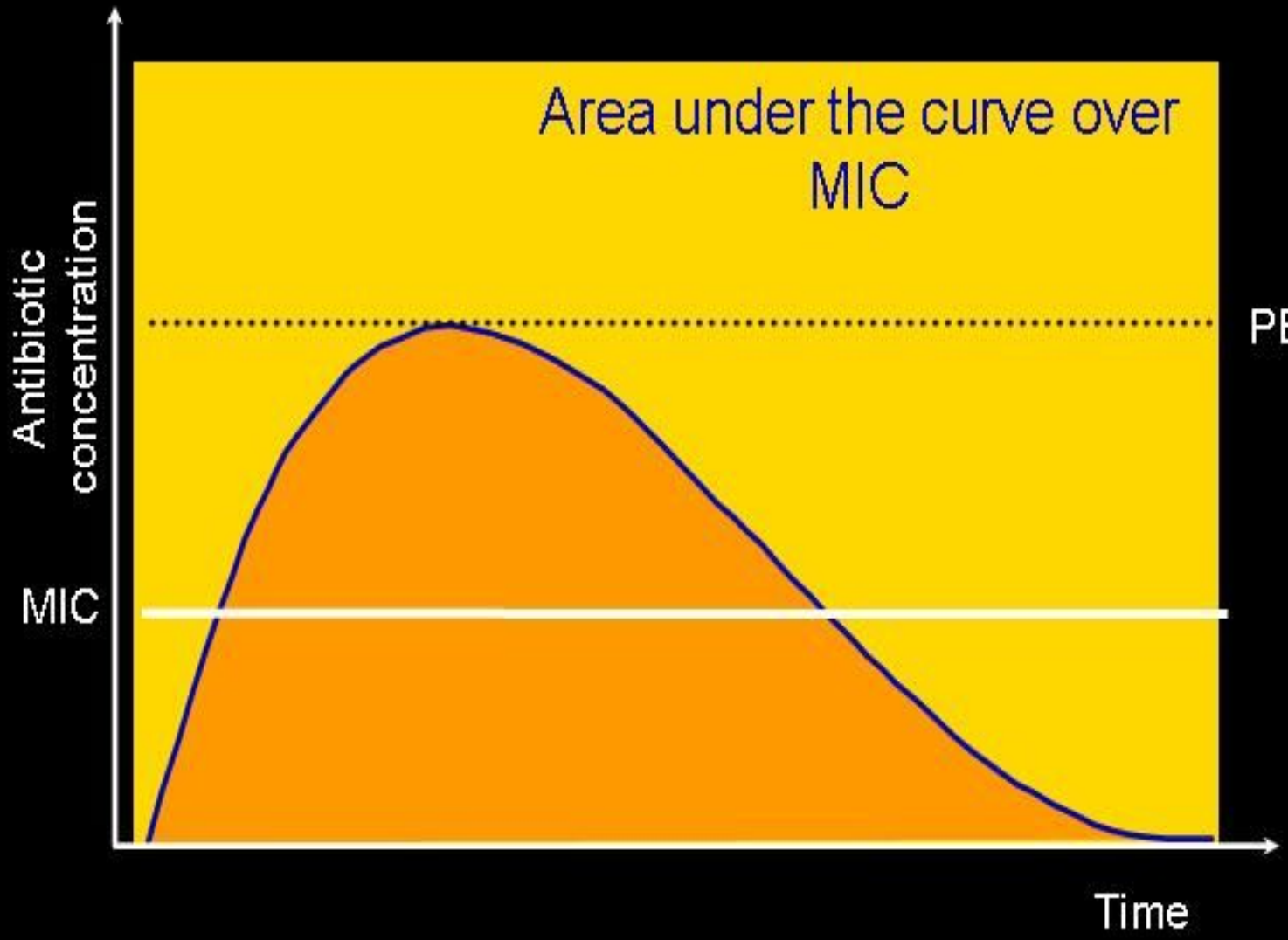
Important PK/PD Parameters

AUC/MIC

rasio AUC terhadap MIC

Peak/MIC

Rasio kadar puncak terhadap MIC



PK/PD and Antimicrobial Efficacy

2 pola utama bacterial killing

- Concentration dependent
  - Correlated with AUC/MIC Peak/MIC
  - Aminoglycosides, quinolones, macrolides,azalides, clindamycin, tetracyclines, glycopeptides, oxazolidinones
- Time dependent
  - Correlated with Time above MIC (T>MIC)
  - Betalactams

Craig, 4th ISAAR, Seoul 2003

Goal of therapy based on PK/PD

Pattern of Activity	Antimicrobials	Goal of therapy and relevant PK/PD Parameter
Concentration dependent killing	Quinolones, Daptomycin, ketolides, Macrolides, azithromycin, clindamycin, streptogramines,tetracyclines, glycopeptides, oxazolidinones	Maximise concentrations; AUC/MIC, peak/MIC Use high doses; daily dosing for some agents
Time dependent killing with no persistent effects	Betalactams	Maximise duration of exposure; T>MIC Use more frequent dosing; longer infusion times including continuous infusion

Preparation error

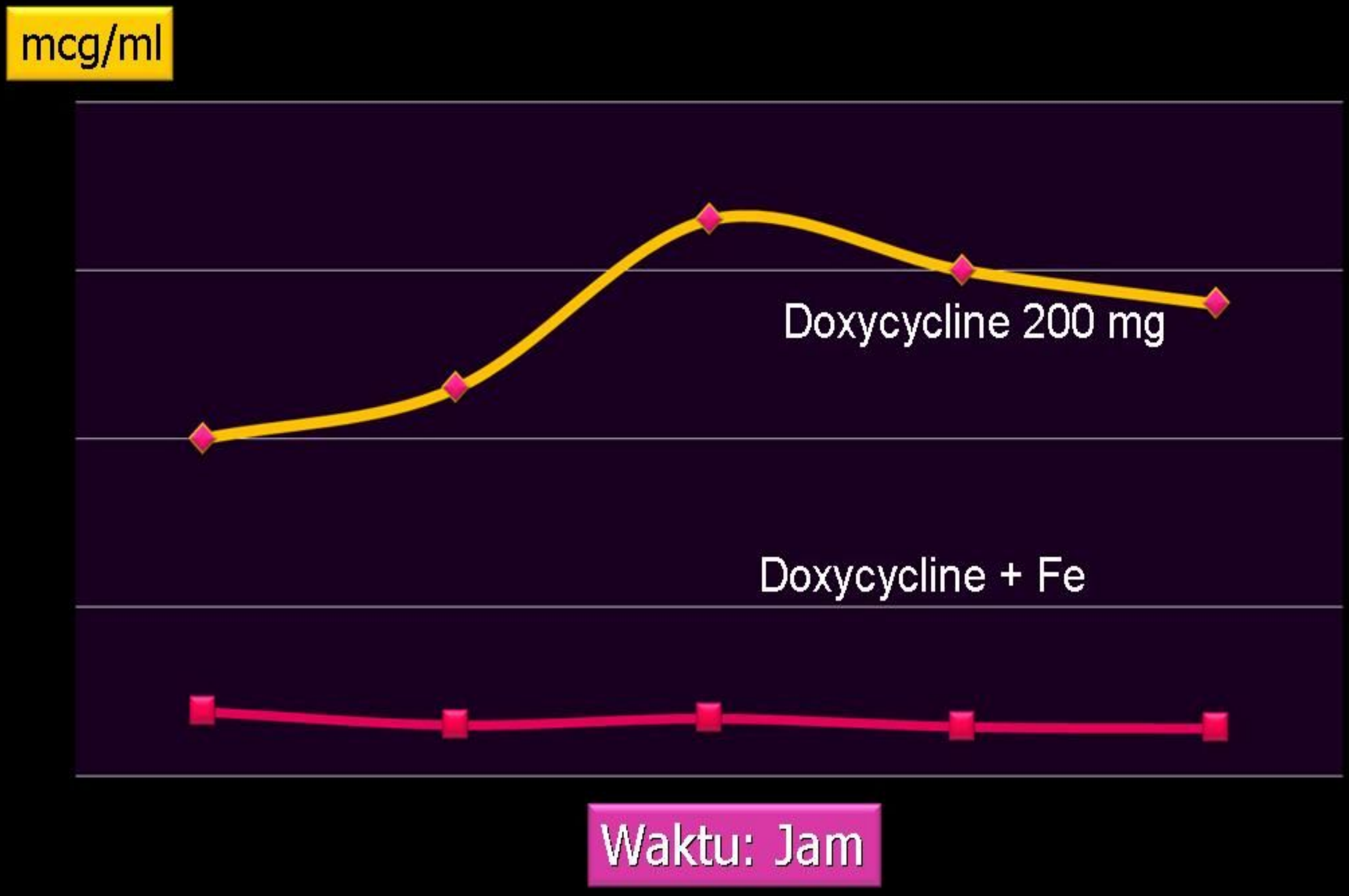
Azithromycin mg 100
Augmentin mg 100
Ibuprofen mg 100
GG tab ½
Dexametason tab ½
Luminal mg 30
Vitamin C mg 20
Mfla dtd no. XII
S 3dd I

