Preventing Transmission of MDROs: What Works and What Doesn't Focus on GNRs

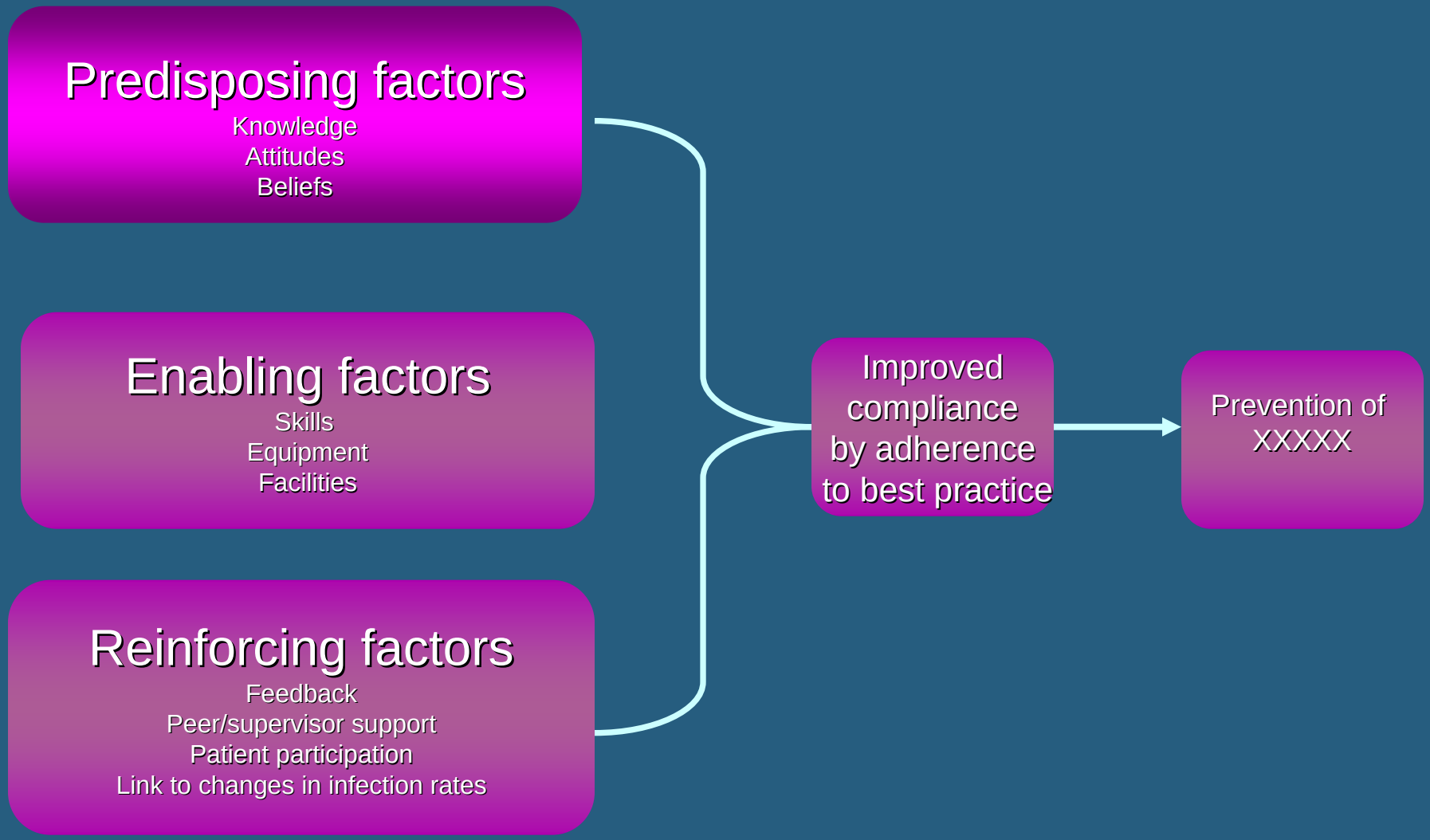
Trish M. Perl, MD, MSc
Hospital Epidemiologist, Johns Hopkins Hospital
Professor of Medicine, Johns Hopkins University

What Are Guidelines?

- “systematically developed statements to assist the practitioner and patient decisions about appropriate health care for specific clinical circumstances”. Guidelines are written to improve 1) the quality of care, 2) the appropriateness of care, 3) the cost effectiveness and to serve as educational tools.
- The goal is not to create standard care but others may choose to adopt them as such. Clinical guidelines are never a substitute for practical judgment.

Kish, 2001 CID 15; 32(6):851, Field et al. IOM to advise the public health service on clinical practice guidelines National Academy Press 1990

A Framework to Improve Practice: Implications for Guidelines



Who Develops Guidelines that Impact Infection Control?

- Professional societies
  - SHEA
  - IDSA
  - APIC
  - ATS and other professional societies etc
- HICPAC (CDC)
- The European Union and other countries
- WHO

Strength and Quality of the Evidence

*TABLE 2. Strength of Recommendation and Quality of Evidence***	
CATEGORY/GRADE	**DEFINITION**
Strength of Recommendation	
A	Good evidence to support a recommendation for use.
B	Moderate evidence to support a recommendation for use.
C	Poor evidence to support a recommendation.
Quality of Evidence	
I	Evidence from >1 properly randomized, controlled trial.
II	Evidence from ≥1 well-designed clinical trial, without randomization; from cohort or case-controlled analytic studies (preferably from >1 center); from multiple time-series; or from dramatic results from uncontrolled experiments.
III	Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

BMJ 327:1459 (2003)

Parachute use to prevent death and major trauma related to gravitational challenge: systematic review of randomised controlled trials

Gordon C S Smith, Jill P Pell

Abstract

Objectives To determine whether parachutes are effective in preventing major trauma related to gravitational challenge.

Design Systematic review of randomised controlled trials.

Data sources: Medline, Web of Science, Embase, and the Cochrane Library databases; appropriate internet sites and citation lists.

Study selection: Studies showing the effects of using a parachute during free fall.

Main outcome measure Death or major trauma, defined as an injury severity score >15.

Results We were unable to identify any randomised controlled trials of parachute intervention.

Conclusions As with many interventions intended to prevent ill health, the effectiveness of parachutes has not been subjected to rigorous evaluation by using randomised controlled trials. Advocates of evidence based medicine have criticised the adoption of interventions evaluated by using only observational data. We think that everyone might benefit if the most radical protagonists of evidence based medicine organised and participated in a double blind, randomised, placebo controlled, crossover trial of the parachute.

Parachutes reduce the risk of injury after gravitational challenge, but their effectiveness has not been proved with randomised controlled trials

Our search strategy did not find any randomised controlled trials of the parachute.

Guideline Development

- Make recommendations
- Include performance measures
- Review
  - Outside peer review
  - Stakeholder review
  - Organization committee review
  - BOD review
- Prepublication and publication strategy

Kish, 2001 CID 15; 32(6):851, Field et al. IOM to advise the public health service on clinical practice guidelines National Academy Press 1990

MDRO Guidelines

1996: CDC/HICPAC

contact isolation for “patients known or suspected to be infected/colonized with epidemiologically important organisms.” *(Garner et al. ICHE 1996;17:53.)*

2003: SHEA

all healthcare facilities try to control MRSA & VRE by identifying colonized patients with active surveillance cultures so they can be cared for using contact precautions *(Muto et al. ICHE 2003;24:362-86)*

2006: CDC/HICPAC

update recommendations for control of MDRO published. (*http://www.cdc.gov/ncidod/dhqp/pdf/ar/ mdroGuideline2006.pdf)*

CDC MDRO Guidelines

Table 2. Control measures for MDROs employed in studies performed in health care settings, 1982-2005

