

PREVENTING ANTIMICROBIAL RESISTANCE IN HOSPITALIZED INFANTS AND CHILDREN: (YET ANOTHER) 12 STEP PROGRAM

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PROPORTION OF *S. aureus* NOSOCOMIAL INFECTIONS RESISTANT TO OXACILLIN (MRSA) AMONG INTENSIVE CARE UNIT PATIENTS 1989-2003*



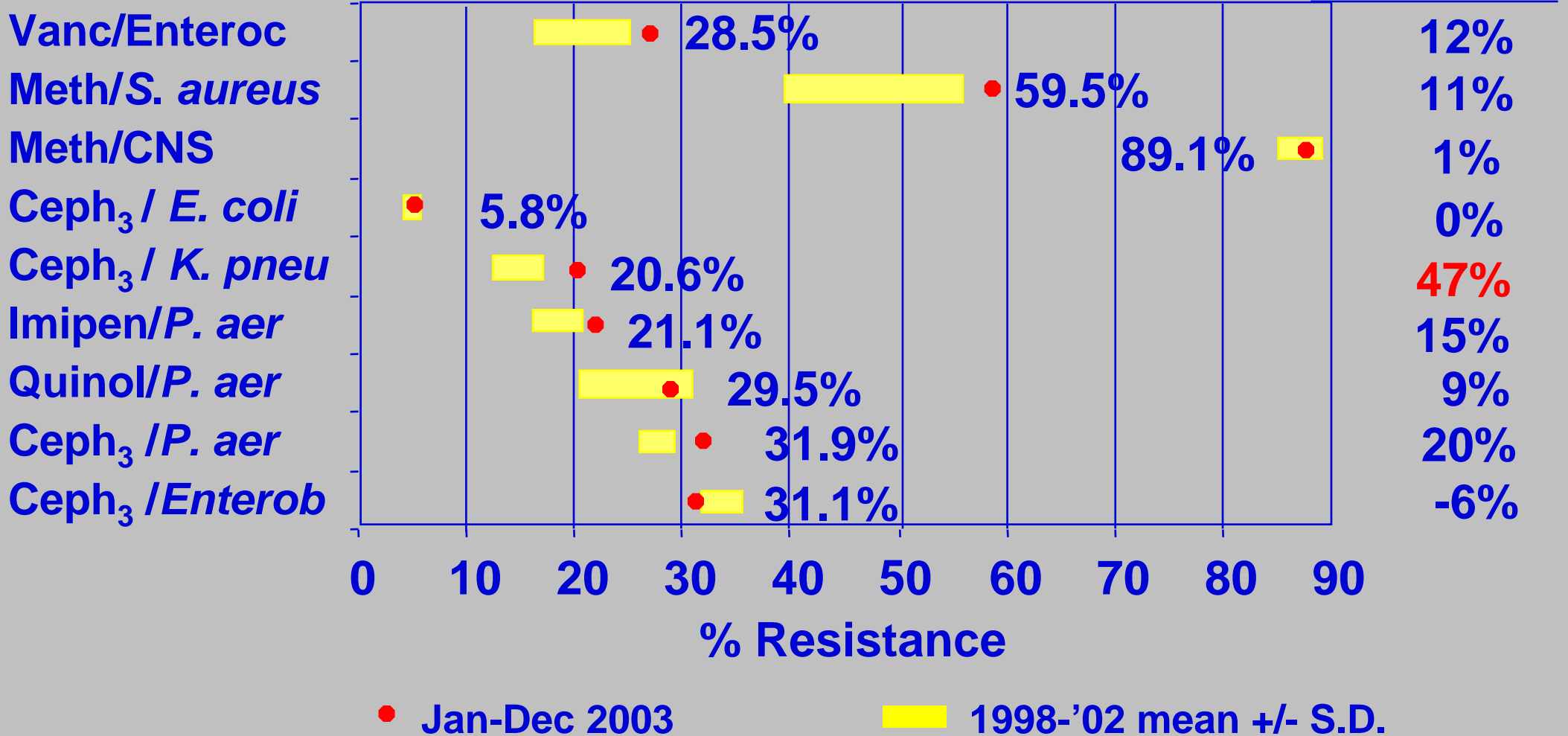
2002: 25% of *S. aureus* isolates from NICUs and PICUs MRSA

*Source: NNIS System, data for 2003 are incomplete

AMR PATHOGENS: NNIS ICU'S

2003 vs 1998-'02

%↑ RESIST
'03 vs. '98-'02



BACKGROUND: DEVELOPMENT OF PROGRAMS

- ◆ Recognition of national crisis in **antimicrobial resistance** that requires action by all healthcare providers
- ◆ Studies by CDC, including focus groups, surveys, projects, etc. to develop effective program
 - “Perception of antimicrobial resistance nationally bigger problem than in *my* institution or practice”
 - Use of **health belief model** as framework: Adherence to recommended interventions determined by belief in
 - The **susceptibility to infection** if no action taken
 - **One’s ability to follow measures** that will contribute to preventing transmission or emergence of resistance



12 Steps To Prevent Antimicrobial Resistance

- Targeted intervention programs for clinicians caring for high risk patients
 - *hospitalized adults**
 - *hospitalized children**
 - *geriatric patients*
 - *emergency patients*
 - *obstetrical patients*
 - *critical care patients*
 - *dialysis patients**
 - *surgical patients**
 - *LTCF**
- Partnership with professional societies; evidence base published in peer-reviewed specialty journals
- Educational tools – web-based / didactic learning modules, pocket cards, slide presentations, etc.
- Launch 2002: hospitalized adult
Launch 2003: pediatrics



Campaign to Prevent Antimicrobial Resistance in Healthcare Settings

- General health communication strategy
- Goals:
 - inform clinicians, patients, and other **stakeholders**, e.g. pharmacy
 - raise **awareness** about the escalating problem of antimicrobial resistance in healthcare settings
 - motivate interest and acceptance of interventional programs using **evidence-based strategies** to prevent resistance

LESSONS FROM 12 STEP PROGRAMS in OTHER DISCIPLINES

- ◆ Are we *addicted* to antibiotics?
 - Antibiotics Anonymous?
- ◆ From the **Serenity Prayer**:

“Grant me the Serenity to accept the things I cannot change,
the **courage to change the things I can,**
and the wisdom to know the difference....”
- ◆ From the **Big Book**:
 - “There *IS* a solution”
 - “Rarely have we seen a person fail who has thoroughly followed our path. Those who do not recover are people who cannot or will not completely give themselves to this **simple program.....**”



Campaign to Prevent Antimicrobial Resistance

Centers for Disease Control and Prevention

National Center for Infectious Diseases
Division of Healthcare Quality Promotion

Clinicians hold the solution!

www.cdc.gov/drugresistance/healthcare



PREVENT ANTIMICROBIAL RESISTANCE

12 STEPS TO PROTECT HOSPITALIZED CHILDREN

PREVENT INFECTION

- 1 Vaccinate hospitalized children and staff
- 2 Get the devices out

DIAGNOSE AND TREAT INFECTION EFFECTIVELY

- 3 Use appropriate methods for diagnosis
- 4 Target the pathogen
- 5 Access the experts

USE ANTIMICROBIALS WISELY

- 6 Practice antimicrobial control
- 7 Use local data
- 8 Treat infection, not contamination or colonization
- 9 Know when to say "no"
- 10 Stop treatment