Anak, 2 tahun

Masalah Penggunaan Antibiotika

Pharmacokinetics dan pharmacodynamics

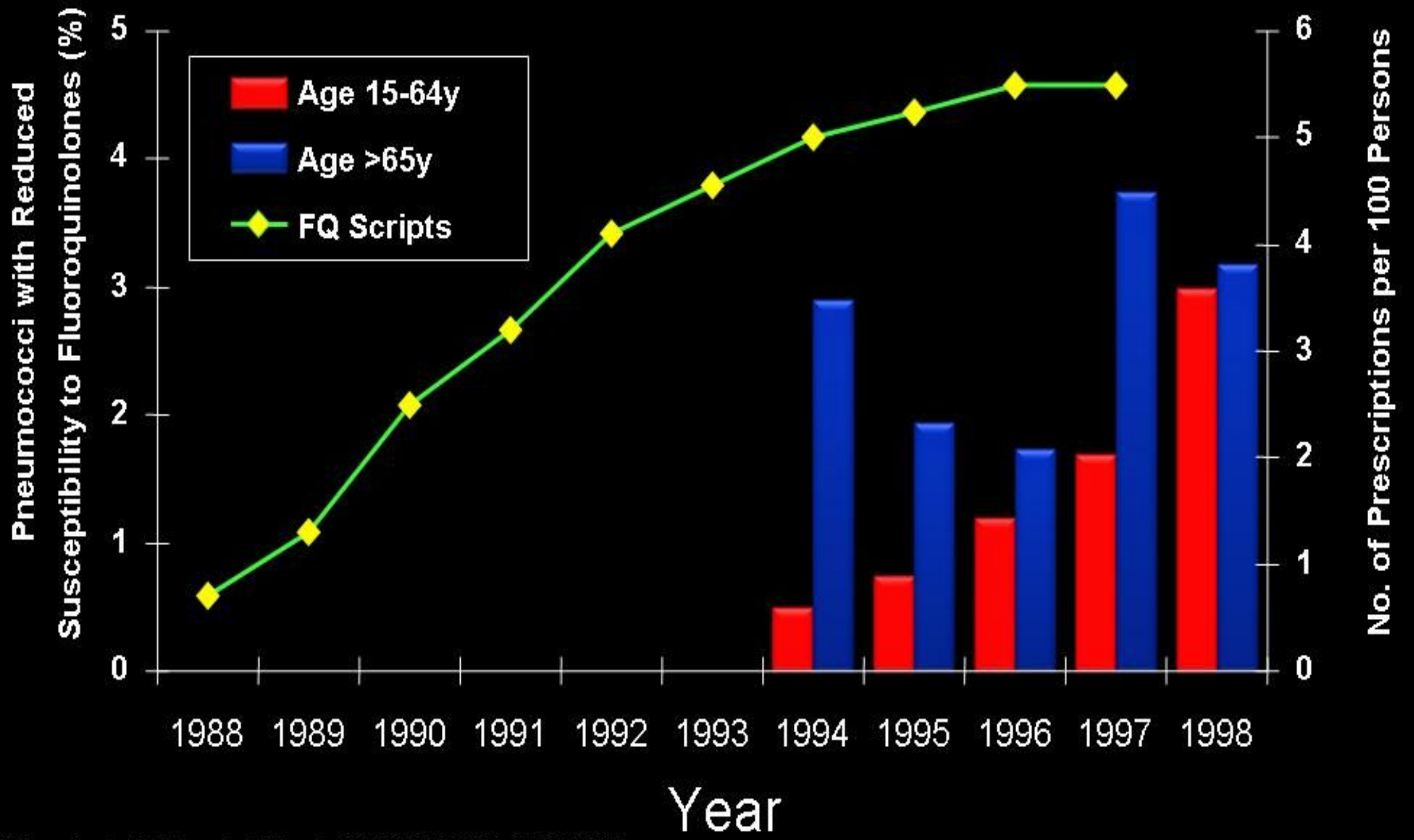
Interaksi Doxycycline-Fe



Masalah Penggunaan Antibiotika

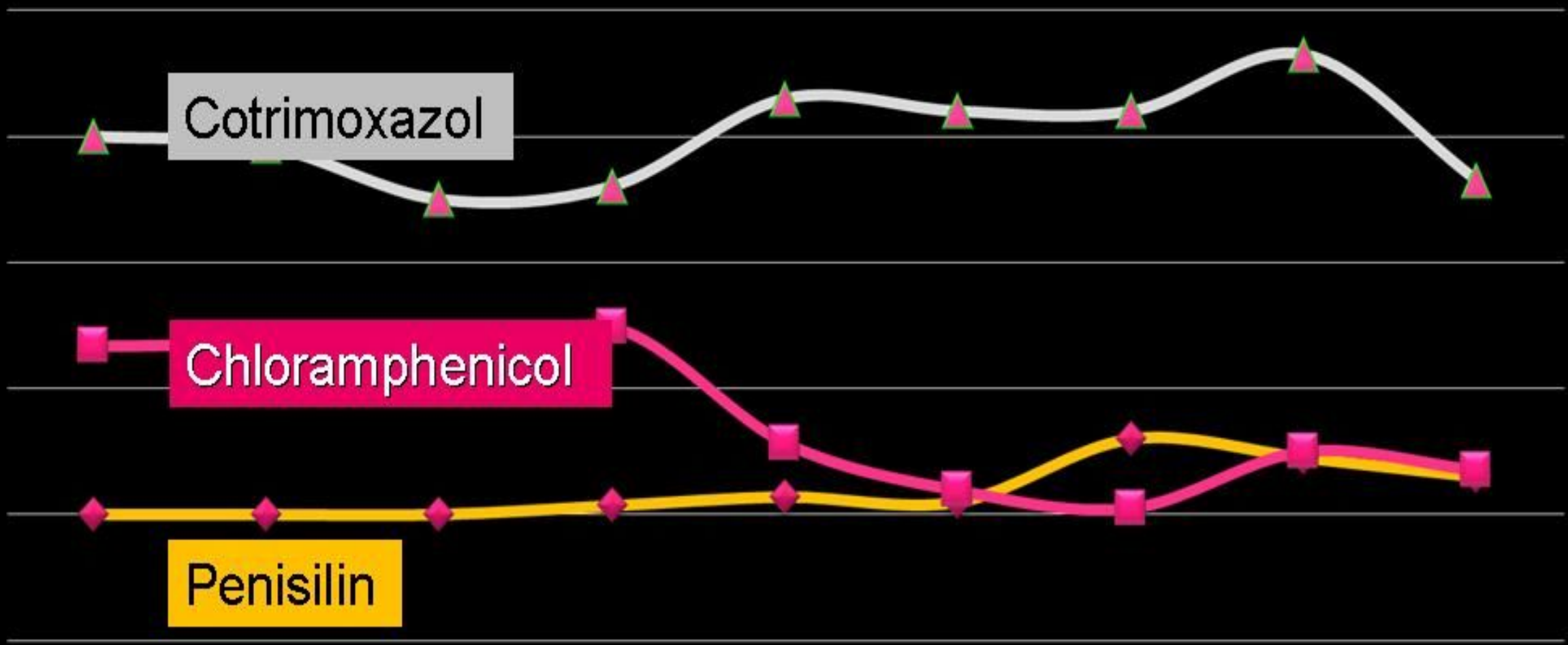
Resistensi bakteri patogen

Penggunaan Fluoroquinolone dan Resistensi Pneumococcus

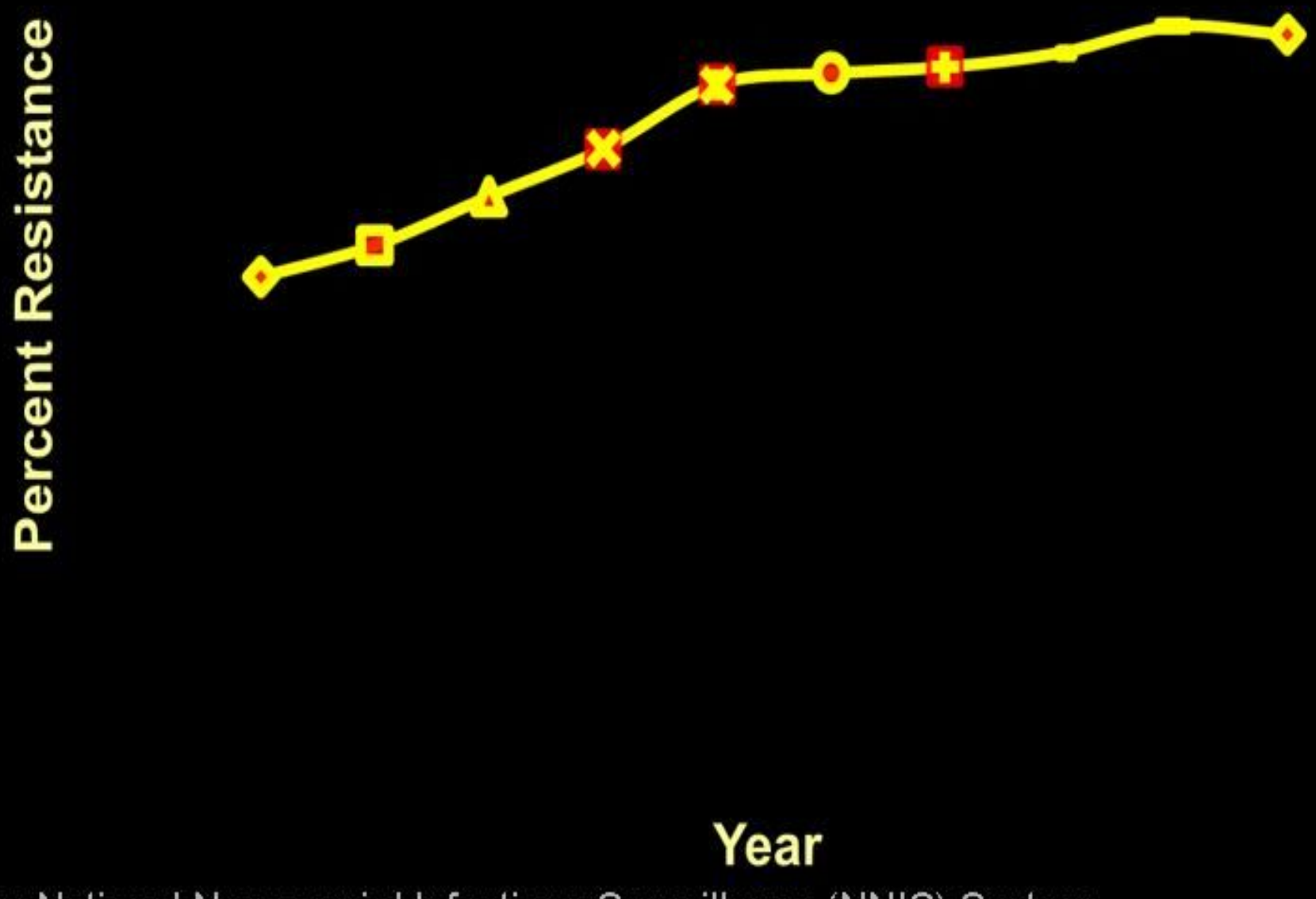


Chen DK, et al. *N Engl J Med*. 1999;341(4):233-239.

Antimicrobial resistance *S. pneumoniae* Time Trends (Thomas et al., 2002)



Methicillin-Resistant *Staphylococcus aureus* (MRSA) pada pasien Intensive Care Unit, 1995-2004