Focus of MDRO (No. of studies)	MDR-GNB (n = 30)	MRSA (n = 35)	VRE (n = 39)
	No. (%) of studies using control measure		
Education of staff, patients, or visitors	19 (63)	11 (31)	20 (53)
Emphasis on handwashing	16 (53)	21 (60)	9 (23)
Use of antiseptics for handwashing	8 (30)	12 (36)	16 (41)
Contact precautions or glove use*	20 (67)	27 (77)	34 (87)
Private rooms	4 (15)	10 (28)	10 (27)
Segregation of cases	4 (15)	3 (9)	5 (14)
Cohorting of patients	11 (37)	12 (34)	14 (36)
Cohorting of staff	2 (7)	6 (17)	9 (23)
Change in antimicrobial use	12 (41)	1 (3)	17 (44)
Surveillance cultures of patients	19 (63)	34 (97)	36 (92)
Surveillance cultures of staff	9 (31)	8 (23)	7 (19)
Environmental cultures	15 (50)	14 (42)	15 (38)
Extra cleaning and disinfection	11 (37)	7 (21)	20 (51)
Dedicated equipment	5 (17)	0	12 (32)
Decolonization	3 (10)	25 (71)	4 (11)
Ward closure to new admission or to all patients	6 (21)	4 (12)	5 (14)
Other miscellaneous measures	6 (22)†	9 (27)‡	17 (44)§

References for MDR-GNBs.[6,8,9,11,16,38,174,175,180,209,210,213-215,218,334,388,406,407] References for MRSA.[68,89,152,153,165-173,183,188,194,204,205,208,240,269,279,280,289,304,312,327,365,392,397,408-412]

*Contact precautions mentioned specifically, use of gloves with gowns or aprons mentioned, barrier precautions, strict isolation, all included under this heading.

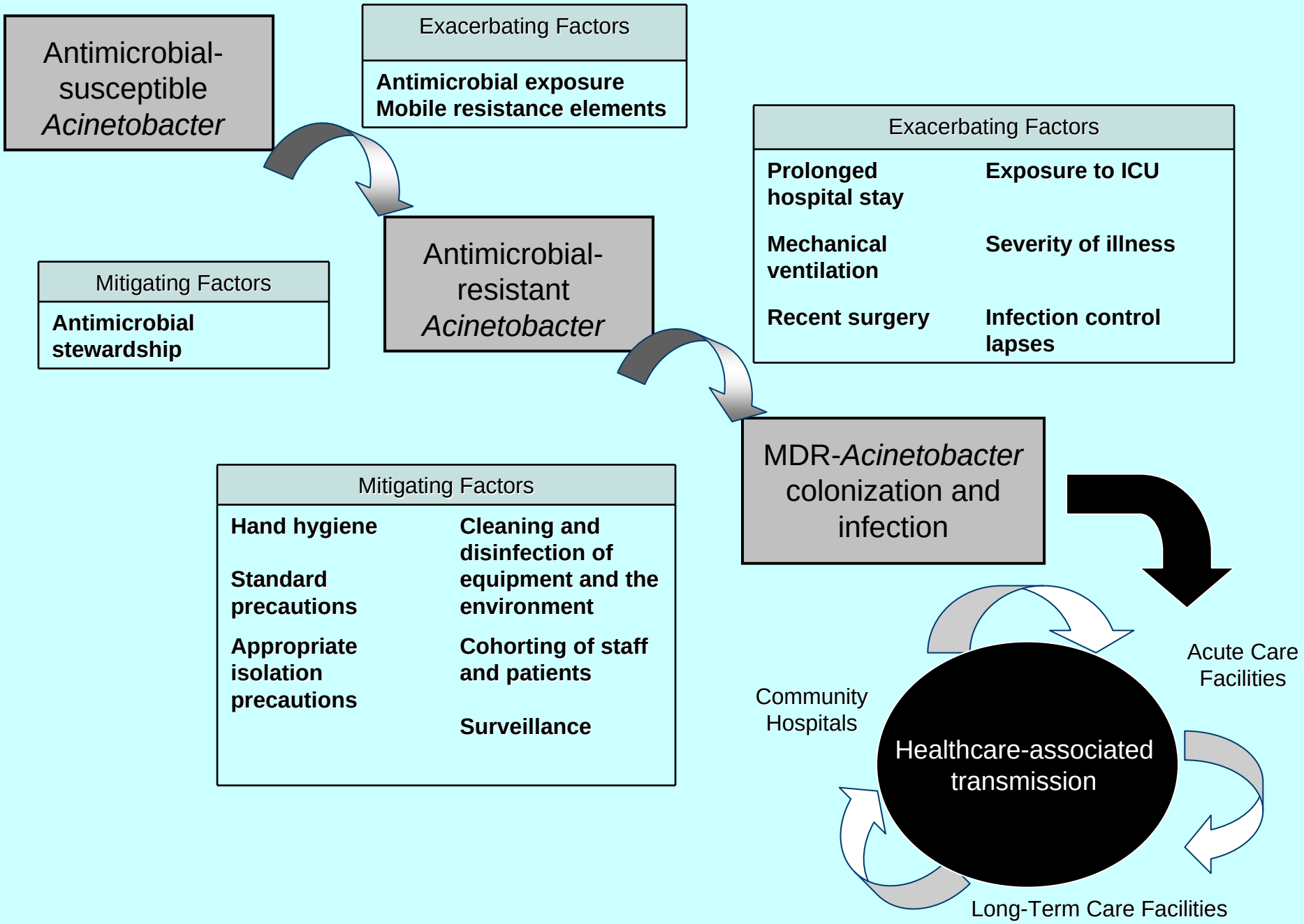
†Includes signage, record flagging, unannounced inspections, selective decontamination, and peer compliance monitoring (1 to 4 studies employing any of these measures).

‡Includes requirements for masks, signage, record tracking, alerts, early discharge, and preventive isolation of new admissions pending results of screening cultures (1 to 4 studies employing any of these measures).

§Includes computer flags, signage, requirement for mask, one-to-one nursing, changing type of thermometer used, and change in rounding sequence (1 to 7 studies employing any of these measures).

CDC 2006 MDRO Guidelines

- Includes MRSA, VRE, MDR-GNR
- Does not include TB
- Proposes a combination (concurrent control steps)
- Assumes a team approach
- Assumes periodic review, re-evaluation and escalation if necessary


Antimicrobial-susceptible *Acinetobacter*
Exacerbating Factors
Antimicrobial exposure
Mobile resistance elements
Antimicrobial-resistant *Acinetobacter*
Exacerbating Factors
Prolonged hospital stay
Exposure to ICU
Mechanical ventilation
Severity of illness
Recent surgery
Infection control lapses
Mitigating Factors
Antimicrobial stewardship
MDR-*Acinetobacter* colonization and infection
Mitigating Factors
Hand hygiene
Cleaning and disinfection of equipment and the environment
Standard precautions
Appropriate isolation precautions
Cohorting of staff and patients
Surveillance
Healthcare-associated transmission
Acute Care Facilities
Community Hospitals
Long-Term Care Facilities

MDRO Control: Approach

- Risk assessment-determine
  - Types of patients and units
  - Prevalence
  - Feasibility
- Two tiered strategy
  - 1st tier--baseline MDRO control activities
    - Monitor rates (1A)
    - Contact isolation for all pts colonized/infected (1A)
    - Hand hygiene (1A)
    - Environmental cleaning
  - 2nd tier-escalation of practices when MDROs are not decreasing
    - Case finding (1B)

Risk Assessment

Table 2. Characteristics of the Multidrug-Resistant *Acinetobacter* Surveillance Culture Study Cohort

	Without MDR *Acinetobacter*	With MDR *Acinetobacter*	All
Patients	n = 1098	n = 13	N = 1111
Age, mean (95% CI) [range], y	56.4 (55.4-57.4) [17-102]	49.1 (39.4-58.8) [19-74]	56.3 (55.3-57.3) [17-102]
Women, No. (%), [95% CI]	527 (48.0) [45.0-51.0]	10 (76.9) [46.2-95.0]	537 (48.3) [45.4-51.3]
Paraplegia, No. (%) [95% CI]	12 (1.1) [0.6-1.9]	3 (23.1) [5.0-53.8]	15 (1.4) [0.8-2.2]
Admissions	n = 1210	n = 13	N = 1223
Admitted directly from a long-term care or rehabilitation facility, No. (%) [95% CI][a]	47 (3.9) [2.9-5.1]	6 (46.2) [19.2-74.9]	52 (4.3) [3.2-5.5]

Abbreviations: CI, confidence interval; MDR, multidrug-resistant.
[a]Of 13 patients with MDR *Acinetobacter*, 9 (69%) had been in a long-term care or rehabilitation facility within the preceding 6 months.