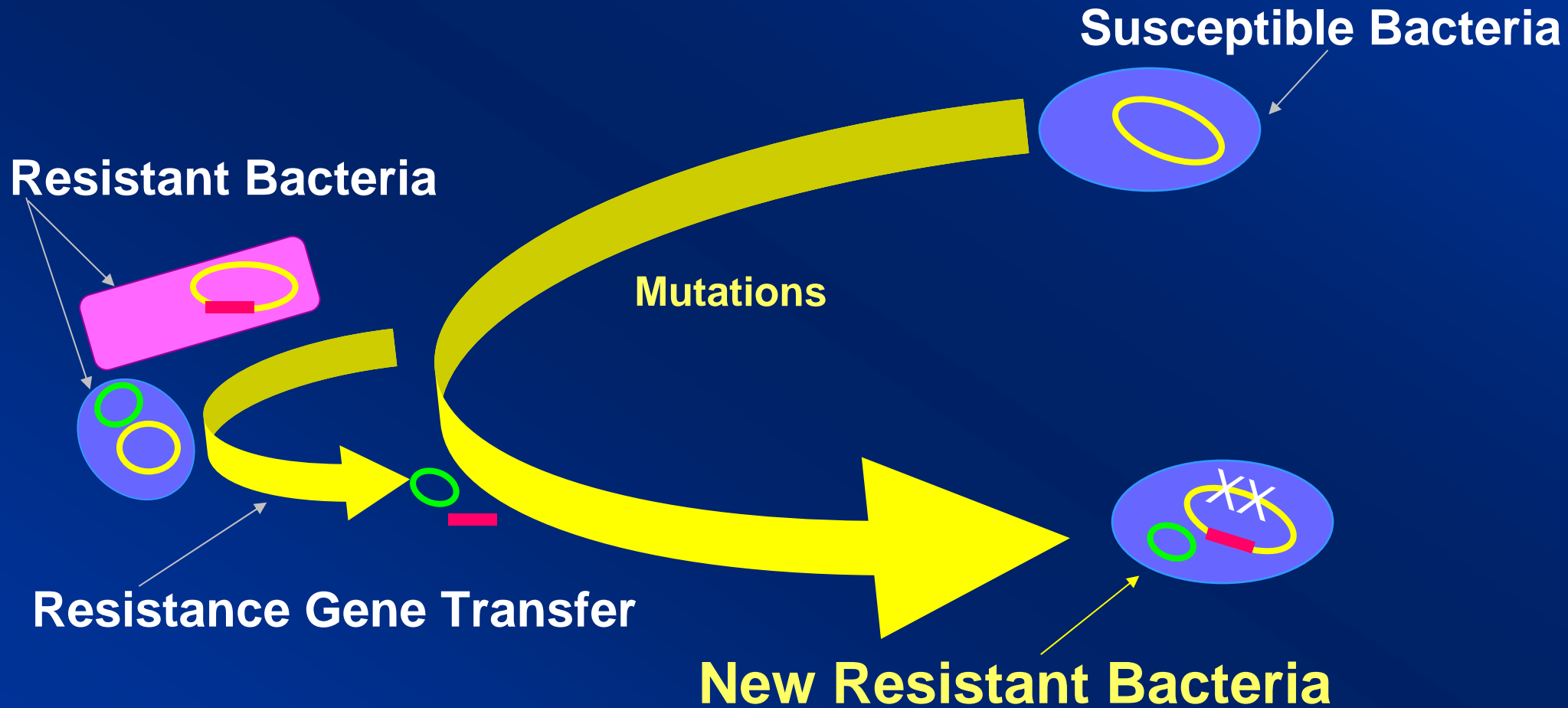
PREVENT TRANSMISSION

- 11 Practice infection control
- 12 Practice hand hygiene

Visit www.cdc.gov/drugresistance/healthcare for the complete picture on how you can prevent antimicrobial resistance and protect hospitalized children.



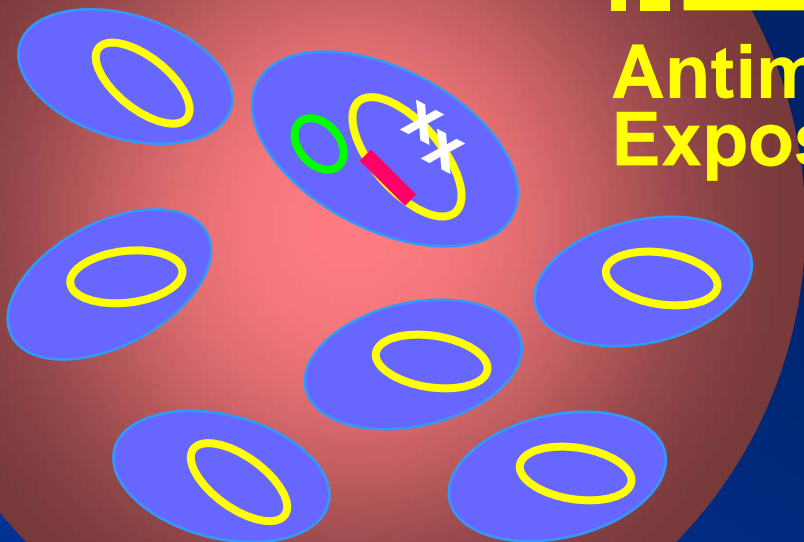
EMERGENCE OF ANTIMICROBIAL RESISTANCE





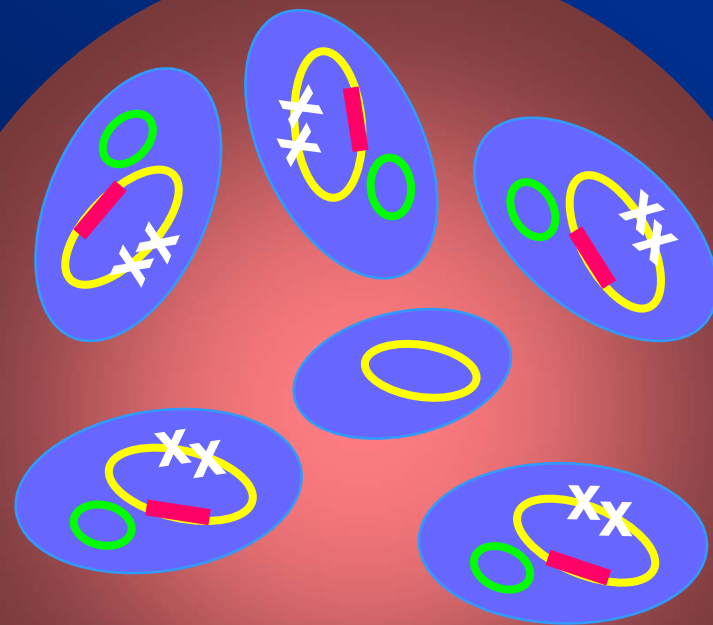
SELECTION FOR ANTIMICROBIAL-RESISTANT STRAINS

Resistant Strains
Rare

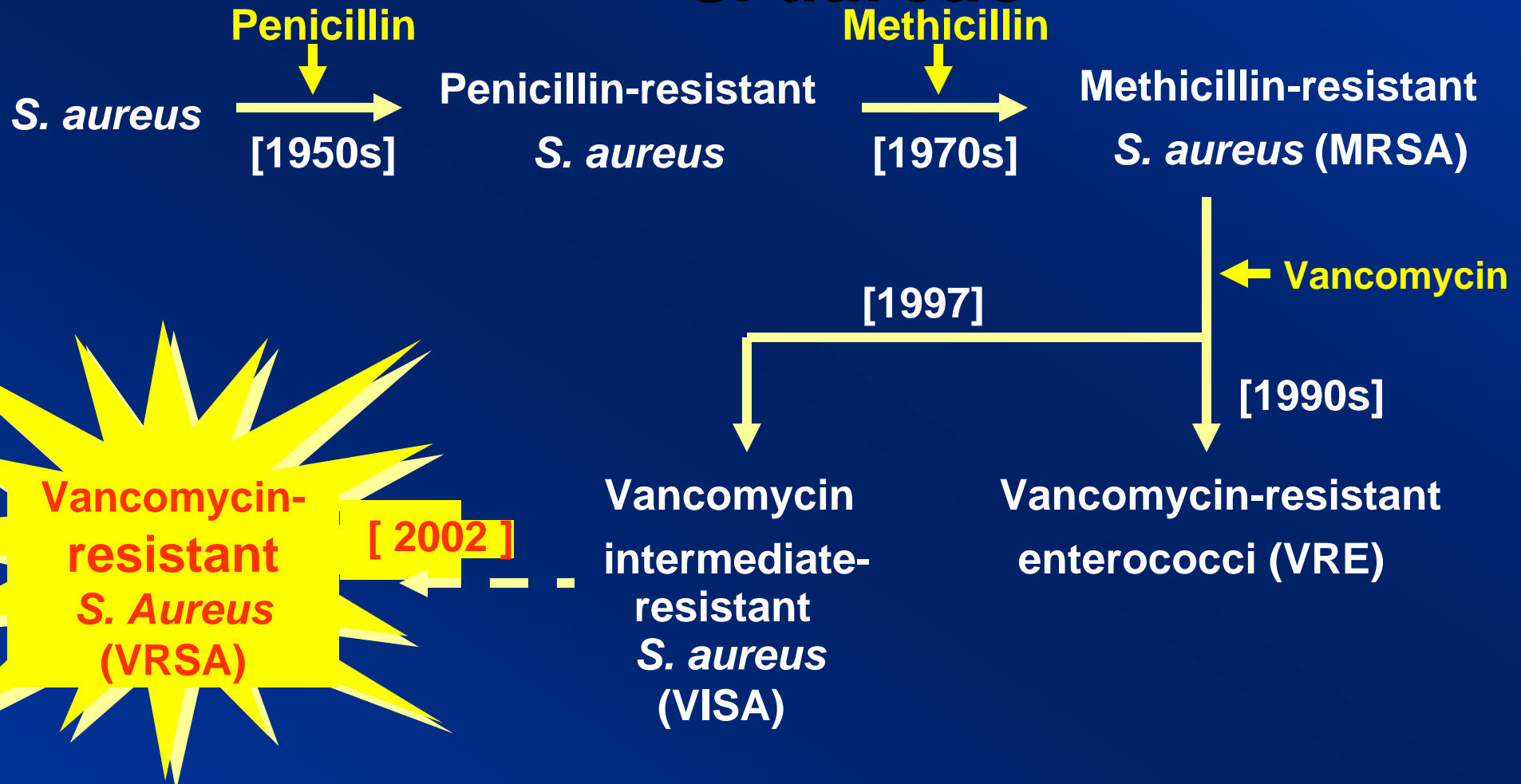


Antimicrobial
Exposure

Resistant Strains
Dominant



EVOLUTION OF DRUG RESISTANCE IN *S. aureus*



➤ [Link to: MMWR on VRSA](#)

➤ [Link to: CDC Facts about VISA](#)

➤ [Link to: CDC Facts about VRE](#)



Antimicrobial Resistance: Key Prevention Strategies

Susceptible Pathogen

*Prevent
Transmission*

*Prevent
Infection*

**Antimicrobial
Resistance**

Infection

*Optimize
Use*

*Effective
Diagnosis
& Treatment*

Antimicrobial Use



CAMPAIGN TO PREVENT ANTIMICROBIAL RESISTANCE: HOSPITALIZED INFANTS & CHILDREN

- ◆ **Collaboration of CDC, AAP, other pediatric stakeholders**
- ◆ **Models for successful educational interventions to influence antimicrobial prescribing practices in pediatric ambulatory settings**

(Belongia Pediatrics 2001; McCraig JAMA 2002; Perz JAMA 2002)