Source: National Nosocomial Infections Surveillance (NNIS) System

➢ *Link to: NNIS Online at CDC*

Vancomycin-Resistant *Enterococci* (VRE) pada pasien di Intensive Care Unit, 1995-2004

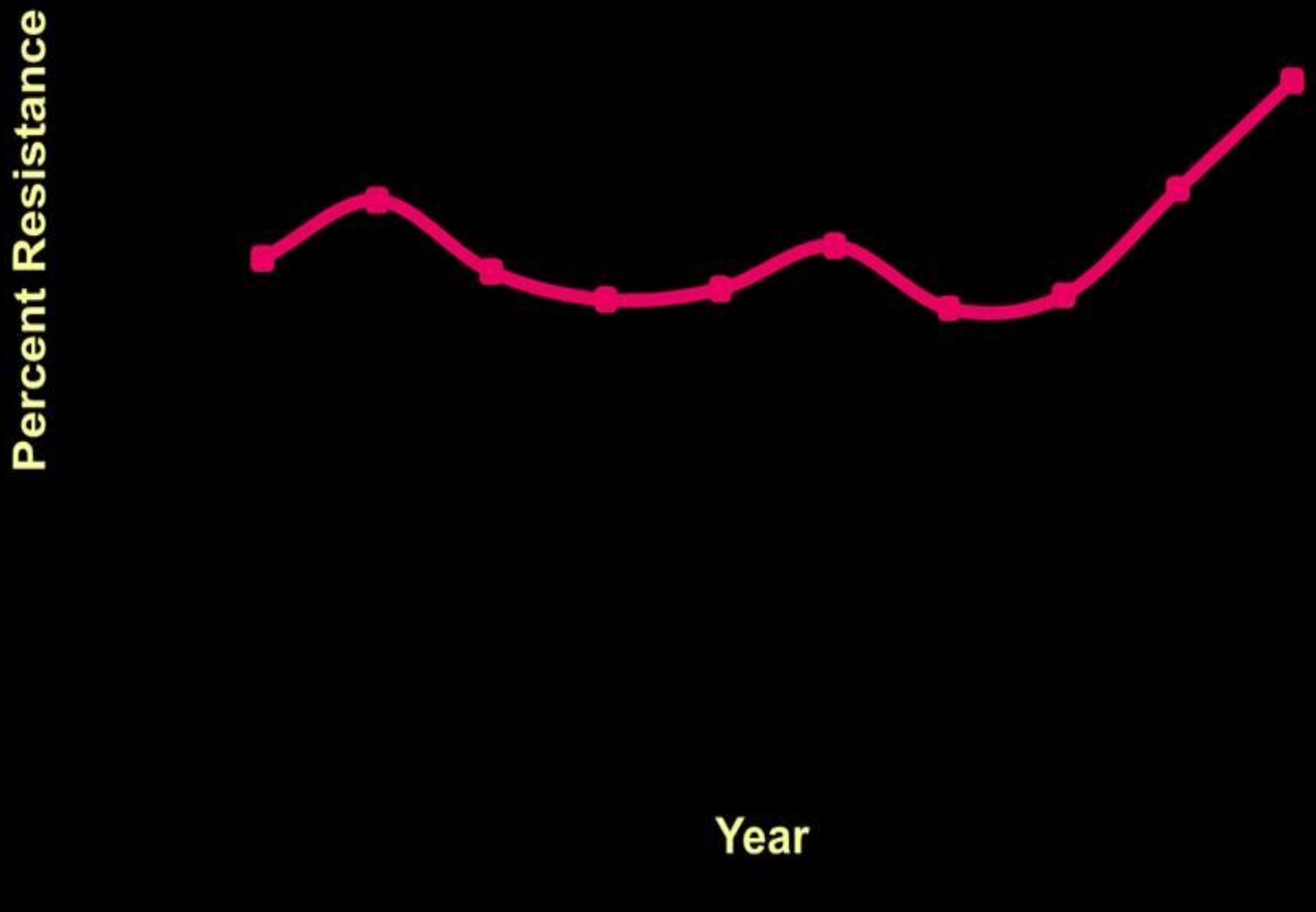
Source: National Nosocomial Infections Surveillance (NNIS) System

Peningkatan Prevalensi resistensi bakteri di ICU : '2005 vs '2001-2004

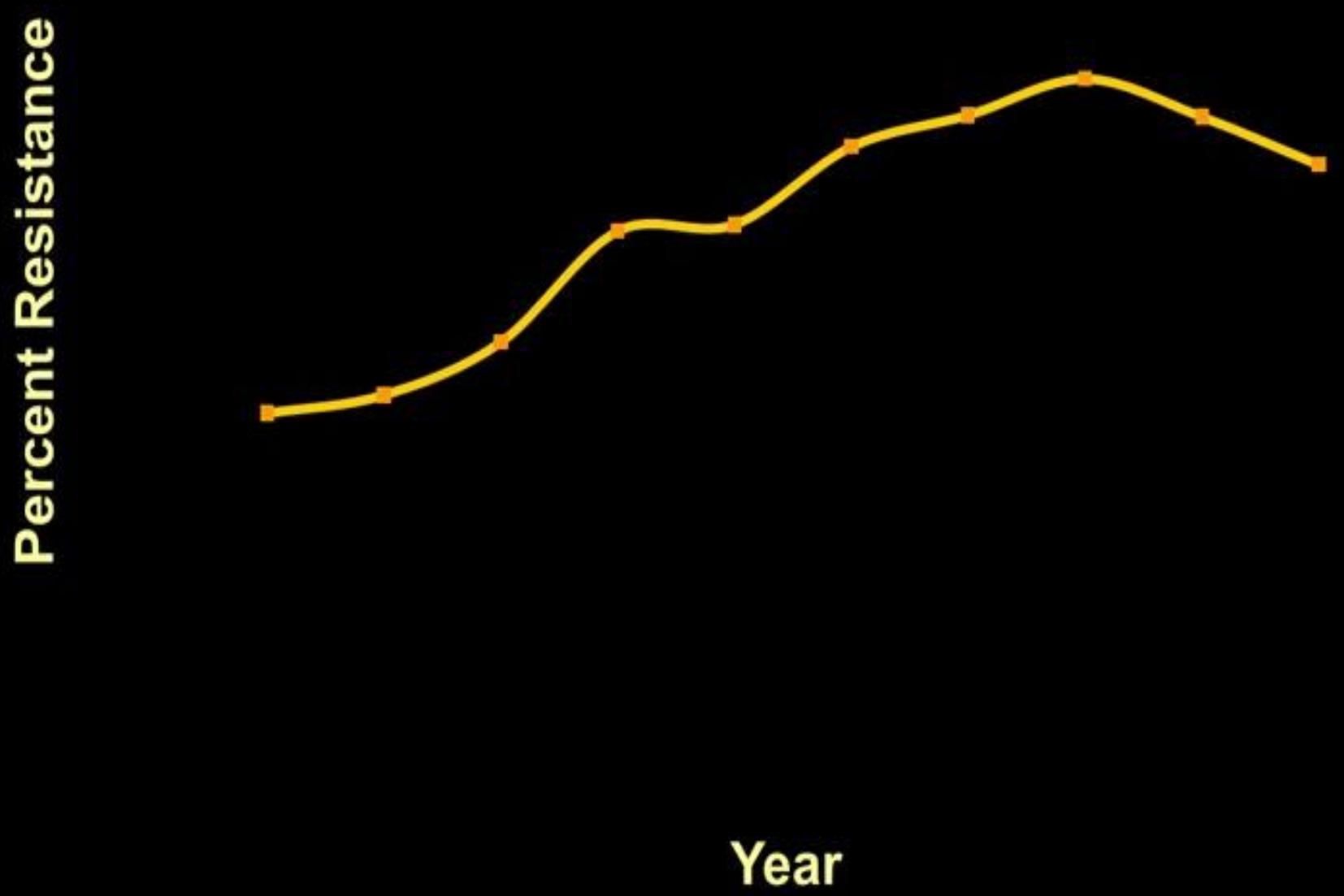
Organism	# Isolates	%↑*
Fluoroquinolone-R *Pseudomonas* spp.	2657	49%
3rd generation cephalosporin-R *E. coli*	1551	48%
Methicillin-R *Staphylococcus aureus*	2546	40%
Vancomycin-R enterococci	4744	40%
Imipenem-R *Pseudomonas* spp.	1839	20%