Maragakis , et al. JAMA. 2008;299::2513

MDRO guidelines

1. Implement administrative measures
2. Educate and train healthcare personnel
3. Use antimicrobial agents judiciously
4. Perform surveillance
5. Obtain and monitor facility specific antimicrobial susceptibility reports and trends in MDROs over time
6. Institute infection control precautions (isolation and contact precautions) to prevent MDRO transmission
7. Implement environmental control measures

MDRO Control: Administrative

- Human resources
  - Trained ICPs
  - Adequate HCW staffing
  - Training
  - Compliance monitoring
- System changes
  - Communication
  - Rapid laboratory testing
- Facility and environmental changes
  - Hand hygiene available
  - Environmental cleaning
- Fiscal/political needs
- Written plan to implement

Isolation Guidelines: Standard Precautions

- Hand hygiene
- PPE/gowns and gloves as indicated
- Educate HCWs about respiratory etiquette
- Place patients with potential to transmit organisms in private rooms if possible
- Clean patient care equipment and environment appropriately
- Use appropriate disinfectants
- Clean personal items regularly
- Use aseptic technique to avoid contamination
- Use single dose vials

Contamination of Gowns, Gloves and Hands

TABLE 1. Frequency of Contamination of Gowns, Gloves, and Hands of Healthcare Workers (HCWs) after Caring for Patients Colonized or Infected with Specified Bacteria

Source of culture-positive sample	No. (% [95% CI]) of observations	
	Patients with MDR *Acinetobacter baumannii* carriage (n = 199)	Patients with MDR *Pseudomonas aeruginosa* carriage (n = 134)
Gloves	72 (36.2 [29.5–42.9])	9 (6.7 [2.5–11.0])
Gown	22 (11.1 [6.7–15.4])	6 (4.5 [1.0–8.0])
Gloves and/or gown	77 (38.7 [31.9–45.5])	11 (8.2 [3.6–12.9])
Hands[a]	9 (4.5 [1.6–7.4])	1 (0.7 [0–2.2])

NOTE. CI, confidence interval; MDR, multidrug-resistant.

[a] After removal of gloves and gown and before hand hygiene.

Morgan, D, et al. Infect Control Hosp Epidemiol. 2010;31:epub

Contamination of Gowns, Gloves and Hands

TABLE 3. Bivariate Analysis of Risk Factors for Detection of Multidrug-Resistant *Acinetobacter baumannii* on the Gowns and/or Gloves Worn by Healthcare Workers (HCWs) Caring for Patients with *A. baumannii* Carriage

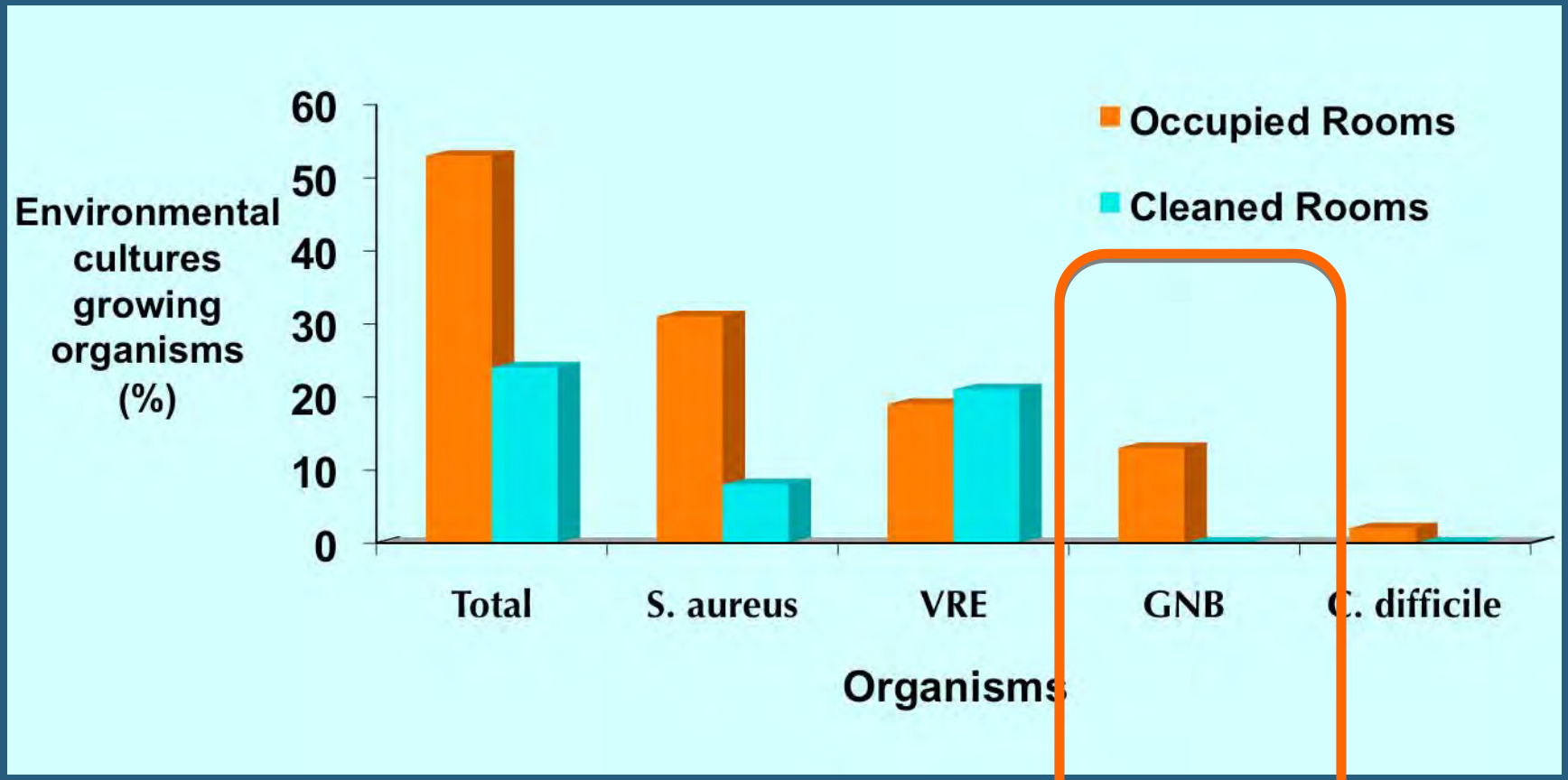
Nature of HCW-patient contact	No. of observations	No. (%) of positive culture results (n = 77)	No. (%) of negative culture results (n = 122)	Proportion (%) of contacts that preceded detection of pathogen	P
Physical examination	18	11 (14.29)	7 (5.74)	11/18 (61)	.04
Wound dressing	16	15 (19.48)	1 (0.82)	15/16 (94)	<.01
Bathing and/or other form of hygiene	37	20 (25.97)	17 (13.93)	20/37 (54)	.03
Care or use of catheter and/or drain	36	16 (20.78)	20 (16.39)	16/36 (44)	.43
Care or use of endotracheal tube or tracheostomy site	78	37 (48.05)	41 (33.61)	37/78 (47)	.04
Checking vital signs	40	13 (16.88)	27 (22.13)	13/40 (33)	.37
Administering enteral medication	30	10 (12.99)	20 (16.39)	10/30 (33)	.51
Activity with intravenous pumps or lines	98	40 (51.95)	58 (47.54)	40/98 (41)	.54
Time in room of more than 5 minutes	125	64 (83.12)	61 (0.50)	64/125 (51)	<.01
Provider type					<.01
Physical, occupational, respiratory therapist	65	20 (25.97)	45 (36.89)	20/65 (31)	
Registered nurse	123	51 (66.23)	72 (59.02)	51/123 (41)	
Medical doctor or nurse practitioner	10	6 (7.79)	4 (3.28)	6/10 (60)	