PATIENT FACTORS

◆ INTRINSIC PATIENT FACTORS

- Immature immune system of neonate
- Lack of previous infection and resulting immunity
- Congenital or acquired immune deficiencies
- Congenital anatomic anomalies

◆ VIOLATION OF NATURAL DEFENSES

- Device use in NICU / PICU
- Violation of natural defense barriers

◆ IMPACT

- AMR infections more difficult to treat
- Increased morbidity, mortality, costs

12 STEPS TO PREVENT ANTIMICROBIAL RESISTANCE IN HOSPITALIZED CHILDREN

PREVENT INFECTION

1. Vaccinate
2. Get devices out
(Use chemoprophylaxis)
(Assure safe solutions, formula, food)

DIAGNOSE & TREAT

3. Use appropriate diagnostic methods
4. Target the pathogen
5. Access the experts

USE ANTIMICROBIALS WISELY

6. Practice antimicrobial control
7. Use local data
8. Treat infection, not contamination / colonization
9. Know when to say “no” to vanco, broad spectrum drugs
10. Stop treatment

PREVENT TRANSMISSION

11. Practice infection control
12. Practice hand hygiene

STRATEGY 1: PREVENT INFECTION

STEP 1: VACCINATE

- ◆ ***Vaccinate or provide immunity through antibody containing products***
 - **Standards for Pediatric Immunization Practices** *(NVAC. MMWR 1993; 42 [RR-5]; Pediatrics 2003; 112: 958)*
 - “Children should receive vaccinations for which they are eligible by age or health status ***prior to discharge from the hospital***”
 - Standing orders for influenza, pneumococcal vaccines recommended for adults *(MMWR 2000; 49 [RR-1])*
 - Provide to children with prolonged hospital stay according to chronological age

Recommended Childhood and Adolescent Immunization Schedule UNITED STATES • 2006

Vaccine ▼	Age ▶	Birth	1 month	2 months	4 months	6 months	12 months	15 months	18 months	24 months	4-6 years	11-12 years	13-14 years	15 years	16-18 years	
Hepatitis B ¹	HepB		HepB	HepB	HepB ¹	HepB				HepB Series						
Diphtheria, Tetanus, Pertussis ²				DTaP	DTaP	DTaP		DTaP			DTaP	Tdap		Tdap		
<i>Haemophilus influenzae</i> type b ³				Hib	Hib	Hib ³	Hib									
Inactivated Poliovirus				IPV	IPV	IPV					IPV					
Measles, Mumps, Rubella ⁴							MMR				MMR	MMR				
Varicella ⁵							Varicella			Varicella						
Meningococcal ⁶												MCV4			MCV4	
Pneumococcal ⁷				PCV	PCV	PCV	PCV				PCV	PPV				
Influenza ⁸						Influenza (Yearly)				Influenza (Yearly)						
Hepatitis A ⁹						HepA Series										

Vaccines within broken line are for selected populations

This schedule indicates the recommended ages for routine administration of currently licensed childhood vaccines, as of December 1, 2005, for children through age 18 years. Any dose not administered at the recommended age should be administered at any subsequent visit when indicated and feasible. ■ Indicates age groups that warrant special effort to administer those vaccines not previously administered. Additional vaccines may be licensed and recommended during the year. Licensed combination vaccines may be used whenever

any components of the combination are indicated and other components of the vaccine are not contraindicated and if approved by the Food and Drug Administration for that dose of the series. Providers should consult the respective ACIP statement for detailed recommendations. Clinically significant adverse events that follow immunization should be reported to the Vaccine Adverse Event Reporting System (VAERS). Guidance about how to obtain and complete a VAERS form is available at www.vaers.hhs.gov or by telephone, 800-822-7967.

■ Range of recommended ages ■ Catch-up immunization ■ 11-12 year old assessment

STEP 1: VACCINATE

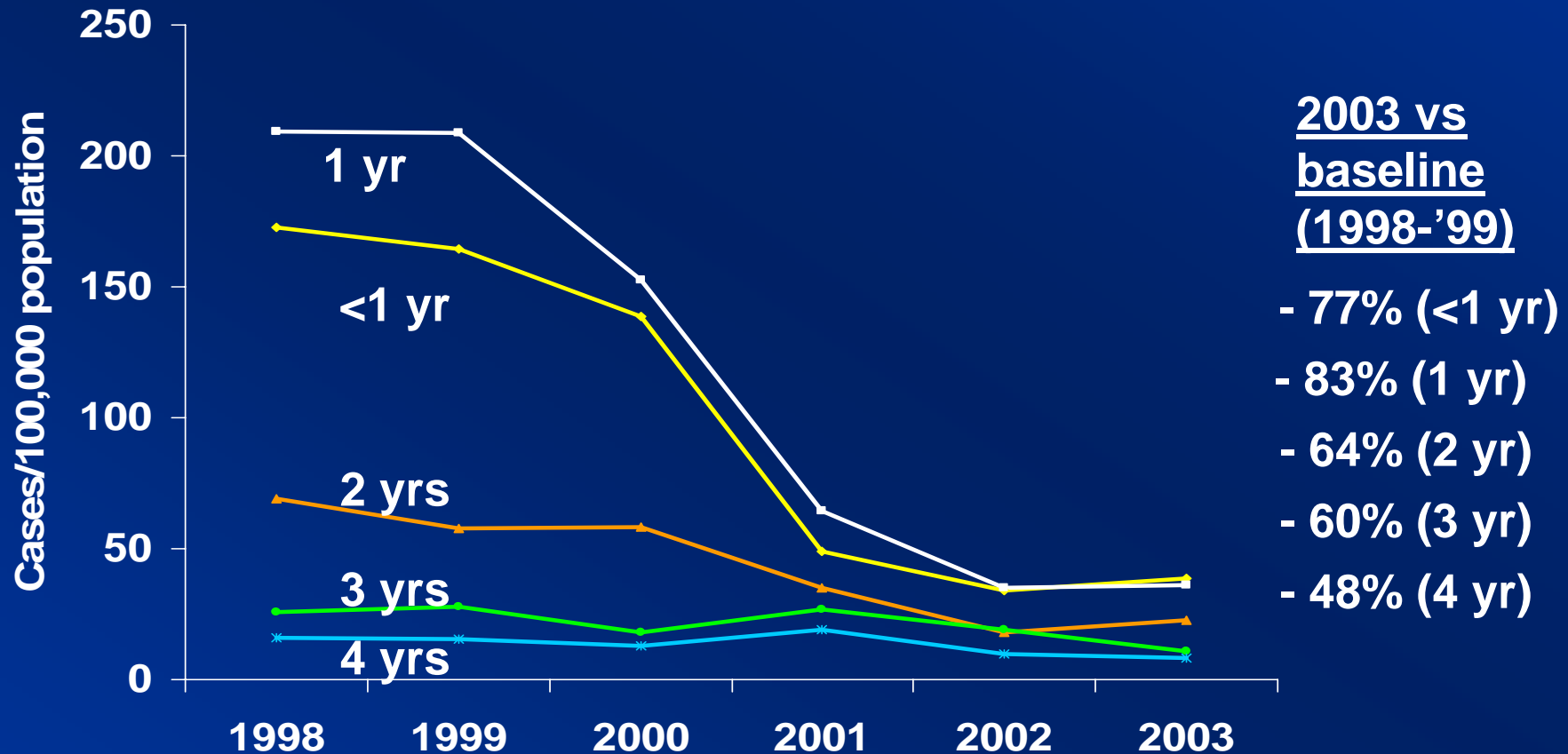
- ◆ Vaccines recommended **routinely** prevent 13 infectious diseases
 - **Bacterial**: DTaP, Hib, PCV-7
 - **Bacterial complications** of: measles, influenza, varicella, pertussis
 - **Influenza vaccine**
 - Healthy children aged 6 months to 5 years, high risk, close contacts (Zangwill KM PIDJ 2004; Ruben FL CID 2004)
 - Reduced AOM, pneumococcal pneumonia, antimicrobial use (Belshe RB NEJM 1998; O'Brien KL CID 2000)
- ◆ Vaccines for **special** indications
 - ***N. meningitidis***: controlling outbreaks, asplenia, college freshmen (MMWR 2000 [RR-7]), adolescents (11-18 yrs.) (MMWR 2005; 54: RR-)
 - ***S. aureus***: conjugate vaccine prevents MSSA and MRSA infections in hemodialysis patients (Shinefield H NEJM 2002)

CONJUGATE PNEUMOCOCCAL VACCINE (PCV-7)

- ◆ Highest rates of invasive pneumococcal **disease** in < 2 year old children (*MMWR 2000; 49[RR-9]*)
- ◆ **Indications:** prevention of invasive disease and acute otitis media
- ◆ 80% penicillin **non-susceptible** *S. pneumoniae* infections caused by vaccine serotypes (*Whitney PIDJ 2002*)
- ◆ **New indication: cochlear implant** recipients (*MMWR 2002; 51: 931*)
- ◆ Significant **reductions** in invasive disease and in penicillin nonsusceptible isolates reported (*Whitney CG NEJM 2000; Kaplan SL Pediatrics 2004; Black S PIDJ 2004*)