National Nosocomial Infections Surveillance (NNIS) System, 2006

Resistensi Klebsiella pneumonia thd Cephalosporin-generasi 3, di ICU, 1995-2004 (NNIS, 2006)



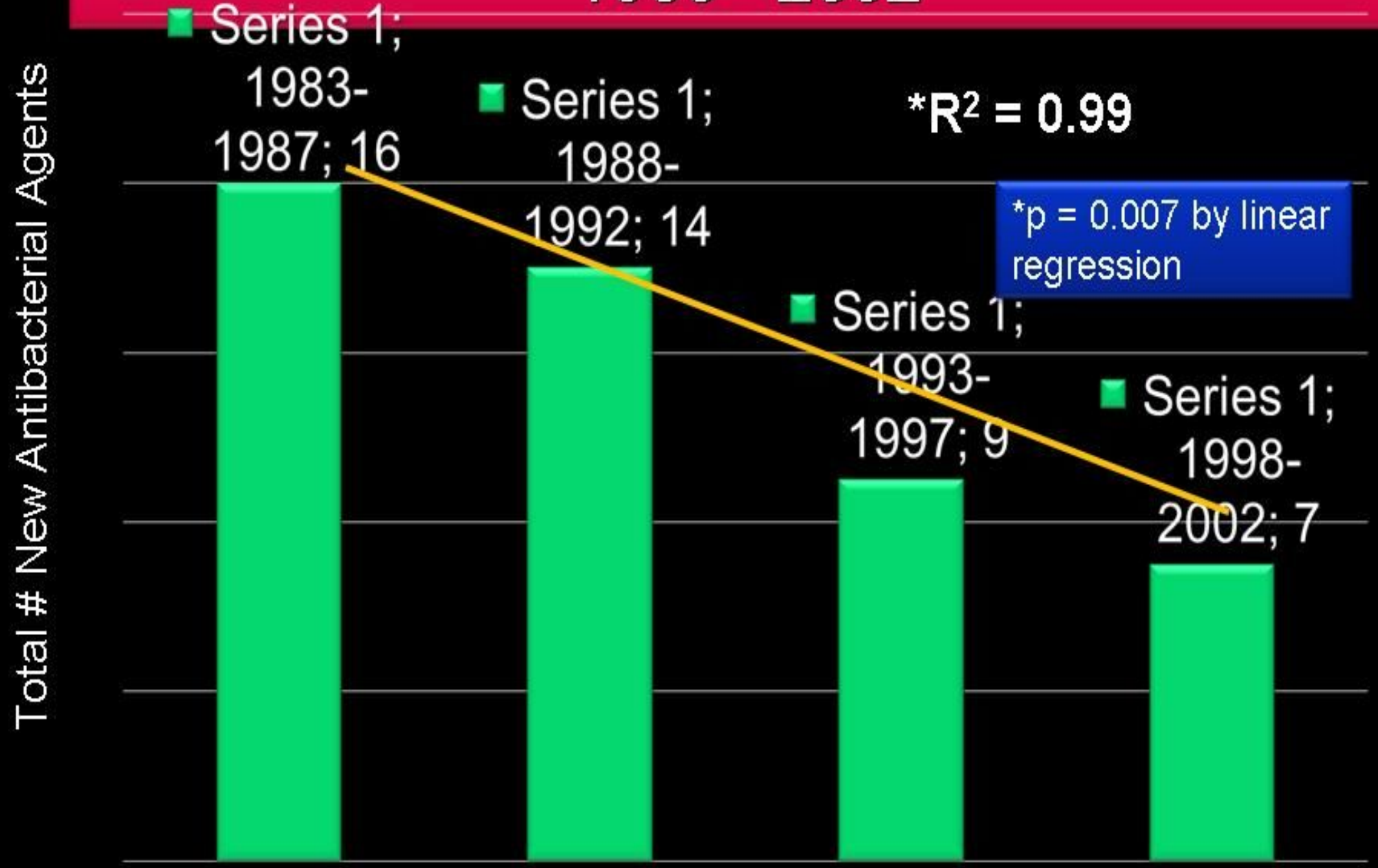
Fluoroquinolone-Resistant *Pseudomonas aeruginosa* pada pasien ICU, 1995-2004 (NNIS, 2006)



Ironi Pengembangan Antibiotika di Dunia

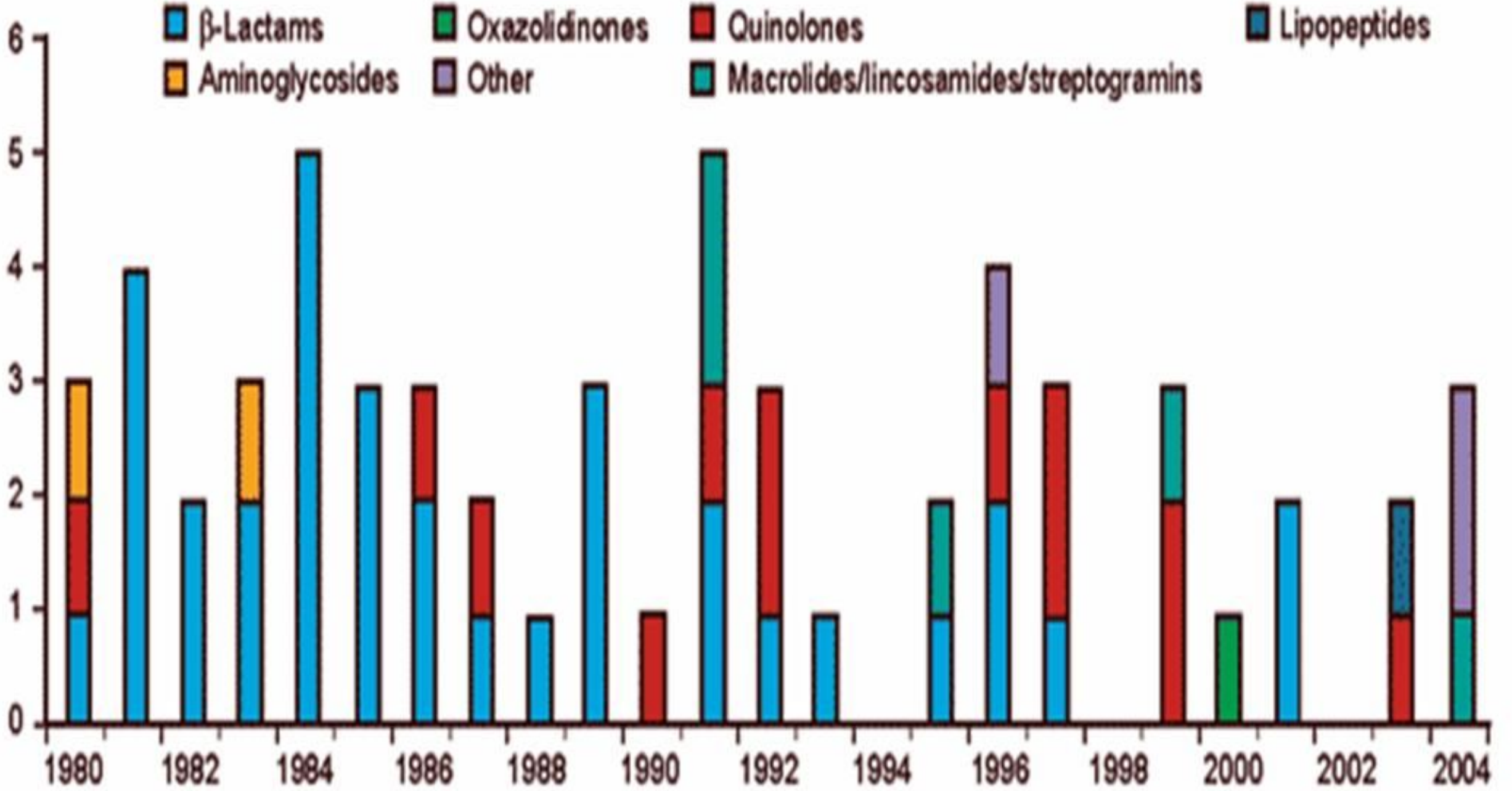
Klas antibiotika	Tahun dipasarkan
Sulphonamida	1936
Penicillins	1940
Tetracyclines	1949
Chloramphenicol	1949
Aminoglycosides	1950
Macrolides	1952
Glycopeptides	1958
Streptogramins	1962
Quinolones	1962
Oxazolidinones	2001
Glycylcyline	2005