Morgan, D, et al. Infect Control Hosp Epidemiol. 2010;31:epub

MDRO Control: Environmental Cleaning

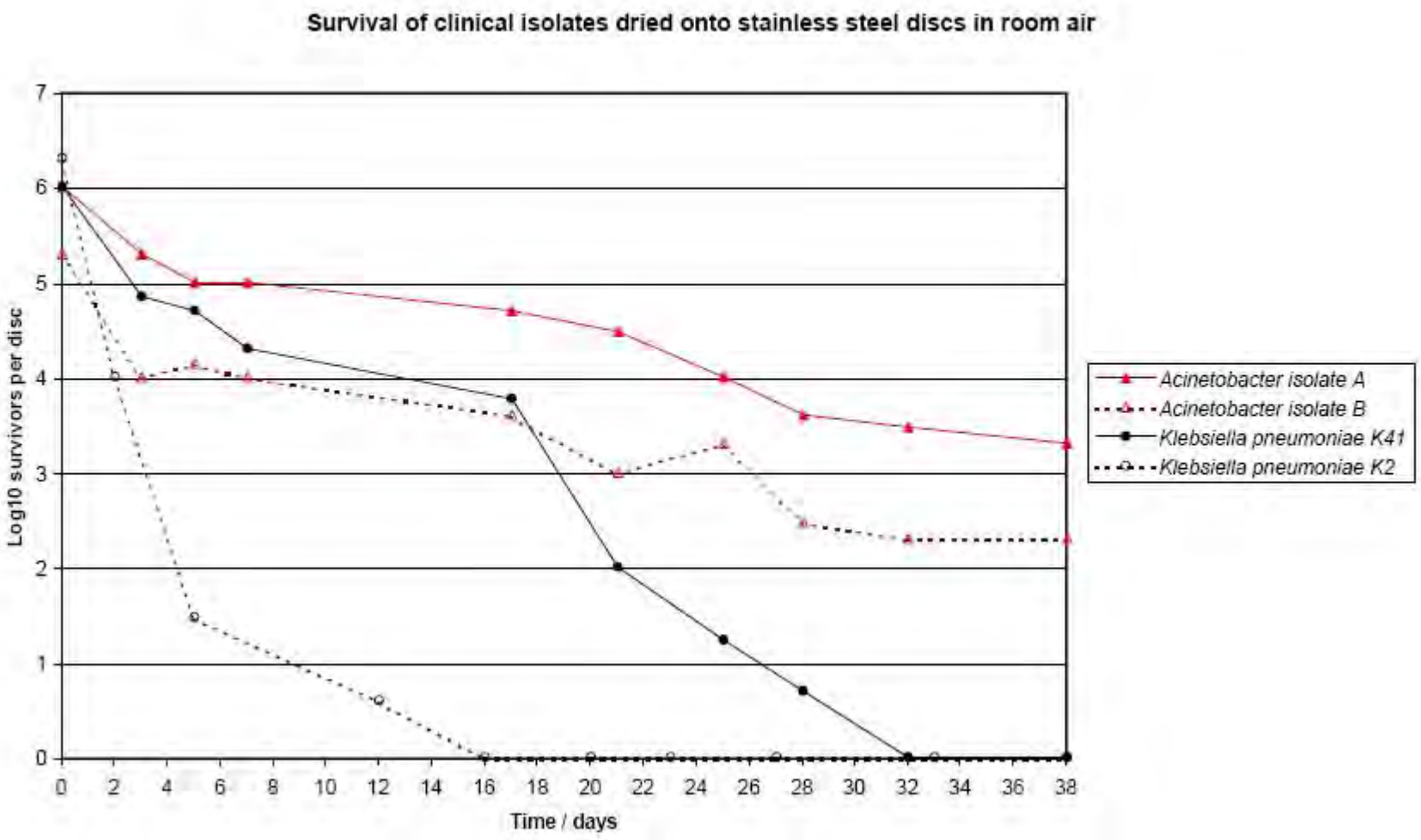
- Dedicated equipment
- Assign cleaning personnel to specific units
- Increase focus on specific areas
  - High touch items
  - Commodes
- Monitoring compliance with cleaning and disinfection procedures

Hand Imprint Cultures After Contact with Environmental Surfaces

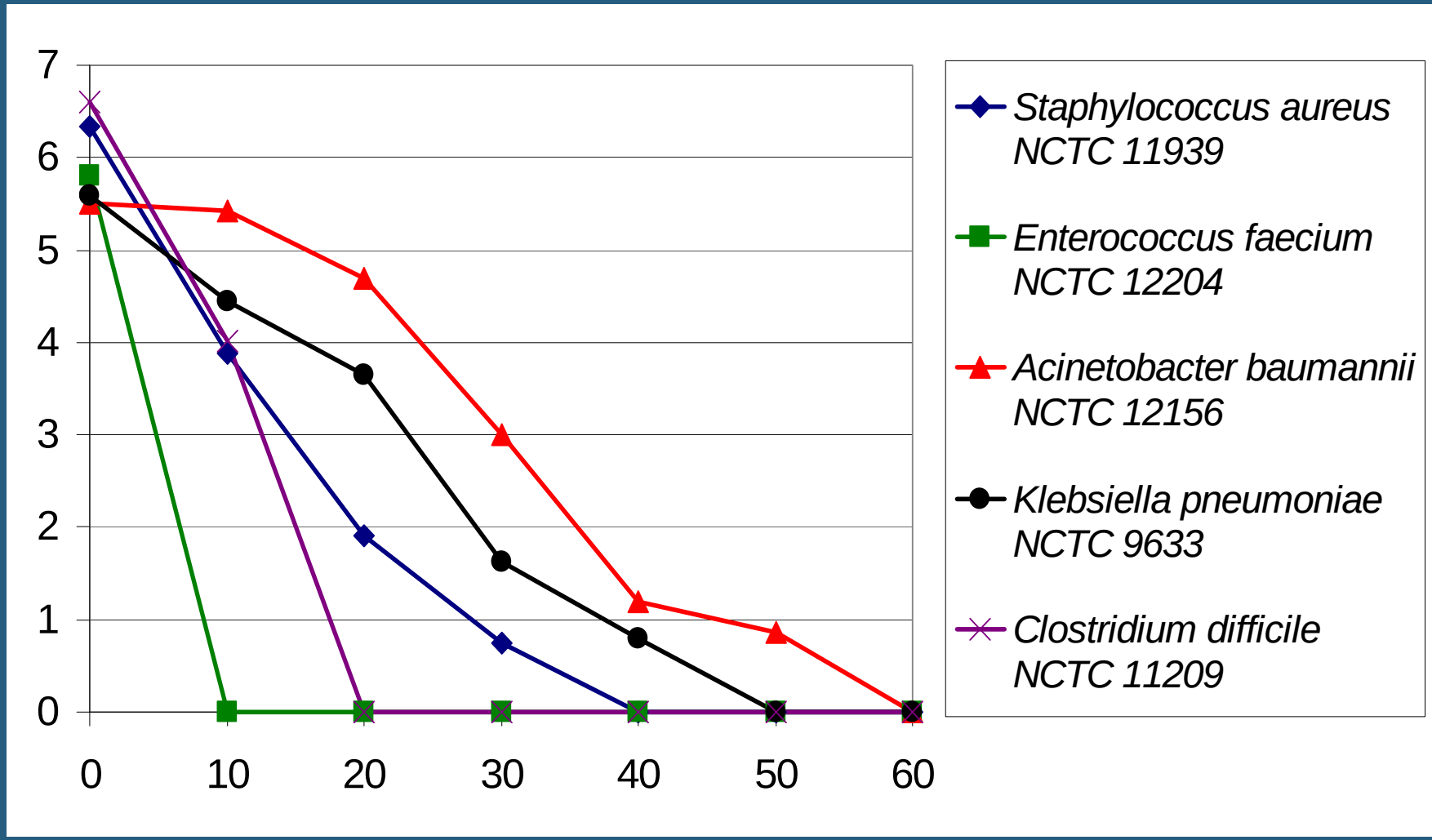


Bhalla A, et al. Infect Control Hosp Epidemiol. 2004;25:164-7.