EFFECT IN TARGET AGE GROUP

Invasive Pneumococcal Disease Rates
in Children <5 Years, ABCs, 1998-2003

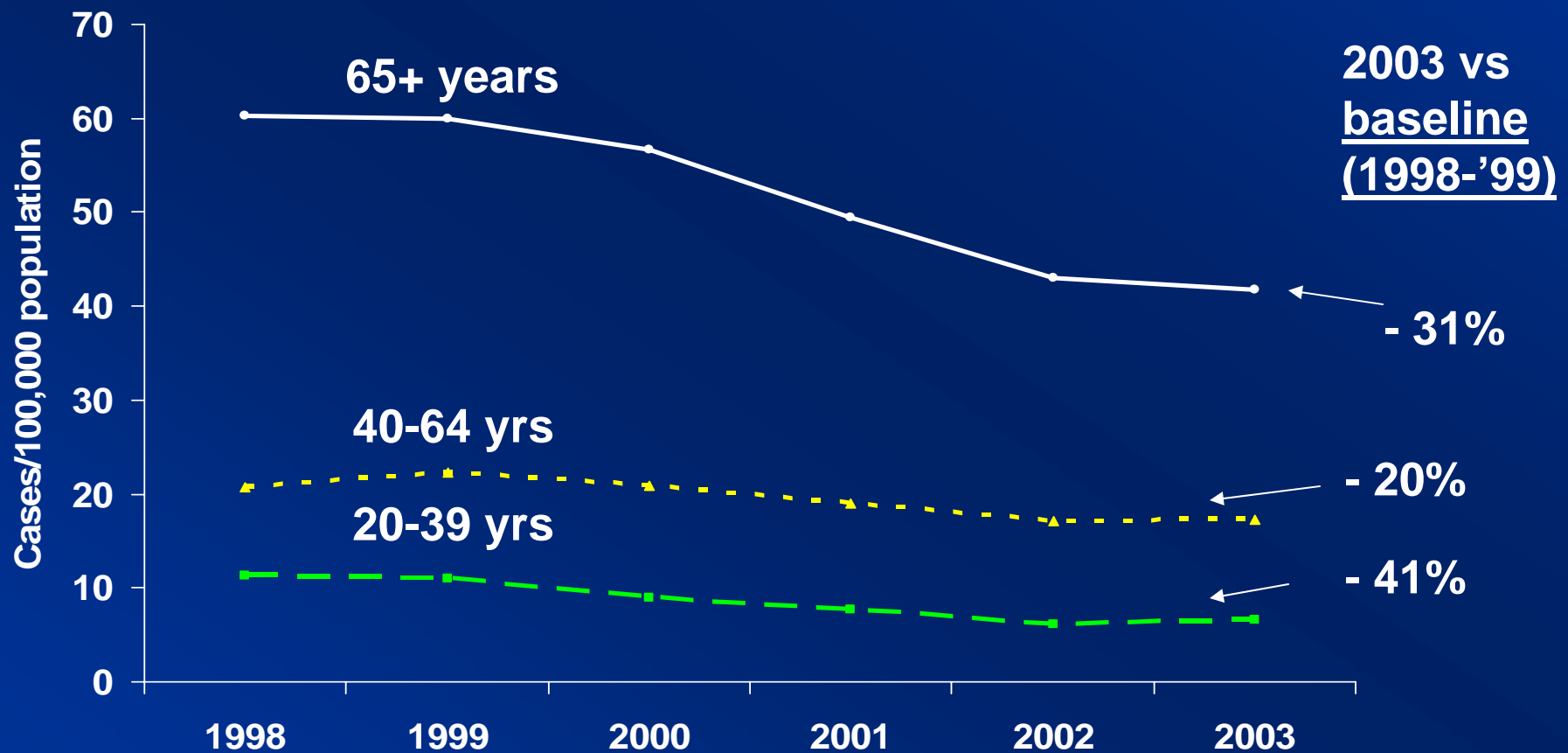


MMWR 2005; 54: 893 (9/16/05)

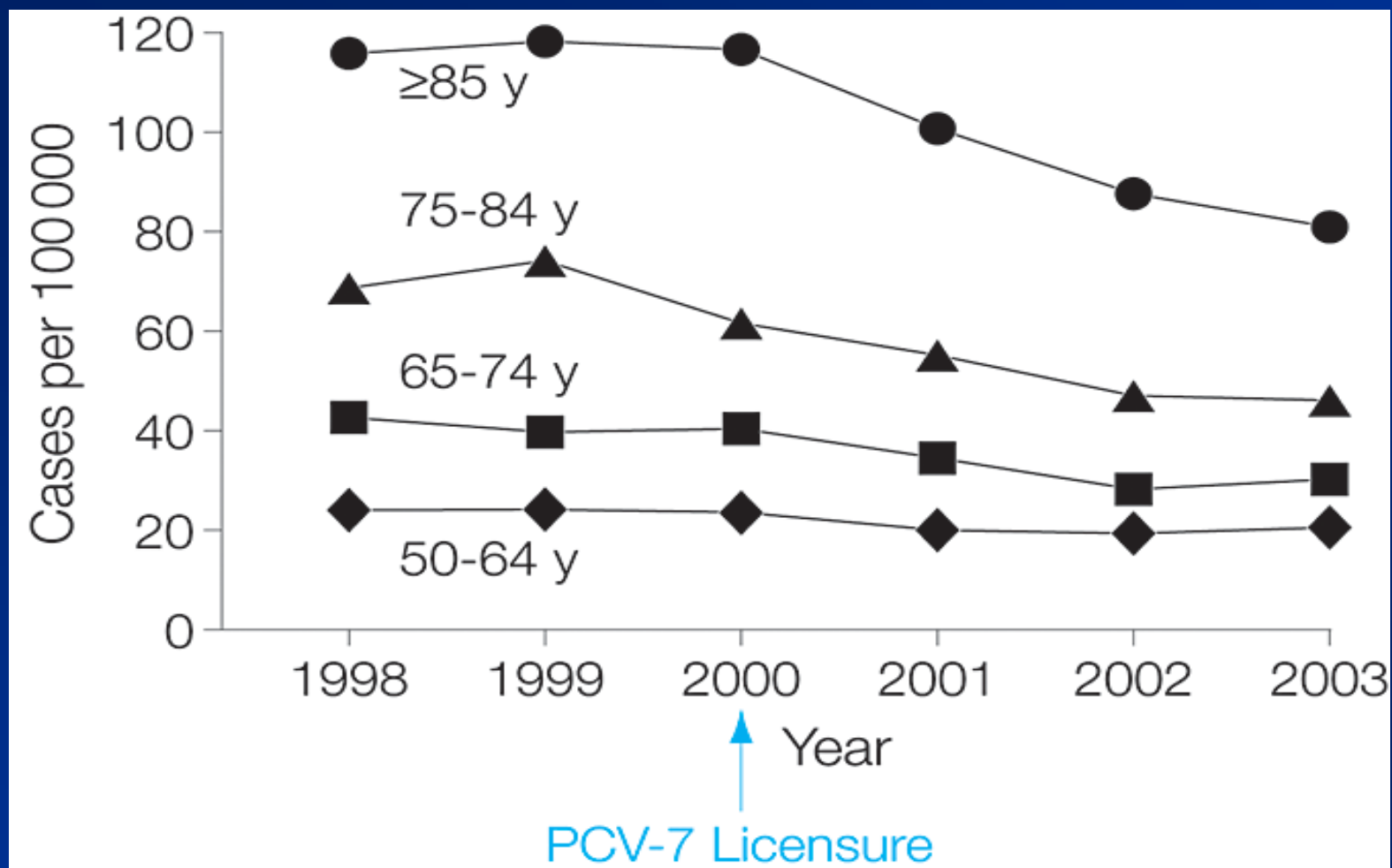
HERD EFFECT IN ADULTS

Invasive Pneumococcal Disease Rates over Time

ABCs, 1998-2003 (MMWR 2005; 54: 893 [9/16/05])



Annual Incidence of Invasive Pneumococcal Disease by Age Group for Adults ≥ 50 Years--Active Bacterial Core Surveillance, 1998-2003



% Reductions from 1998-99 to 2002-03: -28% overall

≥ 85 yrs.: -28%; 75-84 yrs: -35%; 65-74 yrs: -29%; 50-64 yrs: -17% , $p < .001$

(Lexau, C. A. et al. JAMA 2005;294:2043-2051).

PROVIDE PASSIVE ANTIBODY

◆ **Palivizumab** for high risk infants < 2 yrs.

– **Decrease in hospitalizations for RSV disease**
(Impact Pediatrics 1998; Romero PIDJ 2003; Pedraz PIDJ 2003)

– **Decrease in antimicrobial use** *(Hall J Pediatr 1988)*

– **Indications**

- **< 24 months with chronic lung disease, \leq 32 weeks gestation, 32-35 weeks gestation plus \geq 2 risk factors** *(Redbook 2003)*