Trend pengembangan antibiotika di Dunia 1983 - 2002



New antibacterial agent ≡ new molecular entity (NME) with antimicrobial properties, administered for systemic infection; topical agents, immunomodulators excluded

Edwards J, *ICAAC*, 2003



US Food and Drug Administration approvals of systemic antibacterial new molecular entities, 1980–2004.

Gram-positive superbugs

Resistant Gram-positive bacteria terminology	
PRSP	Penicillin resistant Streptococcus pneumoniae
MDRSP	Multidrug resistant Streptococcus pneumoniae
MRSA	Methicillin resistant Staphylococcus aureus
VRSA	Vancomycin resistant Staphylococcus aureus
VISA (GISA)	Vancomycin (Glycopeptide) intermediate Staphylococcus aureus
VRE (GRE)	Vancomycin (Glycopeptide) resistant Enterococcus

Gram-negative superbugs

Resistant Gram-negative bacteria terminology	
ESBL-producing Enterobacteriaceae	Extended spectrum beta-lactamases producing Enterobacteriaceae, e.g. *Escherichia coli*, *Klebsiella pneumoniae*
MRPA (MDR-PA)	Multidrug resistant *Pseudomonas aeruginosa*
MRAB (MDR-AB)	Multidrug resistant *Acinetobacter baumannii*
	Pan-resistant *Pseudomonas aeruginosa*/ *Acinetobacter baumannii*

Masalah Penggunaan Antibiotika

Biaya

Variasi harga generik vs branded generic

Nama obat	Harga	Ratio harga
Ciprofloxacin 500	306	
Baquinor 500	12.765	41,63
Bactiprox 500	8.625	28,13
Tequinol 500	10.750	35,07
Interflox 500	12.125	39,54
Cetirizine	380	
Tiniz	2.660	7
Ozen	3.165	8,33
Intrizin	3.165	8,33
Cerini	3.125	8,23

Variasi harga siprofloksasin branded generic

Zeniflox	1.800
Interflo	3.410
Baquin	3.750
Kifarox	5.950
Lapiflox	5.939
Ciflos	8.366
Wiaflox	12.828
Ciproxin	28.800

4,5 kali generik

Generik: Rp 380,-

75 kali generik

STRATEGIES ????????

Approach to empiric therapy

- Site of infection
- Likely organisms
- Broad spectrum therapy if very ill
- Cultures
- Modify therapy based on culture results
- Optimally use: narrow spectrum, long-half life, low toxicity, inexpensive

Bacteria by Site of Infection

Mouth

Peptococcus
Peptostreptococcus
Actinomyces

Skin/Soft Tissue

S. aureus
S. pyogenes
S. epidermidis
Pasteurella

Bone and Joint

S. aureus
S. epidermidis
Streptococci
N. gonorrhoeae
Gram negative rods

Abdomen

E. coli, Proteus
Klebsiella
Enterococcus
Bacteroides sp.

Urinary Tract

E. coli, Proteus
Klebsiella
Enterococcus
Staph saprophyticus

Upper Respiratory

S. pneumoniae
H. influenzae
M. catarrhalis
S. pyogenes

Lower Respiratory Community

S. pneumoniae
H. influenzae
K. pneumoniae
Legionella pneumophila
Mycoplasma, Chlamydia

Lower Respiratory Hospital

K. pneumoniae
P. aeruginosa
Enterobacter sp.
Serratia sp.
S. aureus

Meningitis

S. pneumoniae
N. meningitidis
H. influenza
Group B Strep
E. coli
Listeria

ANTIBIOTIC STEWARDSHIP

"Balancing adequate coverage with reducing emergence of resistance"

Now thats what I call self confidence!

Stewardship memerlukan

- Updated knowledge utk prevalenci bakteri
- Updated pola resistensi bakteri
- Formularium
- Awareness terhadap potensi seleksi bakteri resisten
- Pertimbangan faktor pasien

Instrumen untuk antibiotic stewardship

1. Guidelines
2. Restrictions
3. Area specific practices eg: ICU/NICU/HDU
4. CombinationTx
5. Antibiotic or Crop cycling/ rotation

Tools for good antibiotic stewardship

1. Guidelines

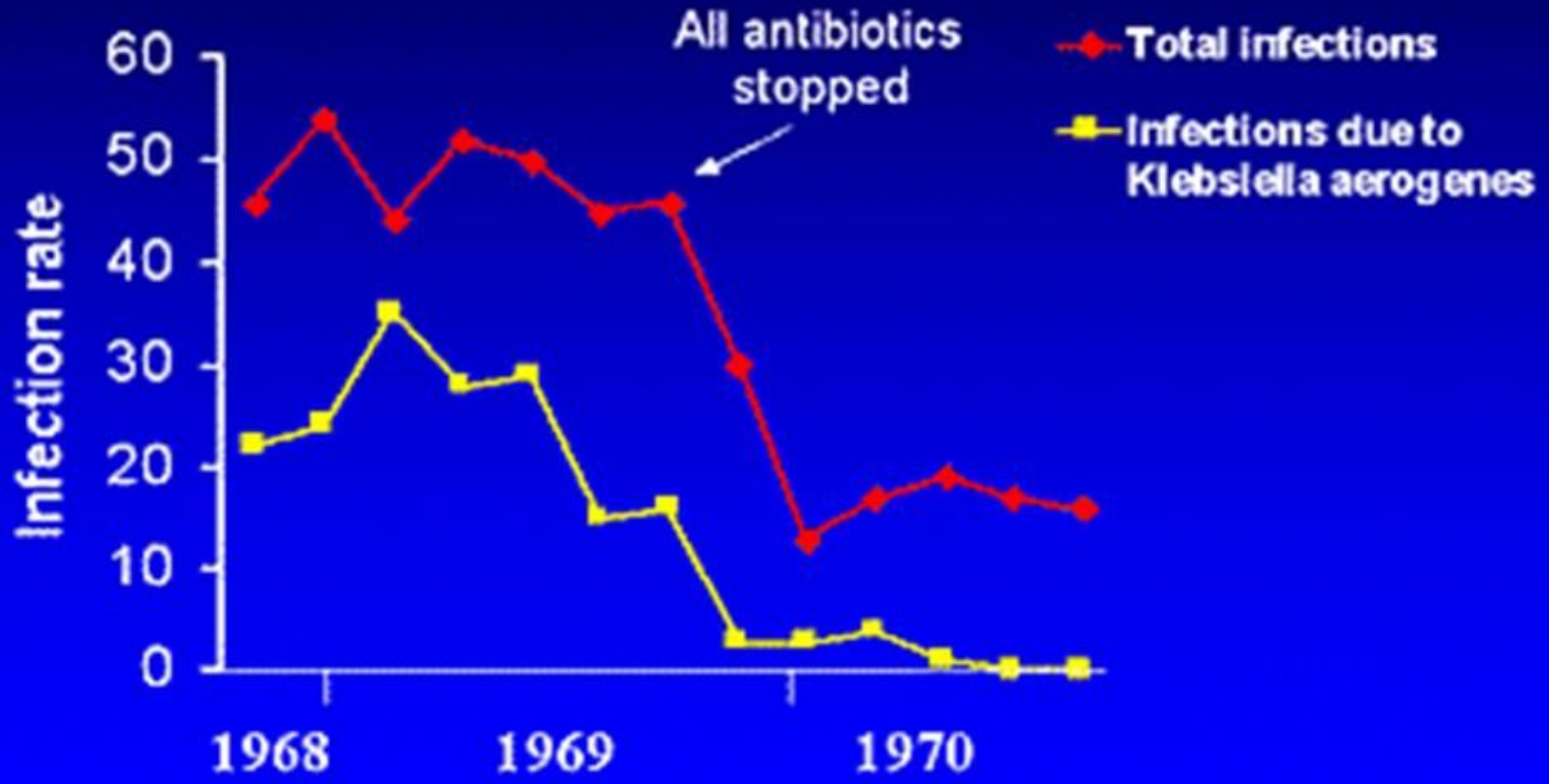
Guideline-Singapore-Antibiotics in adult.pdf