Environmental Survival of Gram Negative Bacilli



Cleaning with hydrogen peroxide



French GL, etal. 44th ICAAC,, 2004; Rogers JV, Sabourin CL, etal. J Appl Microbiol 2005;99:739-748; Bates CJ, Pearse R. J Hosp Infect 2005;61:364-366; Cabinet bio-decontamination trial. Centre for Applied Microbiology and Research (CAMR) , Porton Down. March 1995.

MDRO Control: Education

- Encourage behavior change
  - Knowledge
  - feedback
- Involve all healthcare workers
  - Physicians
  - Nurses
  - Other healthcare workers

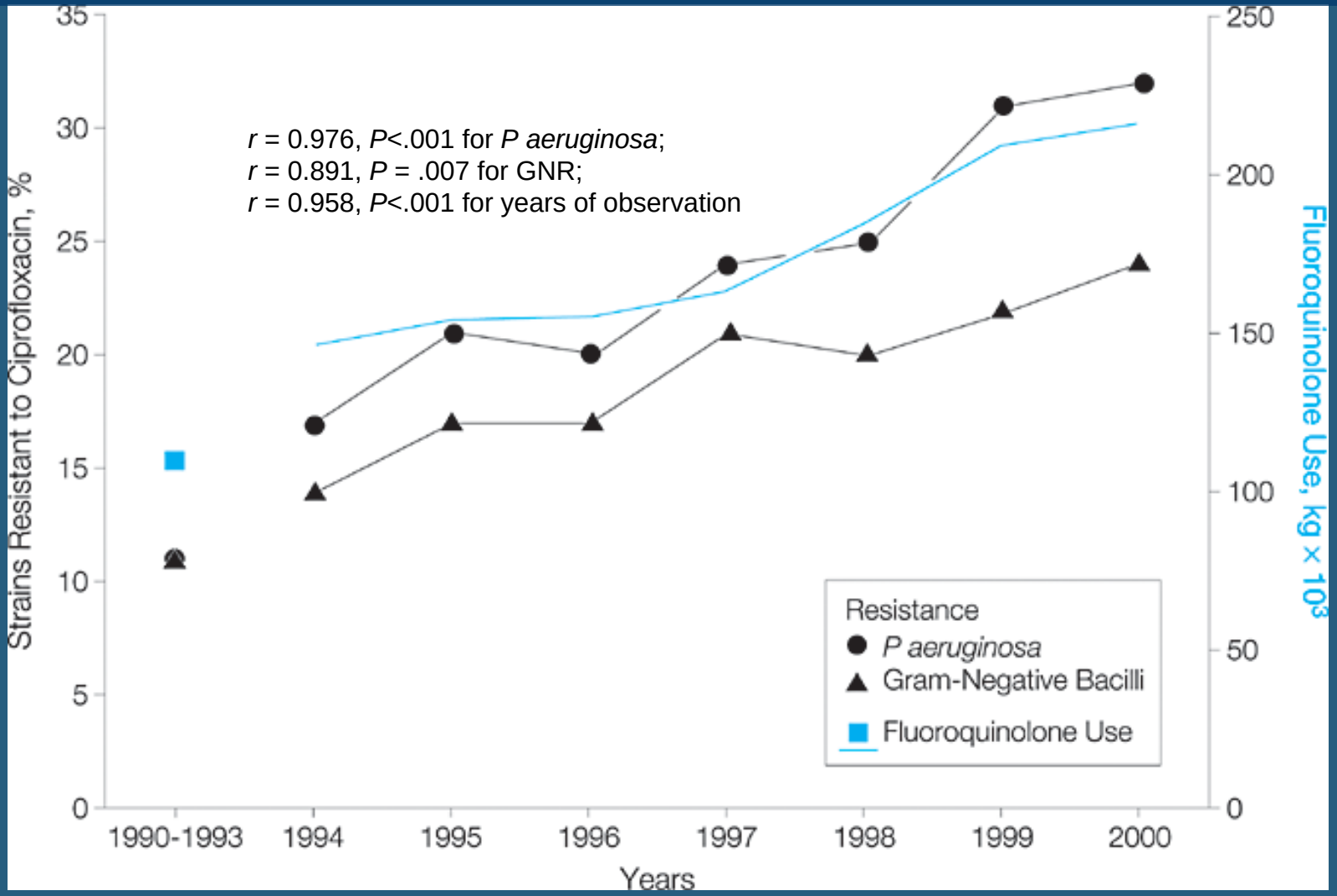
MDRO Control: Decolonization

- Strategies best for MRSA; limited for VRE and GNRs
- Limited by recolonization, difficulty in decolonization in patients with active infection, resistance

MDRO control: Antibiotics and Infection Control

- Judicious use of antibiotics
  - Automatic stop orders
  - Follow guidelines ie surgical prophylaxis
  - Limit pharmaceutical involvedment in guidelines
- Standard precautions:
  - Home health care
  - Ambulatory settings
  - Long term care with out draining wounds or secretions
- Standard and contact precautions:
  - Acute care for colonized and infected
  - Long term care where cannot control secretions or draining wounds

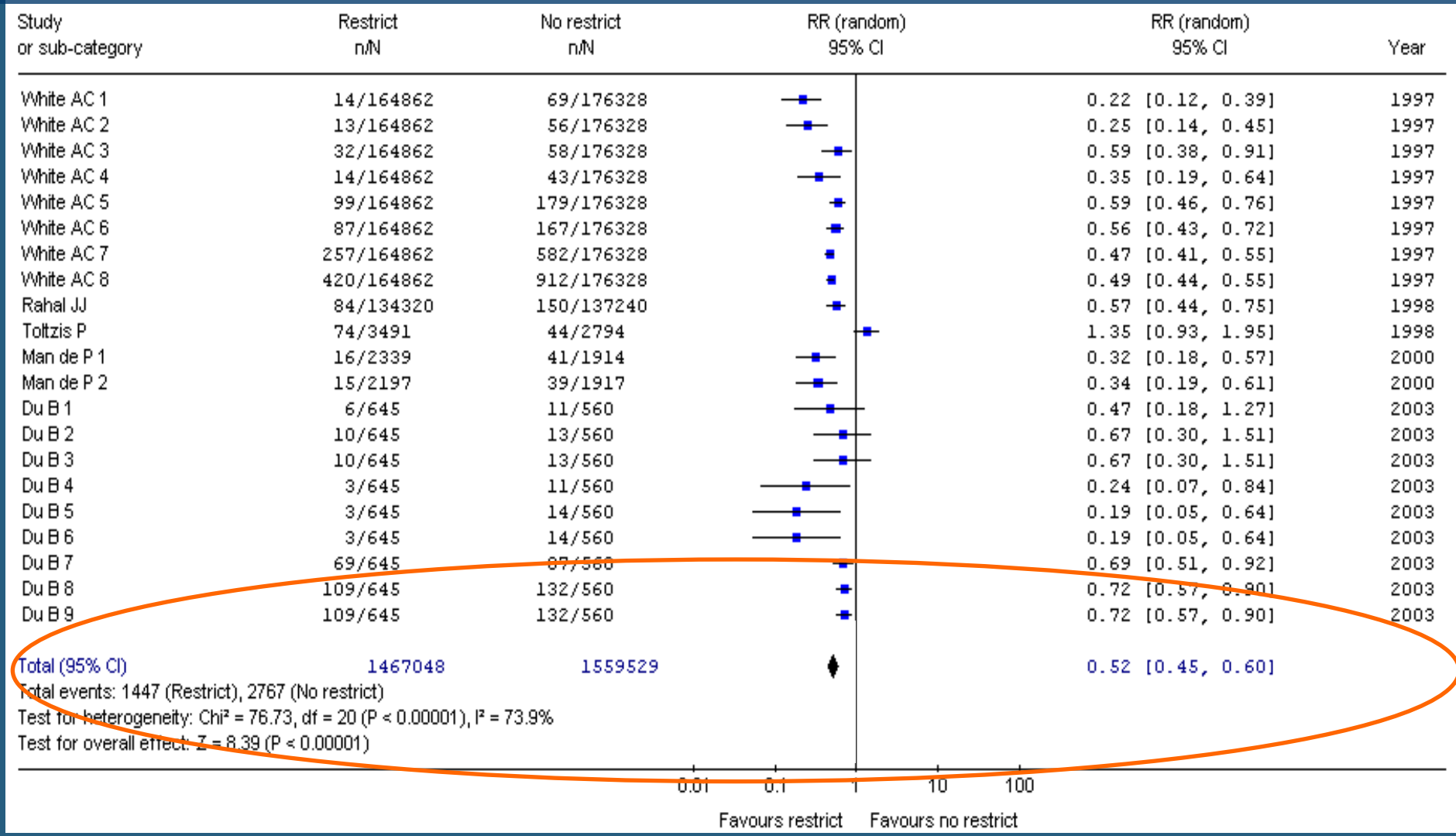
Fluoroquinolone use and resistance rates in *P. aeruginosa* and GNR



Neuhauser MM, et al. JAMA. 2003;289:885-8.