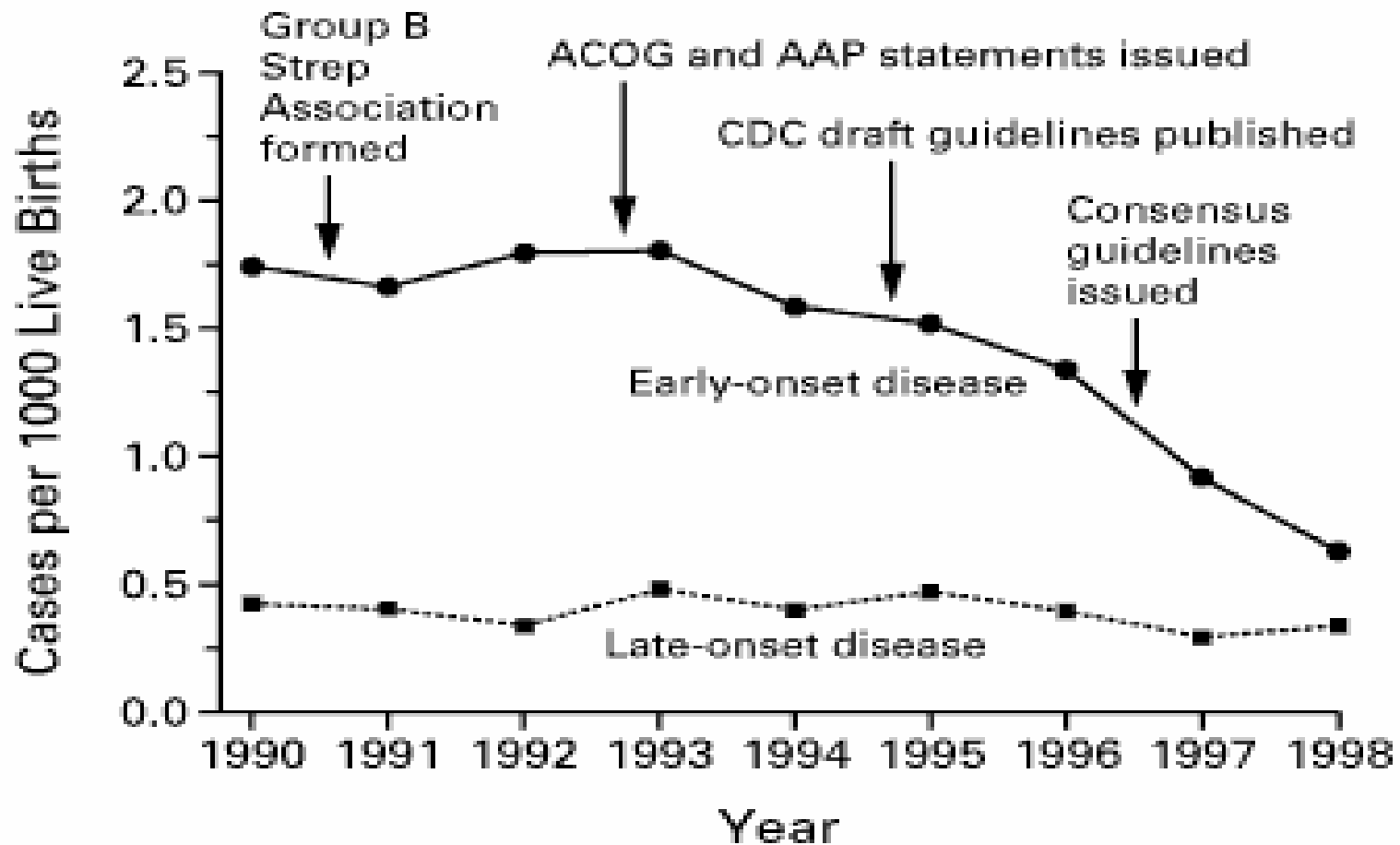
- **< 12 months with **congenital heart disease** plus CHF, pulmonary hypertension, cyanosis**
(Feltes J Pediatr 2003)

◆ **IGIV** for recent allogeneic HSCT patients with hypogammaglobulinemia to prevent bacterial infection *(Redbook 2003; MMWR 2000; RR-10)*

VACCINATE HCWs

- ◆ **Hospital outbreaks associated with infection transmitted from HCWs** (MMWR 1997; [RR-18])
 - **Measles** (Atkinson Am J Med 1991)
 - **Rubella** (Fliegel AJIC 1982)
 - **Varicella** (Weber ICHE 1996)
 - **INFLUENZA** (2003 NFID Call to Action)
 - **Outbreaks in children's hospitals** (Maltezou J Hosp Infect 2003)
 - **Increased morbidity and mortality in HSCT patients, children** (MMWR 2000; 49:RR-10; MMWR 2004; 52 (Dispatch): 1286)
 - **Guidance documents** (Talbot TR ICHE 2005; 26: 882; MMWR 2006; 55: RR-2)
 - **PERTUSSIS: adult acellular vaccine provisional recs.** (Campins-Marti Vaccine 2001; NIP 12/15/05)

(USE ANTIMICROBIAL PROPHYLAXIS)



***70% Reduction**

Schrag et al NEJM 2000;342:15

(USE ANTIMICROBIAL PROPHYLAXIS WHEN PROVEN TO BE SAFE AND EFFECTIVE)

◆ Intrapartum

- **GBS: universal screening of women at 35 weeks gestation, treatment with IV penicillin q 4 hrs. for colonized women** (Schrag NEJM 2002; MMWR 2002; [RR-11]; MMWR 2005)
- **Antiretroviral: 67% decrease in perinatal transmission** (MMWR 2002; [RR-18])

◆ Post partum

- **Gonococcal ophthalmia** (MMWR 2002; 51: RR-6)
- **Topical cord care to prevent MSSA, MRSA, GAS**

◆ Children

- **RF, high risk household contacts of invasive GAS, SS disease, *N. meningitidis*, *B. pertussis*, UTI, *Pneumocystis*, endocarditis, immunodeficiencies**

(PERI-OPERATIVE PROPHYLAXIS)

Mangram. AJIC 1999

◆ 2 components

- Antimicrobial agents
- Standardized procedures for site prep, wound care, O.R. traffic

◆ Procedures

- Specified general surgical procedures
- Cardiovascular surgery
- Placement of implants, neurosurgical shunts

(PERI-OP PROPHYLAXIS: CRITERIA FOR CHOOSING DRUG REGIMENS)

Bratzler DW CID 2004; 38:1706

- ◆ **Narrow spectrum** agent active against likely pathogens
- ◆ Administered by anesthesiologist in O.R. for peak **30-60 minutes** at time of incision
- ◆ Correct number of **doses**, e.g. 1-2
- ◆ **Repeat** dose(s) for prolonged procedure

NNIS CENTRAL LINE-ASSOCIATED BSI RATE 1/95 - 6/03 (AJIC 2003; 31:481)

ICU TYPE	# UNITS	RATE/1000
<i>Burn</i>	21	8.5
<i>Trauma</i>	28	7.8
<i>Pediatric</i>	79	7.3
Medical	143	5.7
Surgical	160	5.2
Neurosurg	52	4.8
Coronary	114	4.2
Med-Surg T/non	133/187	5.0/3.7
Respiratory	9	3.4
Cardiothoracic	71	2.9

UMBILICAL & CENTRAL LINE-ASSOCIATED BSI, HRN 1/95-6/03

BIRTHWT.	# HRNs	RATE/1000
\leq 1000gms.	143	10.6
1001-1500gms.	141	6.4
1501-2500gms.	137	4.1
> 2500gms.	141	3.7

STEP 2: GET THE DEVICES OUT

- ◆ **Intravascular catheters single most important risk factor for BSI in NICU, PICU**
 - **Association with prolonged bacteremia, suppurative foci in NICU** (*Chapman PIDJ 2003; Karlowicz PIDJ 2002; Nazemi Pediatrics 2003; Benjamin Pediatrics 2001*)
- ◆ **Other high risk populations**
 - **Heme-onc** (*Shah ICHE 2002*)
 - **G.I.** (*Kurkchubashe 1992*)
- ◆ **Peritoneal and hemo-dialysis catheters** (*Furth 2000*)
- ◆ **Feeding tubes** (*Mehall 2002*)
- ◆ **Neurosurgical shunts** (*Haines Neurosurgery 1994*)
- ◆ **ECMO** (*Coffin ICHE 1997; Steiner J Pediatr Surg 2001*)

STEP 2: GET THE DEVICES OUT

- ◆ **Recommendations to prevent CVL infections**
(MMWR 2002; 51: RR-10)
 - **Use devices only when medically necessary**
 - **Train designated teams to insert and maintain CVLs**
 - **Use maximal sterile barrier precautions and chlorhexidine during insertion of CVLs**
 - **Use chlorhexidine for exit site care**
 - **Remove catheters promptly when no longer needed**

(ASSURE SAFE SOLUTIONS, FORMULA, FOOD)

- ◆ Contaminated fluids, **multi-dose vials**, distilled water (*Mangram ICHE 1996*)
 - Gram negative bacilli, *B. cepacia*, *Ralstonia*
- ◆ Intrinsically contaminated powdered **formula**: *Enterobacter sakazakii* outbreaks of meningitis (*MMWR 2002; 51: 297*)
 - Aseptic preparation, hang times < 4 hrs., discard after 24 hrs.
- ◆ **Food** contamination
 - *Listeria* (*MMWR 2002; 51:1149*), *Salmonella* (*MMWR 2003; 51:1149*)
 - **Safe handling practices** (*Kendall P. J Am Diet Assoc 2003; 103:1646*)

STRATEGY 2: DIAGNOSE AND TREAT EFFECTIVELY

STEP 3: USE APPROPRIATE METHODS TO ESTABLISH A DIAGNOSIS

- ◆ Obtain complete set of cultures prior to initiating antibiotics
- ◆ Accurate and prompt identification of emerging pathogens and susceptibility testing by clinical microbiology lab



Susceptibility Testing Proficiency: 48 Clinical Microbiology Laboratories

<u>Test Organism</u>	<u>Accuracy</u>
Methicillin-resistant <i>S. aureus</i>	100%
Vancomycin-resistant <i>E. faecium</i>	100%
Fluoroquinolone-resistant <i>P. aeruginosa</i>	100%
Erythromycin-resistant <i>S. pneumoniae</i>	97%
Carbapenem-resistant <i>S. marcescens</i>	75%
ESBL <i>K. pneumoniae</i>	42%