GUIDELINE-use_of_antibiotics_in_paed_care.pdf

SIGN-Antibiotic prophylaxis in surgery.pdf

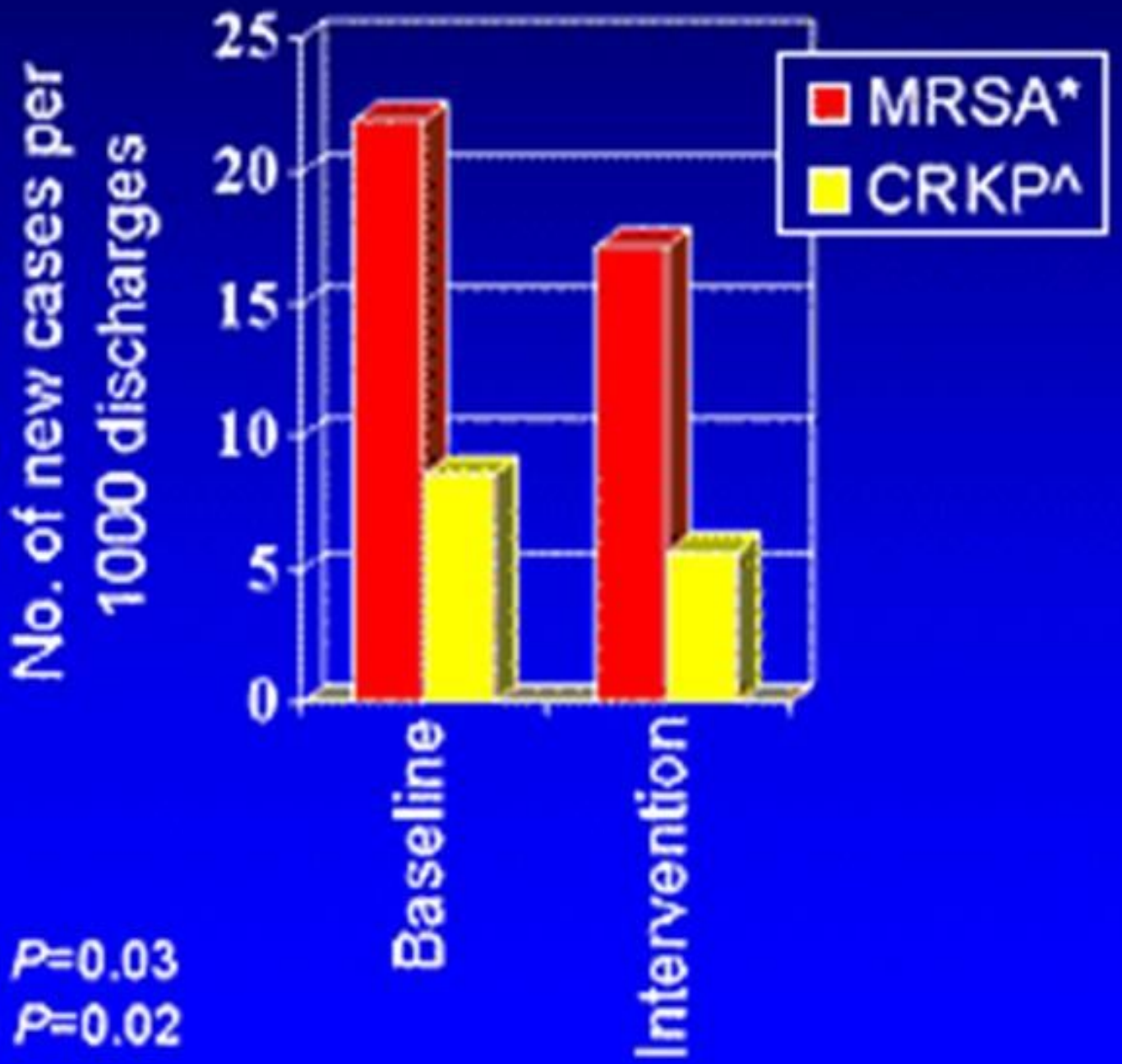
2. Restrictions

Impact of Antibiotic Restriction on Resistance



Price. *Lancet.* 1970.

Impact of Formulary Changes on MRSA and Ceftazidime Resistant *K. pneumoniae*



- Reduced usage of cephalosporins, imipenem, clindamycin and vancomycin
- Increased usage of ß-lactam/ß-lactamase inhibitors

Landman. *Clin Infect Dis.* 1999.

Penggunaan vancomycin rasional

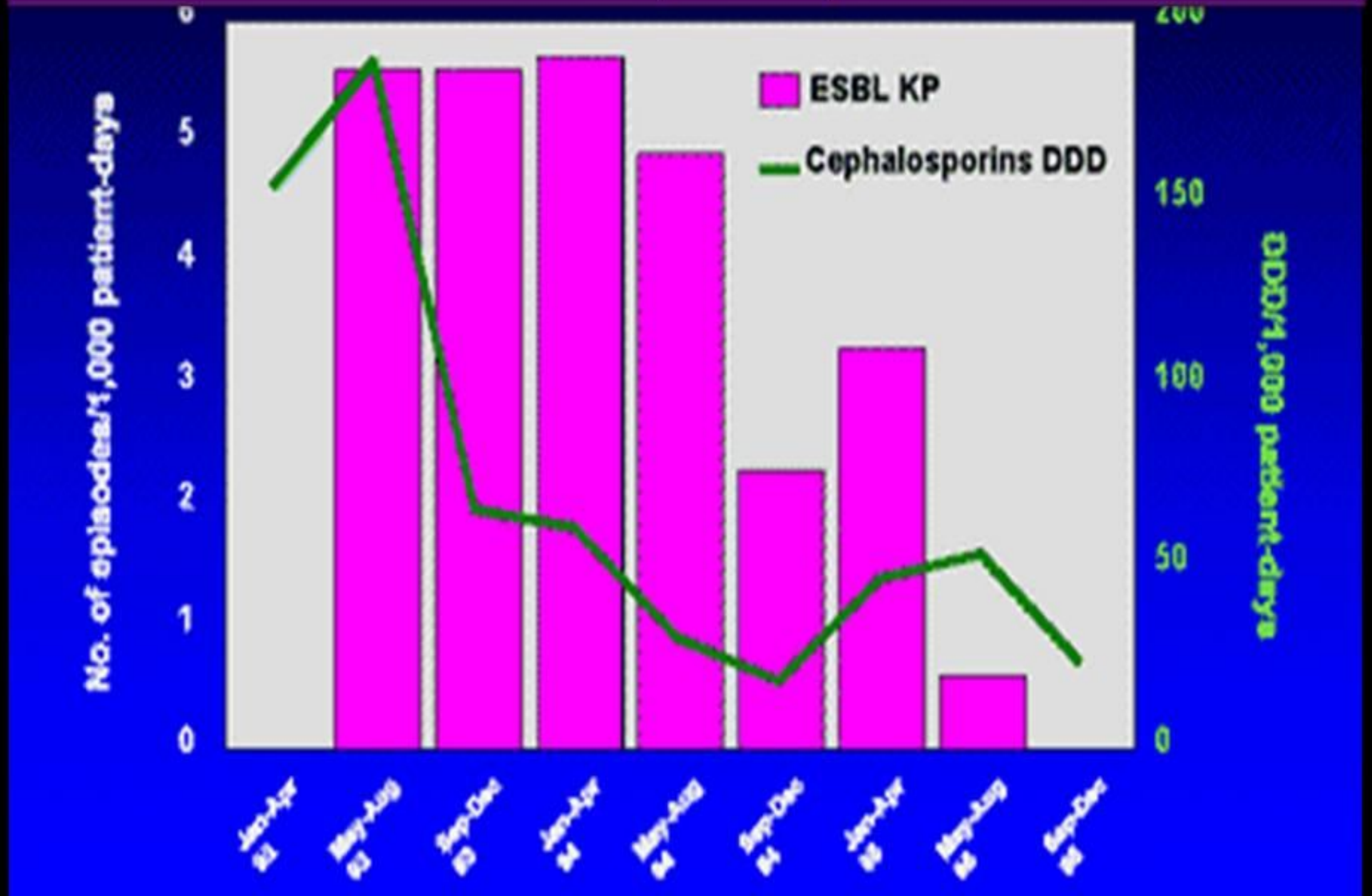
1. Infeksi **serius** oleh bakteri gram-positive yang resisten terhadap beta-laktam
2. Serious (anaphylactoid) b-lactam allergies
3. Infeksi oleh MRSA dan MRSE
4. Life-threatening infection oleh *Clostridium difficile*

Strategi pengendalian resistensi bakteri

- Antibiotic guideline
- Hospital drug formulary untuk antiinfeksi;
- Pendidikan dan regulasi peresepan;
- Pemantauan dan audit penggunaan obat;
- Surveillance dan sistem pelaporan pola resistensi hospital flora;
- Deteksi pasien yang terkolonisasi communicable resistant bacteria
- Promosi dan monitoring praktek pengendalian infeksi di rumahsakit seperti hand hygiene.