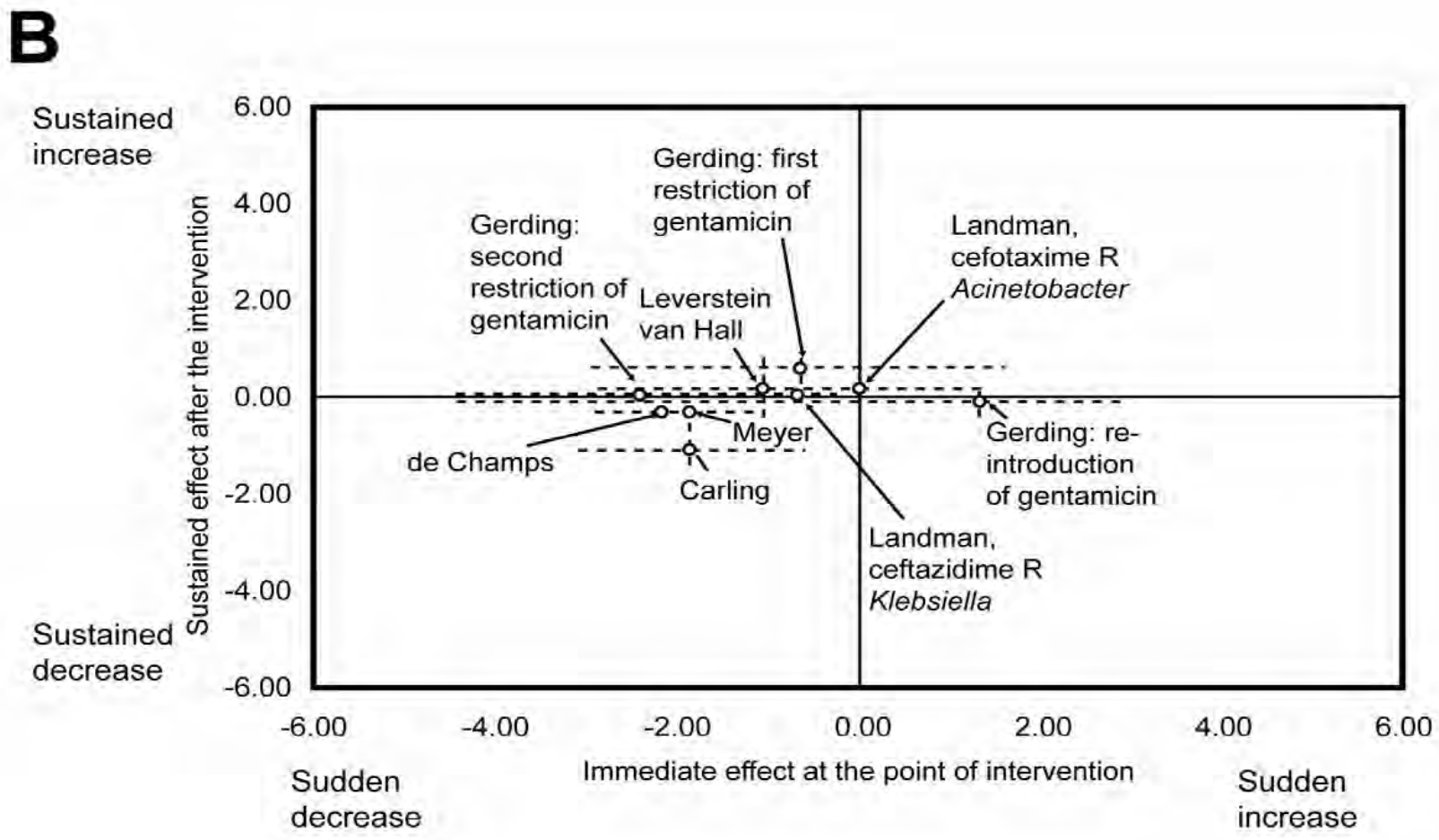
Meta-analysis: Effect of Antimicrobial Restriction

Review: Cephalosporin restriction in controlling cephalosp[illegible]esistance
Comparison: 01 Restriction of antibiotics versus no restriction[illegible]
Outcome: 01 Antibiotic resistant GNB/Enterobacteriaceae



Ng & Tambyah 2nd APSIC

Do These Approaches Work? Effects for MDR-GNR



Davey P, et al. Systematic Review of Antimicrobial Drug Prescribing in Hospitals. Emerging Infectious Diseases .2006;12:211-216.

Isolation Guidelines: Administrative

- Incorporate prevention of infectious agents into the the organization pt and OHS safety programs (IB/IC)
- Provide administrative support, fiscal and human resources for IC (IB/IC) and OHS (IB/IC)
- Provide adequate numbers and trained individuals to manage IC program (IB/IC) and trained microbiology personnel (IB)
- Delegate authority for patient placement and assignment of precautions to IC (IC)

Isolation Guidelines: Contact Precautions

- Transmission based precautions for epidemiologically significant organisms or communicable disease
- Contact precautions--for pts with known or suspected infections or syndromes with risk for contact transmission
  - Private room
  - Cohort
  - In OPD--place in exam room as soon as possible
  - Gloves and gown
  - Clean room frequently

Preventing Transmission: Data For Gram Negatives?

- Prospective cohort (2001–2004)—MICU/SICU at UMD. Perianal cultures on admission, weekly and on discharge
- 1806 patients admitted to ICU
  - 74 had ESBL producing *E. coli* on admission, 23 acquired ESBL and 14/23 PFGE were unique, 3 (13%) transmitted nosocomially
  - 27 acquired *K. pneumoniae*, 14 (52%) met our definition of patient-to-patient transmission. 6/27 (22%) had a subsequent ESBL
  - 8 acquired *K. oxytoca*, 1 (13%) was transmitted patient-to-patient

Harris AD, et al. Am J Infect Control. 2007;35:97-101.