Source: Steward CD, et al: *Diagn Microbiol Infect Dis.* 2000;38:59-67



CDC's *MASTER*: Improving Antimicrobial Susceptibility Testing Proficiency



STEP 3: USE APPROPRIATE METHODS TO ESTABLISH A DIAGNOSIS

◆ Rapid diagnostic techniques

– Bacterial infections

- *B. pertussis*: validated PCR (*Chan 2002*), culture
- MRSA by PBP2a detection in broth and solid media cultures (*Yamazumi 2001*)
- *E. coli* 0157 and others: stool (*Mackenzie 2000*), culture filtrates (*Karmali 1999*)

– Viral infections

- Respiratory viruses: influenza (*Uyeki 2003*), RSV (*Baranfanger 1999; 2000*)
 - Associated with decrease in inappropriate antibiotic use (*Byington 2002*)
- Rotavirus (*Dennehy 1988*)
- Enterovirus (*Ramers 2000*)

STEP 4: TARGET THE PATHOGEN

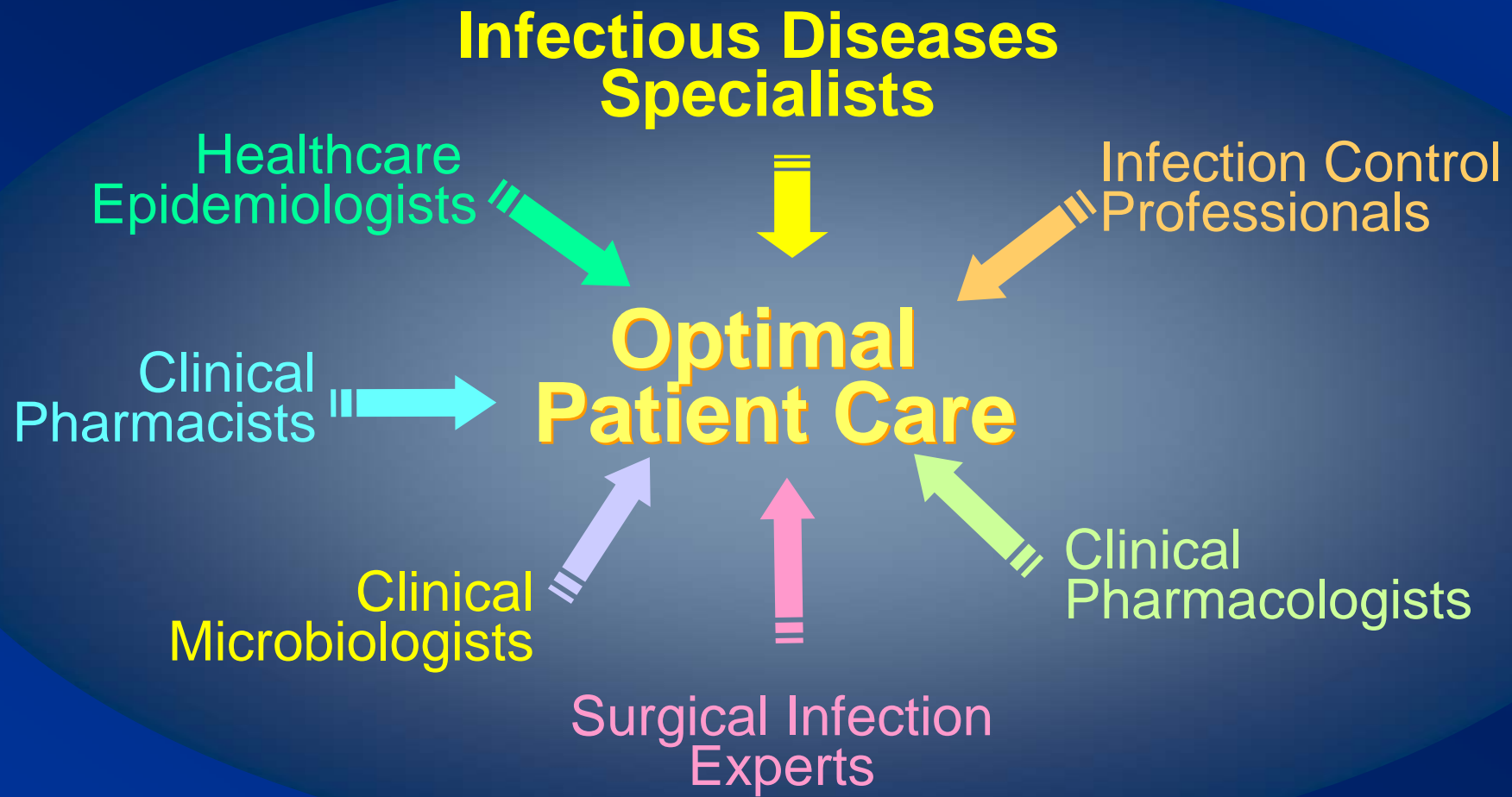
- ◆ **Choice** of antimicrobial agents determined by
 - **Age**
 - **Clinical presentation**
 - Antimicrobial therapy is not indicated for most patients with asthma exacerbations
(Nat'l Asthma Education Guideline 1997)
 - **Resistance** patterns within hospital
 - D-test for use of clindamycin for MRSA infections
 - Aminoglycosides, 3rd generation cephalosporins
 - **Exposure** to high risk environments *(Toltzis P PIDJ 2001)*
- ◆ Inappropriate antimicrobial therapy **19-45%** of pts.; **2.37** relative risk of mortality *(Kollef Chest 1999; Potocki Infection 2003)*

STEP 4: TARGET THE PATHOGEN

- ◆ **Beware of changing epidemiology: Neonatal Network** (*Stoll NEJM 2002, Pediatrics 2002*)
 - **Early onset sepsis** in VLBW infants 1998-2000 vs. 1991-93
 - GBS: reduction from 5.9 to 1.7/1000, $p < .001$
 - *E. coli*: increase from 3.2 to 6.8/1000, $p = .004$
 - **Late onset sepsis**: 48% CONS (11-32%)
- ◆ **1996-2001**: Shift to Gram negative predominance, 43%, in NICU (*Nambiar PIDJ 2002*)
- ◆ **Neutropenic patients with cancer:** IDSA Practice Guideline (*CID 2000*)



Infectious Diseases Expert Resources



STEP 5: ACCESS THE EXPERTS

- ◆ **Benefits of infectious disease expert involvement**
(*Byl CID 1999; Fox CID 2001; Lemmen Infection 2000*)
 - Increase in appropriate empiric therapy
 - More frequent use of oral antimicrobials
 - Reduced use of broad spectrum agents
 - Increased frequency of microbiologic dx.
 - Reduced cost
 - **Increased cure rates**
(*Fowler CID 1998; Gomez J Antimicrob Chemoth 1996*)
 - **6.5** fold increased rate of relapse or death assoc. with failure to follow rec. to remove intravascular device during *S. aureus* bacteremia (*Fowler CID 1998*)
 - **80% adherence to recommendations of I.D. consultants in private, public hospital** (*Petrak CID 2003*)

STRATEGY 3: USE ANTIMICROBIALS WISELY

STEP 6: PRACTICE ANTIMICROBIAL CONTROL

- ◆ **Limit exposure** to narrow spectrum and broad spectrum antimicrobials that is associated with emergence of resistance
 - **Vancomycin** (*Fridkin Ann Intern Med 2001*)
 - **Linezolid** (*Gonzales 2001; Pillai 2002; Pai CID 2002*)
 - **Aminoglycosides** (*Howard J Pediatr 1975; Van der Zwet J Hosp Infect 1999*)
 - **Extended spectrum cephalosporins** (*Bryan AJDC 1985; Pessoa-Silva J Hosp Infect 2003; Boyle PIDJ 2002*)
 - **Carbapenems** (*Sattler PIDJ 2000; Fridkin CID 1999; Raymond Crit Care Med 2001*)

STEP 6: PRACTICE ANTIMICROBIAL CONTROL

- ◆ Choose **bactericidal** over bacteriostatic agents
(Stratton 2003)
- ◆ Role of **combination** therapy
 - Gram positive: synergy
 - Gram negative: to provide at least one active agent until susceptibilitites are available
 - **Neutropenic pts.** *(Hughes CID 2002)*
 - **CF pts.** *(Aaron Am J Respir Crit Care Med 2000; Elphick Cochrane Database 2001)*
 - **Coag. neg. staphylococcal prosthetic valve endocarditis** *(Karchmer Ann Intern Med 1983; Le CID 2003)*