3. Area specific practices eg: ICU/NICU/HDU

ESBL-KP (Extended spectrum beta lactamase) incidence rate and cephalosporin use in ICUs



4. Antibiotika kombinasi

Indikasi Penggunaan antibiotika kombinasi

5 alasan penggunaan antibiotika kombinasi

- Mencegah perkembangan resistensi
- Infeksi oleh polimikroba
- Sinergisme
- Menurunkan toksisitas
- Sebatai terapi inisial

5. Antibiotic or Crop cycling/ rotation

Antibiotic cycling merupakan perangkat antibiotic stewardship (crop rotation) yang efektif

CROP ROTATION POLICY

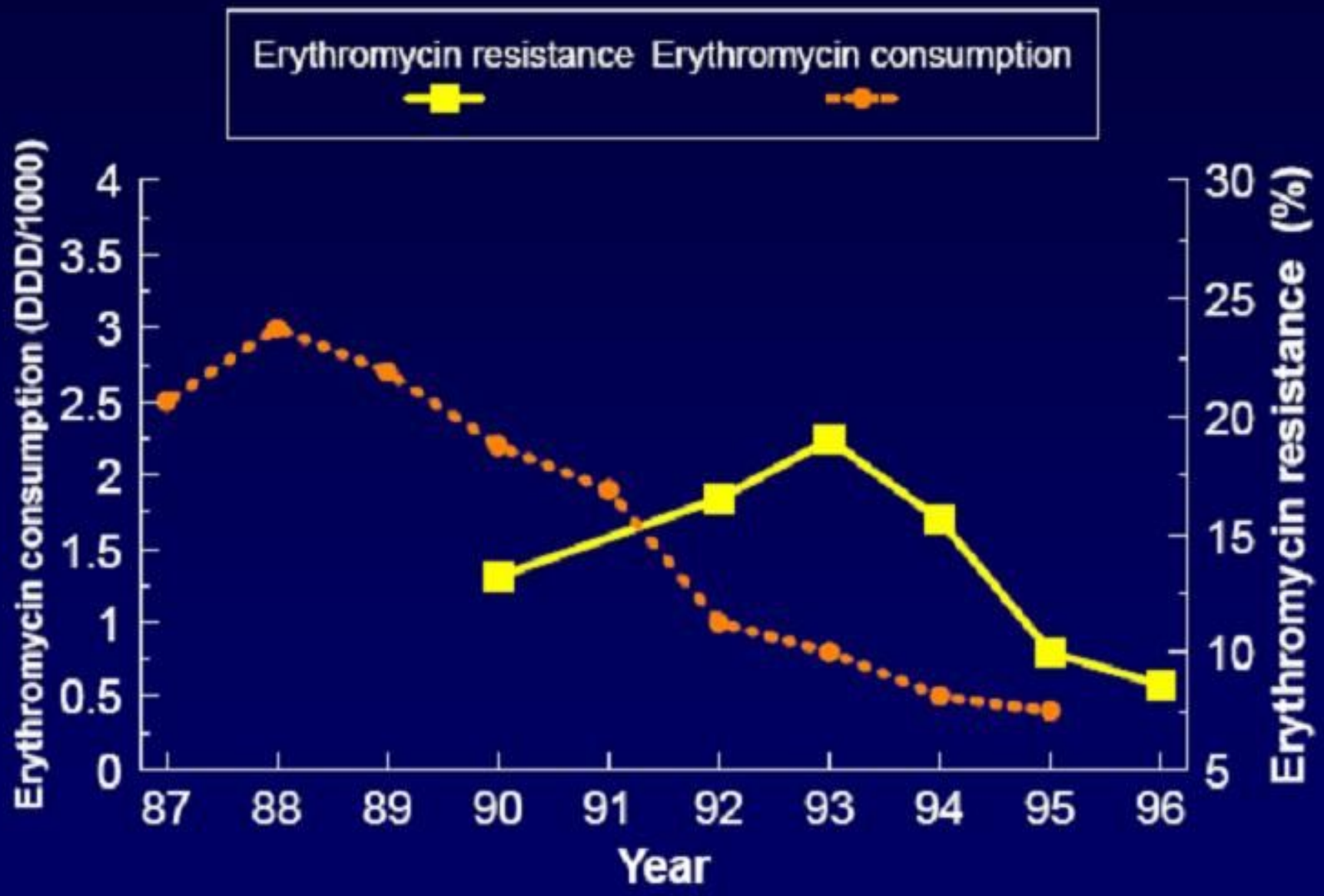
- Digunakan untuk menetapkan jenis antibiotika untuk satu periode tertentu (misalnya 3 bulan)
- Ditetapkan pula jenis antibiotika untuk 3 bulan berikutnya.
- Selanjutnya di recycle

Contoh:
Jan-March 2004: Ciprofloxacine ++++
April -June 2004: Sulperazone ++++
July -Sept 2004 : Ceftazidime ++++
Oct-Dec 2004 : Piperacillin/tazobactam

EVIDENCE?

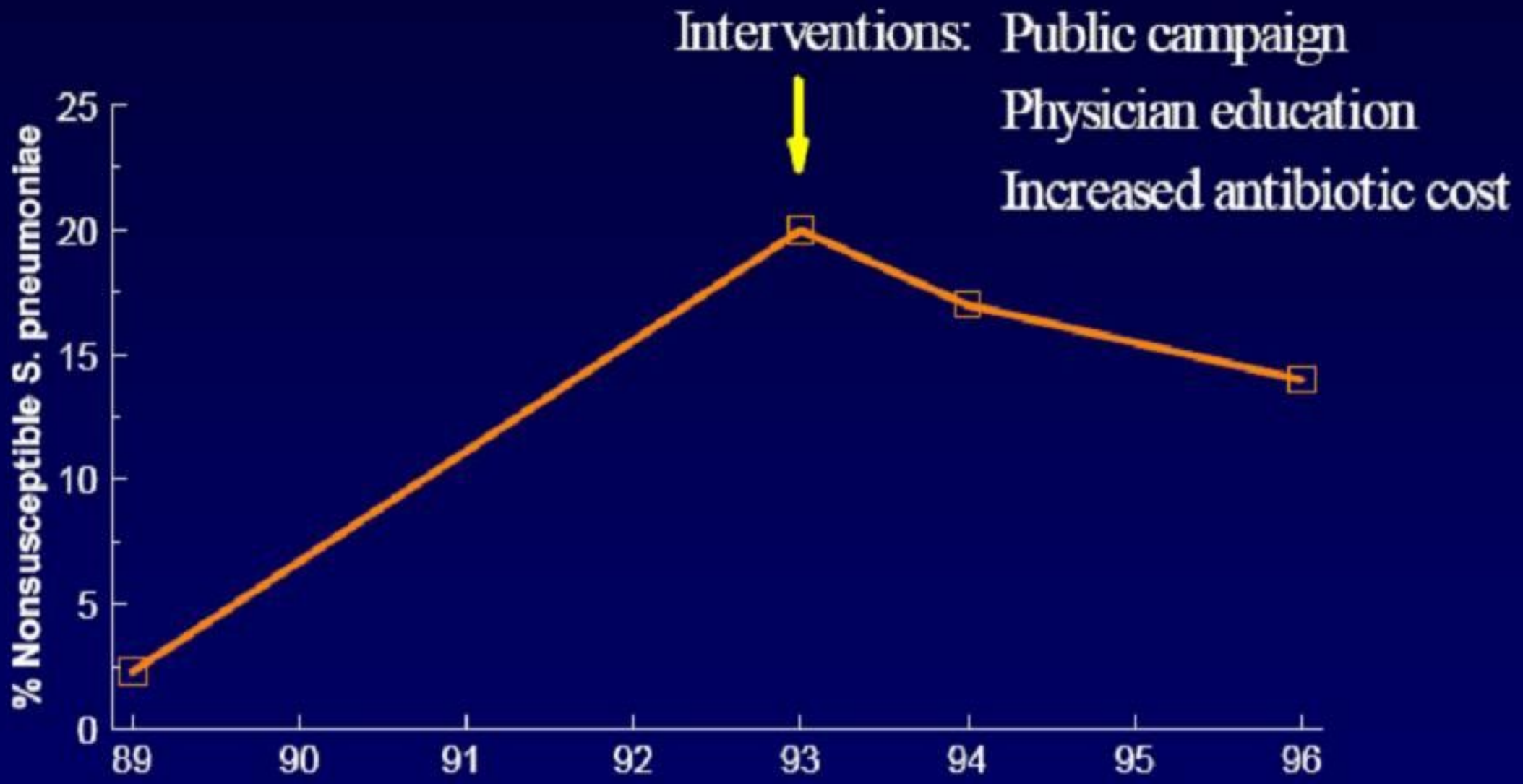
- Meningkatkan survival
- Menurunkan morbiditas
- Menurunkan tingkat resistensi
- Efisiensi biaya
- Meminimalkan ketidakrasionalan

Controlling Erythromycin Resistance in Group A Streptococci, Finland



Seppala,NEJM 1997;337:441

Success at Controlling Pneumococcal Resistance - Iceland



Stephenson, JAMA 1996;275:175
Kristinsson, personal communication

Patient mortality/morbidity

1. 2.9 vs 9.6 deaths per 100 patients
   Raymond et all, 2001, Critcare med/ ICU, USA: quarterly rotation for sepsis, peritonitis, pneumonias.