Experience with Acinetobacter

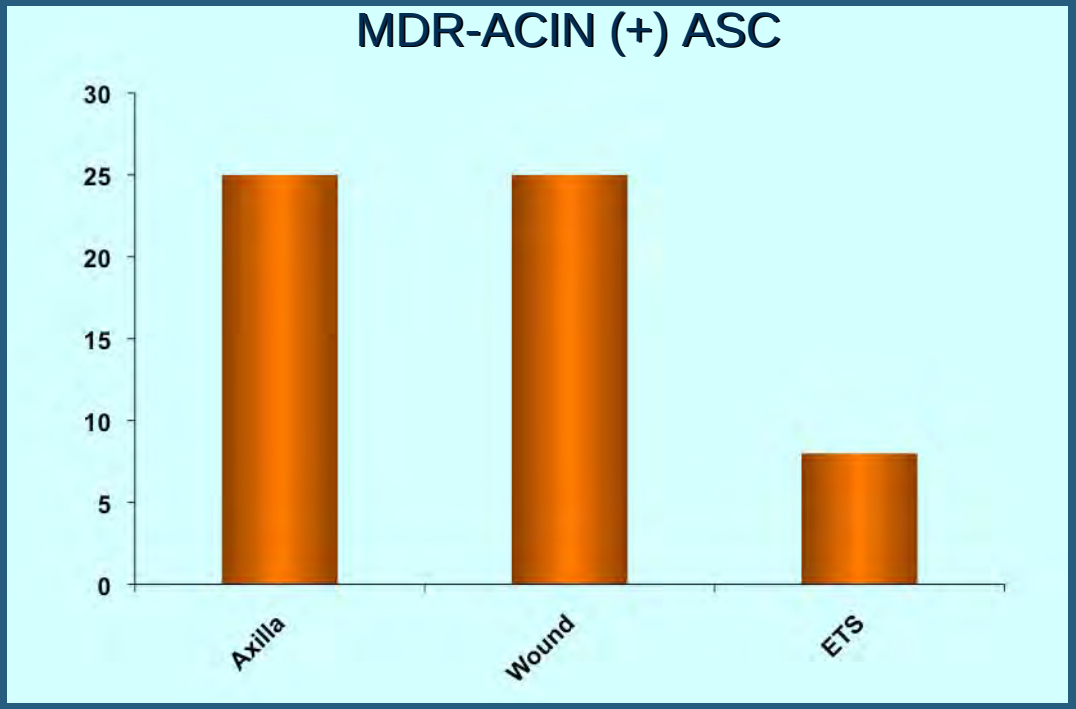
Table 1. Methods for control and prevention of multidrug-resistant *Acinetobacter* infection.

Method	Comments
Point source control	Effective in the outbreak setting when a point source is identified
Standard precautions	Includes hand hygiene, correct and consistent glove use, and appropriate use of gowns and eye protection; reported compliance among healthcare personnel is often poor
Contact barrier precautions	Includes dedicated patient care equipment and gowns and gloves for health care personnel on entry to an isolation room
Environmental cleaning and disinfection	Widespread environmental contamination is often reported in the epidemic setting, and environmental reservoirs likely play a role in the endemic setting as well
Cohorting of patients	Grouping colonized and infected patients into a designated unit or part of a unit
Cohorting of health care personnel	Designating staff to care for only patients colonized or infected with the organism
Clinical unit closure	Required in some outbreak settings to interrupt transmission and allow for thorough environmental disinfection
Antimicrobial stewardship	Programs to promote judicious antimicrobial use and prevent emergence of resistance
Surveillance	Passive or active surveillance can identify infected or colonized patients so that interventions can be implemented

Maragakis and Perl CID 2008:46;1254

The Acinetobacter Iceberg

- 4-month prospective pilot study on 5 medical units at JHH
- Admission and weekly surveillance cultures for MDR-ACIN (Axilla, wound, sputum, endotracheal suction)
- 1601 admissions/transfers with 74%-94% compliance
- 7/1240 (0.006%) admission cultures and 5/470 (0.01%) weekly cultures grew MDR-ACIN
- 80% of patients with prior history had + culture



Maragakis et al, JAMA 2008.

Experience with KPC's

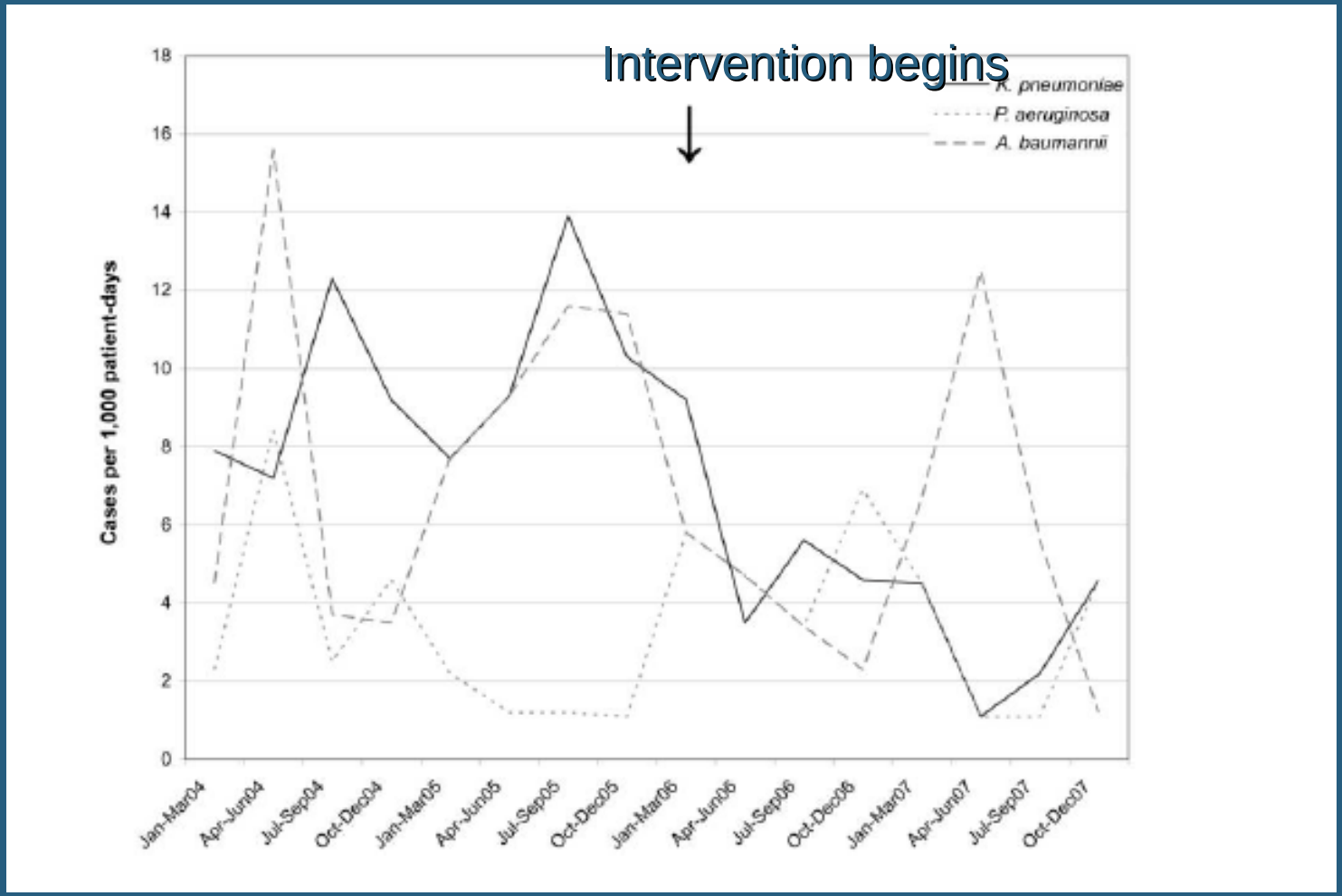
- Beginning 2006 in a 10 bed ICU all pts with KPC's, VRE, MRSA were

1) Placed in contact isolation
2) Cohorted in one end of the ICU
3) Compliance with hand hygiene and cleaning encouraged
4) Routine rectal swabs for KPCs implemented

- Mean number of patients per 1,000 pt days with KPC's decreased from 9.7 to 3.7 ($P<0.001$)