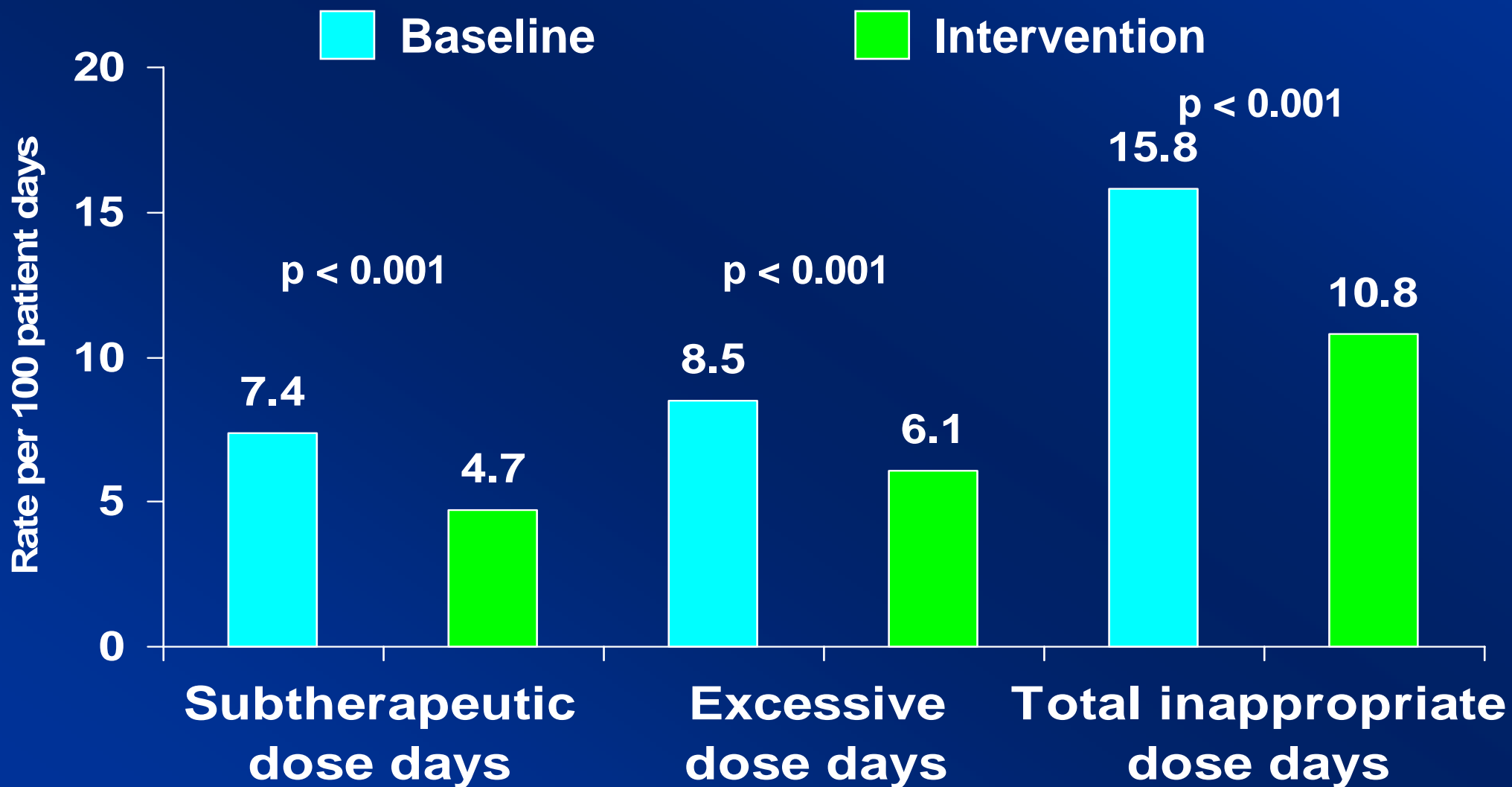


METHODS TO IMPROVE ANTIMICROBIAL USE

- Passive prescriber education
- Standardized antimicrobial order forms
- Formulary restrictions
- Prior approval to start/continue
- Pharmacy substitution or switch
- Multidisciplinary drug utilization evaluation (DUE)
- Antimicrobial cycling (*Gerding ICHE 2000; Fridkin CID 2003*)
- Interactive prescriber education
- **Provider/unit performance feedback**
- **Computerized antimicrobial decision support /on-line ordering** (*Evans NEJM 1998; Mullett Pediatrics 2001*)

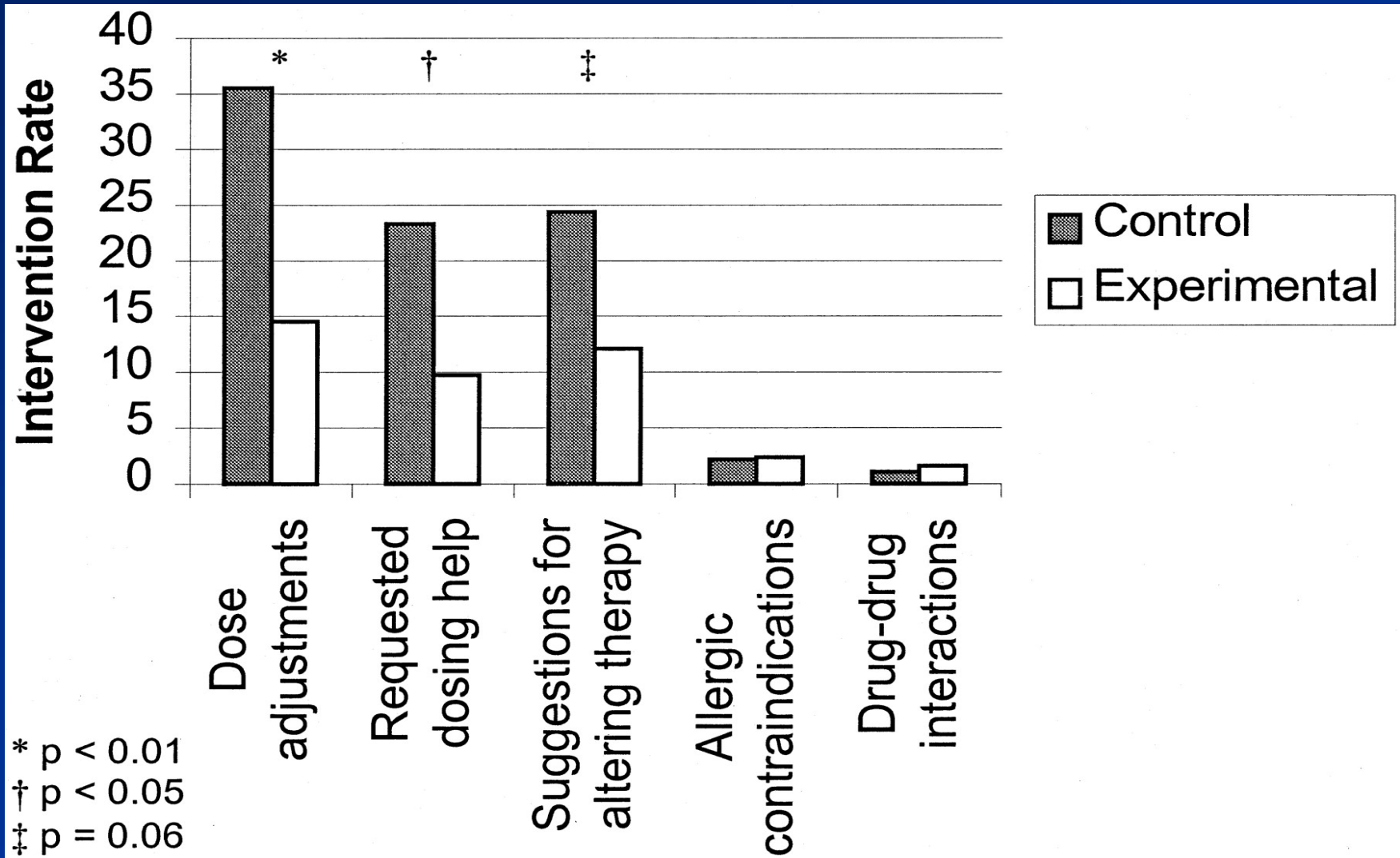
CDS for Antimicrobial Use in a PICU

(Mullett. Pediatrics 2001; 108: e75)



CDS for Antimicrobial Use in a PICU

Mullett CJ, et al. Pediatrics 2001; 108: e75



STEP 7: USE LOCAL DATA

- ◆ **Geographic variation in prevalence of resistant organisms**
 - *S. pneumoniae* (Whitney 2000)
 - **CO-MRSA** (Sattler PIDJ 2002; Naimi CID 2001)
 - **VRE**
 - **Group A streptococcus** (Martin 2002)
- ◆ **Antimicrobial susceptibility reports**
 - **Facility specific**
 - **High risk unit specific**

STEP 8: TREAT INFECTION, NOT CONTAMINANTS

- ◆ Follow recommended practices for **aseptic technique** when obtaining cultures, e.g. antiseptic skin prep
- ◆ Methods to distinguish pathogens from **contaminants**
 - Obtain blood cultures from **2** separate sites
(Struthers 2000; Sanchez 2001)
 - Record **time to positivity** of blood culture
(Haimi-Cohen 2002; Gaur AH CID 2003)
 - Utilize indirect indicators: CRP, IL-8
(Franz 1999; Benitz 1998)
 - Follow validated **definitions** of infections

STEP 8: TREAT INFECTION, NOT COLONIZATION

◆ Bacteremia

- Obtain peripheral and CVL culture
- Do **NOT** routinely culture CVL catheter tips

◆ Pneumonia

- Do not treat tracheal aspirate only

◆ Urinary tract infection

- Remove indwelling urinary catheter and obtain fresh urine for culture

STEP 9: KNOW WHEN TO SAY “NO” (TO VANCO OR OTHER BROAD SPECTRUM AGENTS)

- ◆ **Vancomycin use on pediatric medical and surgical services **excessive** and not according to published guidelines** (*Hopkins ICHE 2000; Shah PIDJ 1999; Shah AJIC 1999; Sinkowitz R PIDJ 1997; 16: 485; Keyserling Pediatrics 2003; 112: e104*)
- ◆ **PPN Surveys** (*Keyserling H Pediatrics 2003; 112:e104*)
 - **1999**: 41/55 (75%) children’s hospitals had vancomycin restriction policies with ≥ 3 measures instituted in 29 (53%)
 - **2000**: Most frequent ordering services
 - NICU (27%), oncology (19%), surgery (16%), general pediatrics (13%), intensivists (11%)

STEP 9: KNOW WHEN TO SAY “NO”