2. **Reduced incidence of ventilator ass pneumonia over 5 year period (23% vs 16%)**
   Gruson D,Crit Care Med. 2003 Jul;31(7):1908-1

3. **Reduced nosocomial infections in non-ICU wards because of antibiotic rotation in ICU**
   Hughes MG,Crit Care Med. 2004 Jan;32(1):53-60.I Surgical patients

Appropriate Use of Antibiotics

- Pilih antibiotika yang paling aktif melawan organisme yang dicurigai
- Berikan secara empirik jika kecurigaan klinis infeksi dapat dipertanggungjawabkan
- Pilih antibiotika yang dapat mencapai jaringan yang terinfeksi
- Gunakan dosis yang adekuat, jangan underdose
- Memahami kapan bakteriostatik cukup adekuat dan kapan perlu bakterisidal
- Pada infeksi serius, life-threatening, mulai dengan broad-spectrum, segera ganti sesuai hasil kultur
- Hentikan antibiotika jika infeksi telah teratasi

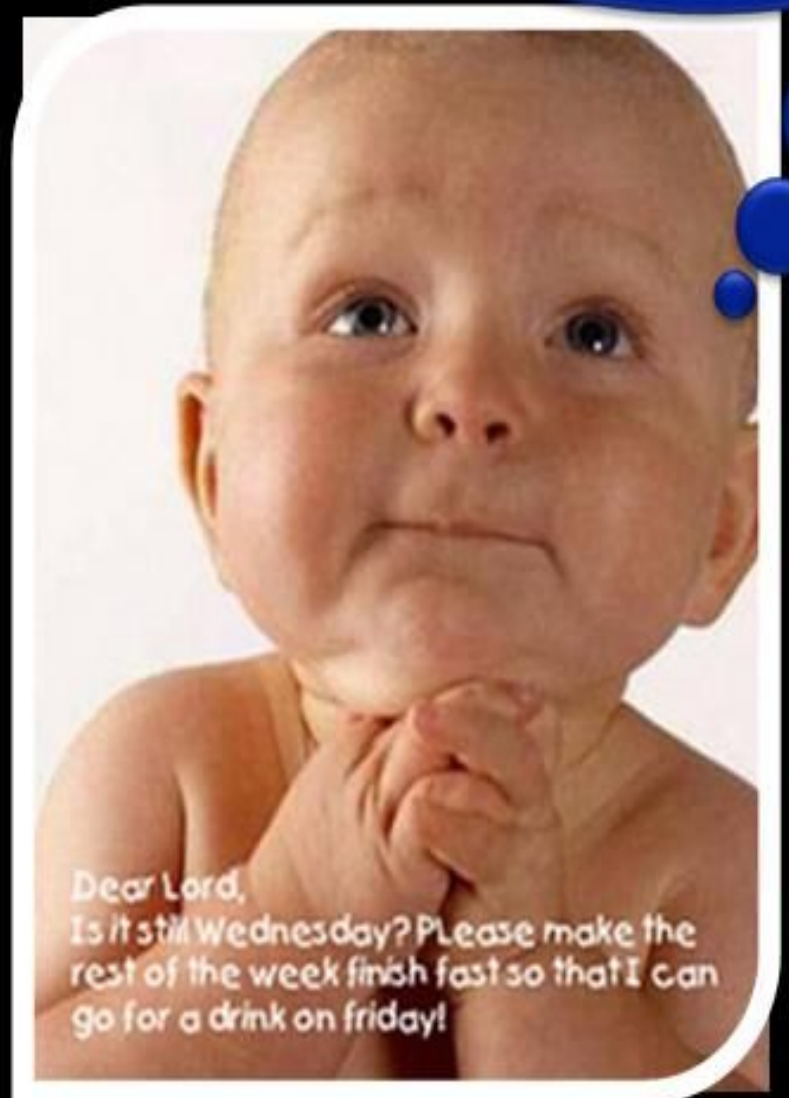
Mengapa antibiotika digunakan secara eksesif?

- Gagal mengidentifikasi & mengeliminasi fokus infeksi
- Gagal membedakan antara infeksi & kontaminasi
- Gagal membedakan antara infeksi & inflamasi
- Gagal mengklasifikasikan keparahan infeksi
- Gagal memahami bhw abses hrs didrain bukan AB
- Gagal memahami bhw gangren hrs reseksi bukan AB
- Gagal menerapkan konsep profilaksi pra bedah
- Gagal membedakan antara dogma & rasional
- Gagal menolak rayuan duta-duta farmasi

Inappropriate Uses of Antibiotics

- Memberikan antibiotika yang keliru/tidak sesuai
- Dosis keliru/tidak adekuat
- Memberikan antibiotika 2nd atau 3rd line padahal 1st line ada
- Memberikan antibiotika tanpa indikasi
- Antibiotika tetap dilanjutkan meskipun tidak berefek
- Tetap memberikan broad-spectrum meskipun hasil kultur single organism
- Reacting to culture results by starting antibiotics without considering the significance of the culture

Knowing is not enough;
we must apply.
Willing is not enough; we
must do.



Johann Wolfgang von Goethe.

Terima kasih

Penicillins

Penicillin G	• Still useful for a number of diseases (e.g. meningitis, syphilis)
Cloxacillin	• For MSSA infections
Ampicillin, amoxicillin	• Active vs. Gram-positive (not MSSA), Gram-negative organisms
Augmentin, Unasyn	• Broad spectrum, covers Gram-positive, Gram-negative and anaerobes
Piperacillin, Tazocin, Timentin	• Are active vs. Pseudomonas

Cephalosporins

Cefazolin, cephalexin

- Active vs. Gram-positive organisms including MSSA

Cefuroxime, Cefaclor

- Covers some Gram-negative organisms

Cefotaxime, Ceftriaxone

- Broad spectrum, enhanced activity towards Gram-negative organisms

Ceftazidime, Cefepime, Sulperazon

- Additive Pseudomonas coverage

Carbapenems

Imipenem

- Broad spectrum, covers Gram-positive, Gram-negative (including ESBL-producing strains), Pseudomonas and anaerobes

Meropenem

- Less seizure-inducing potential, can be used to treat CNS infections

Ertapenem

- Lacks activity vs. Acinetobacter and Pseudomonas
- Has limited activity against penicillin-resistant pneumococci

Quinolones

Ciprofloxacin

- Active vs. MSSA, Gram-negative and Pseudomonas

Levofloxacin

- Has activity vs. Streptococcus pneumoniae, but slightly less active towards Pseudomonas compared to ciprofloxacin

Moxifloxacin

- Has activity vs. anaerobes but less active towards Pseudomonas

Aminoglycosides

Active vs. some Gram-positive and Gram-negative organisms

Gentamicin

- Active vs. Pseudomonas

Tobramycin

- More active vs. Pseudomonas than gentamicin
- Shows less activity against certain other Gram-negative bacteria

Amikacin

- More stable to enzymes, used in severe infections by gentamicin-resistant organisms

Streptomycin

- Used for tuberculosis

Macrolides

- Active vs. Gram-positive organisms, atypicals
- GI side effects

Erythromycin

- Slightly greater activity than erythromycin

Clarithromycin

- Slightly less active than erythromycin vs. Gram-positive but enhanced activity vs. some Gram-negative organisms

Azithromycin

Tetracyclines

Drug of choice in infections caused by Chlamydia, Rickettsia, Brucella and Lyme

Value has decreased due to increasing bacterial resistance

Tetracycline

- Role in Helicobacter pylori eradication (less frequently used than other antibiotics)

Doxycycline

- Once daily

Minocycline

- Broader spectrum

Other antibiotics

Clindamycin

- Vs. Gram-positive cocci and anaerobes

Metronidazole

- Vs. anaerobes
- Preferred therapy in antibiotic associated diarrhoea (Clostridium difficile) than oral vancomycin, although unlicenced

Vancomycin, teicoplanin

- For Gram-positive organisms (including MRSA)

Other antibiotics

Cotrimoxazole

- Role in uncomplicated UTI, UTI prophylaxis, acute exacerbations of chronic bronchitis
- Pneumocystis carinii (now jiroveci) infections

Nitrofurantoin

- For UTI, prophylaxis vs. UTI

Fusidic acid, rifampin

- For penicillin-resistant staphylococci
- Not for monotherapy due to risk of emergence of resistance