- ◆ Suggested targets for improving initiation and discontinuance of vancomycin
 - **Peri-op prophylaxis**: do not use vanco routinely unless endemic MRSA; limit number of doses, assure timing
 - Limit **empiric** therapy to **48 hours**
 - Distinguish **contaminants** from pathogens
 - Use **intravascular devices** according to recommendations *(MMWR 2002; 51: RR-10)*

STEP 9: KNOW WHEN TO SAY “NO”

- ◆ **Verify beta lactam allergy** (*Pichichero M J Pediatr 1998; 132: 137*)
 - Few confirmed by objective testing
 - Alternative agents, oral desensitization
(*Robinson J CID 2002; 35:26*)
- ◆ **Safe outcomes in NICUs that do not use vancomycin empirically**
(*Sanchez P IDSA 1999; Karlowicz M Pediatrics 2002; 110: e42*)
- ◆ **No advantage of vancomycin for treating non-susceptible *S. pneumoniae* outside the CNS in normal hosts** (*Yu VL CID 2003; 37:230; Kaplan S PIDJ 2001; 20: 392*)

STEP 10: STOP TREATMENT

- ◆ **When infection is unlikely**
- ◆ **When culture results indicate no need for antimicrobials**
- ◆ **When infection is cured**

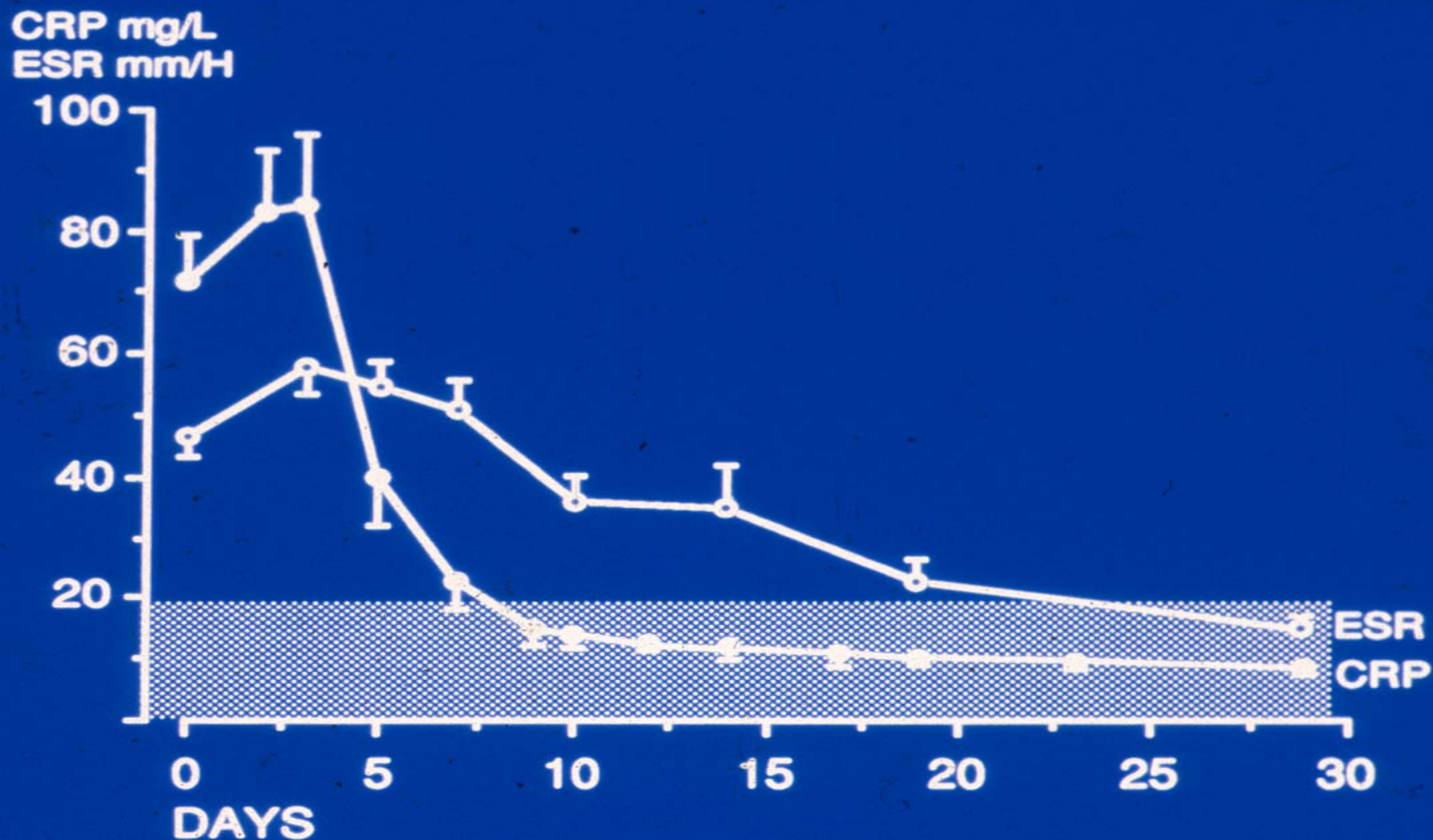


Figure. C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) levels (means \pm SEM) in acute hematogenous osteomyelitis in children during a 1-month follow-up. The stippled area denotes the normal range of values.



Short-course Antimicrobial Treatment of New Pulmonary Infiltrates in an ICU

<u>Variable</u>	<u>Standard Therapy (n=42)</u>	<u>Experimental Therapy (n = 39)</u>
Regimen	clinician discretion (all treated; 18 drugs)	ciprofloxacin 400mg (IV bid x 3 days)
Treatment > 3 days	97%	28%
Antimicrobial resistance	35%	15%
Length of stay mean/median	14.7 / 9 days	9.4 / 4 days
Mortality (30 day)	31%	13%
Antimicrobial cost mean / total	\$640 / \$16,004	\$259 / \$6484

STRATEGY 4: PREVENT TRANSMISSION

STEP 11: PRACTICE INFECTION CONTROL

- ◆ **Evidence-based guidelines** for prevention of infection in healthcare settings
 - CDC/HICPAC guidelines
 - AAP Redbook and Guidelines for Perinatal Care
 - Clinical practice guidelines (IDSA, AAP)
 - SHEA position papers
 - Infection control in cystic fibrosis *(ICHE 2003)*
- ◆ **Clinically and cost effective**
(Macartney 2000; Hall 2000; Chaix JAMA 1999)



A Decade of Progress (1990-1999): Hospital-Onset Infection Rates in NNIS Intensive Care Units

<u>Type of ICU</u>	<u>BSI*</u>	<u>VAP*</u>	<u>UTI*</u>
Coronary	43%	42%	40%
Medical	44%	56%	46%
Surgical	31%	38%	30%
Pediatric	32%	26%	59%

* BSI = central line-associated bloodstream infection rate
VAP = ventilator-associated pneumonia rate
UTI = catheter-associated urinary tract infection rate

STEP 11: PRACTICE INFECTION CONTROL

◆ Standard precautions

- Hand hygiene (*MMWR 2002*), PPE
- Room placement
- Respiratory hygiene/cough etiquette

◆ Expanded precautions

- Contact, droplet, airborne infection isolation
- Role of active surveillance cultures

◆ Systems factors

- Administrative support, adherence monitoring, staffing levels (*Haley 1995; Archibald 1997; Harbarth 1999; Stegenga 2002; Robert ICHE 2000; Alonso-Echanove ICHE 2003; Jackson AJIC 2002*)

◆ Restrict symptomatic visitors, HCWs (*Garcia 1997*)

STEP 12: PRACTICE HAND HYGIENE

MMWR 2002; 51: RR-16

- ◆ Decontaminate hands
 - Before AND after patient contacts
 - After contact with blood/body fluids in the environment
 - After contact with surfaces, equipment near the patient
- ◆ Antimicrobial soap and water preferred if visible soiling or spores; otherwise recommended hand rubs preferred
- ◆ Only natural nails for high risk patients (*Foca M 2000; NEJM 343:695; Moolenaar RL 2000; ICHE 21:80; Gupta A ICHE 2004; 35: 210*)
- ◆ Adherence monitoring with feedback
- ◆ **SET AN EXAMPLE** (*Lankford MG EID 2003; 9: 217*)

12 STEPS TO PREVENT ANTIMICROBIAL RESISTANCE IN HOSPITALIZED CHILDREN

PREVENT INFECTION

1. Vaccinate
2. Get devices out
(Use chemoprophylaxis)
(Assure safe solutions, formula, food)

DIAGNOSE & TREAT

3. Use appropriate diagnostic methods
4. Target the pathogen
5. Access the experts

USE ANTIMICROBIALS WISELY

6. Practice antimicrobial control
7. Use local data
8. Treat infection, not contamination / colonization
9. Know when to say “no” to vanco, broad spectrum drugs
10. Stop treatment

PREVENT TRANSMISSION

11. Practice infection control
12. Practice hand hygiene

IMPLEMENTATION

- ◆ Individualize according to facility conditions, human, fiscal resources and skills available, and culture of providers
 - Single steps
 - Various combinations of steps
- ◆ Surveys of various providers
 - Perception of greater problems than antimicrobial resistance within institution
 - Most important strategies
 - Diagnose and treat infection effectively
 - Use antimicrobials wisely
 - Most important steps
 - Get catheters out
 - Target the pathogen

IMPLEMENTATION

- ◆ **Least important strategies**
 - Prevent infection
 - Prevent transmission
- ◆ **Least important steps**
 - Use local data
 - Vaccinate