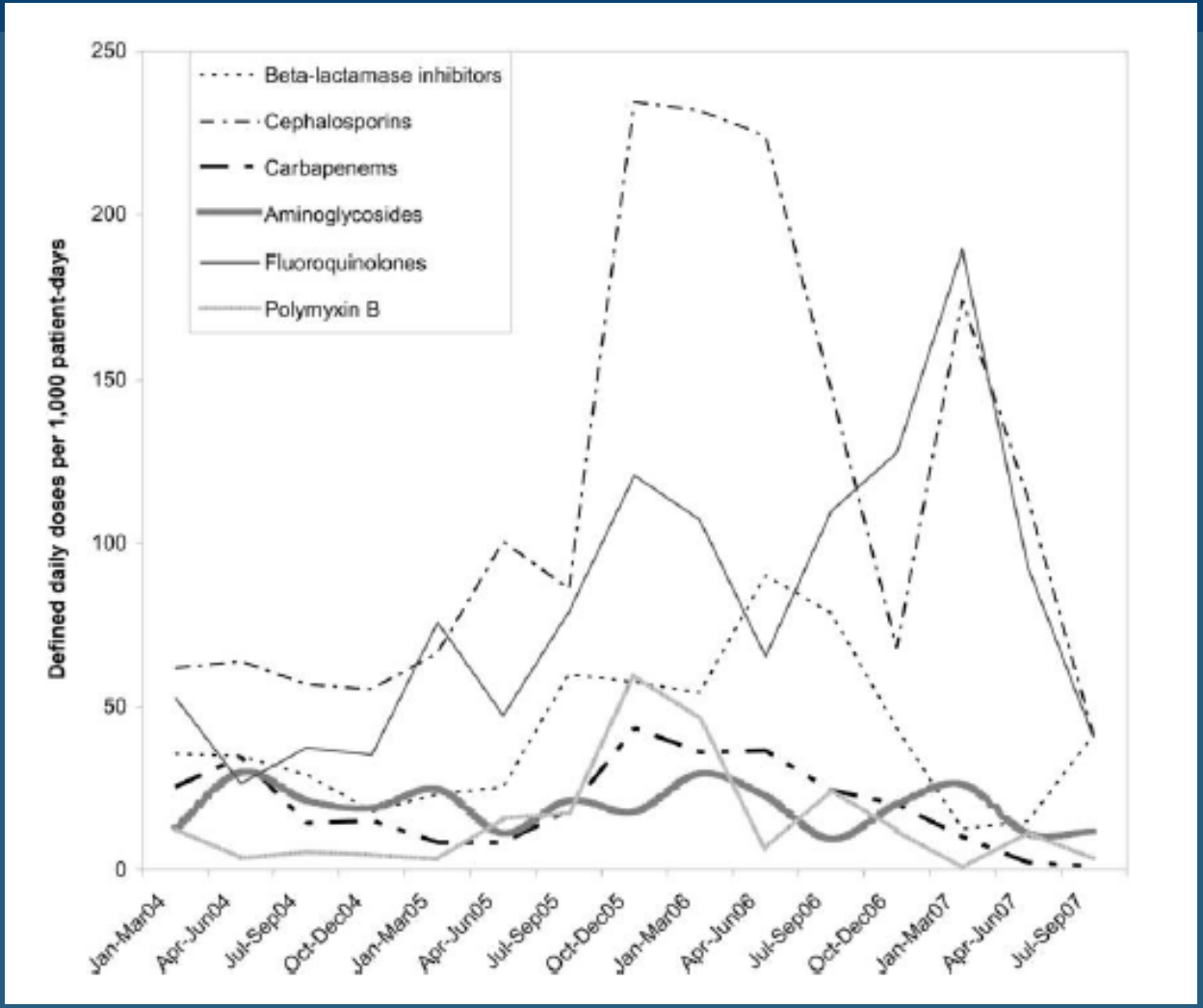
Kochar et al, ICHE 2009:33;447

Experience with KPC's



Kochar et al, ICHE 2009:33;447

Experience with KPC's: ABX use



Kochar et al, ICHE 2009:33;447

KPC guidelines (CDC)

- Isolate using contact precautions (duration not known)
- Screen using peri-rectal and or rectal swabs

MMWR, March 20, 2009: Vol 58(10);256

KPC guidelines (CDC)

Surveillance

- All acute care facilities should review clinical culture results for the preceding 6–12 months to determine whether previously unrecognized CRE have been present in the facility.
  - If this review identifies previously unrecognized CRE, a point prevalence survey (a single round of active surveillance cultures) should be performed to look for CRE in high-risk units (e.g., intensive care units, units where previous cases have been identified, and units where many patients are exposed to broad-spectrum antimicrobials).
  - If this review does not identify previously unrecognized CRE, monitoring for clinical infections should be continued.
- If CRE or carbapenemase-producing *Klebsiella* spp. or *E. coli* are detected from one or more clinical cultures **OR** if the point prevalence survey reveals unrecognized colonization, the facility should investigate for possible transmission by:
  - Conducting active surveillance testing of patients with epidemiologic links to a patient with CRE infection (e.g., patients in the same unit or who have been cared for by the same health-care personnel).
    - Continue active surveillance periodically (e.g., weekly) until no new cases of colonization or infection suggesting cross-transmission are identified.
    - If transmission of CRE is not identified after repeated active surveillance testing, consider altering the surveillance strategy by performing periodic point prevalence surveys in high-risk units.
  - In areas where CRE are endemic, an increased likelihood exists for importation of CRE, and the procedures outlined might not be sufficient to prevent transmission. Facilities in such areas should monitor clinical cases and consider additional strategies to reduce rates of CRE as described in the 2006 Tier 2 guidelines for management of multidrug-resistant organisms in health-care settings (*2*). Recommendations for rate calculations have been described previously (*3*).

MMWR, March 20, 2009: Vol 58(10);256

Other Approaches: What To Do If KPCs Outbreaks Are Ongoing

- Cohort patients
- Cohort staff
- PFGE/molecular typing of strains
- Active surveillance with “flagging of patients” and feed back of data
- Studies to identify sources
- Ongoing training and reinforcement of IC
- Measurement of compliance of processes

Carmeli et al. Clin Microbiol Infect 2010; 16:102-11

Other Approaches: What To Do If KPCs Are Rare or Newly Introduced

- Screen all patients in contact with index case (point prevalence study)
- Epidemiologic investigation and analysis of route cases of cross transmission events with more than 2 secondary cases or one case after implementation of prevention strategies
- Measures to communicate to staff and administration
- Stringent infection control measures to contain/eradicate clusters
- Coordinate with public health authorities

Carmeli et al. Clin Microbiol Infect 2010; 16:102-11

KPCs: The Response at National Levels

TABLE 3. National organizations and their priorities for action in countries with ongoing carbapenemase-producing Gram-negative (CPGN) outbreaks or endemic CPGNs

- National task force
  - Policy-making and communication with hospital administrations
  - Development of stringent and detailed CPGN control guidelines
  - Preparation of intervention tools
  - Supervision of control measures and preparation of corrective actions in the case of ongoing institutional outbreaks without adequate preventive measures
  - Active surveillance with rapid feedback at a regional level and national level
- Reference laboratories
  - Confirmation of suspected CPGN cases
  - Evaluation of molecular epidemiology and establishment of clonality
  - Detection of new resistance mechanisms
  - Development of laboratory manuals with descriptions of adequate methods
  - Quality assurance for clinical microbiology laboratories

Carmeli et al. Clin Microbiol Infect 2010; 16:102-11

Elements of MDRO Guidelines

Guideline recommendation	CDC/ HICPAC	UK MRSA	Australian
Definition	Not addressed	Not addressed	> 48 hours, # new infections/ OBD
Reporting to health authority	Not addressed	Mandatory for bacteraemia (MRSA in England, Wales & NI/All *Staph. aureus* in Scotland	Proposed for MRSA bacteraemia

Elements of MDRO Guidelines

Guideline recommendation	CDC/ HICPAC	UK MRSA	Australian
Hand hygiene	routine	routine	routine
Standard precautions	routine	routine	routine
Surveillance & feedback	recommended	recommended	recommended

Elements of MDRO Guidelines

Guideline recommendation	CDC/ HICPAC	UK MRSA	Australian MRSA
Sites cultured	Nares and skin break down sites	Nares, throat & groin, skin lesions, catheter sites, clinical specimens, umbilicus in neonates	Nares/groin/clinical specimens
Active surveillance cultures	Tier 2--escalation-admission and periodic	Recommended for high risk patients, high risk units & emergency admissions (Universal admission screening under consideration)	2 strategies--hospital wide in readmissions (w/in 6 mo and chronic conditions or specialized unites, admission and wkly

SHEA/IDSA compendium

S12 INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY OCTOBER 2008, VOL. 29, SUPPLEMENT 1

SUPPLEMENT ARTICLE: EXECUTIVE SUMMARY

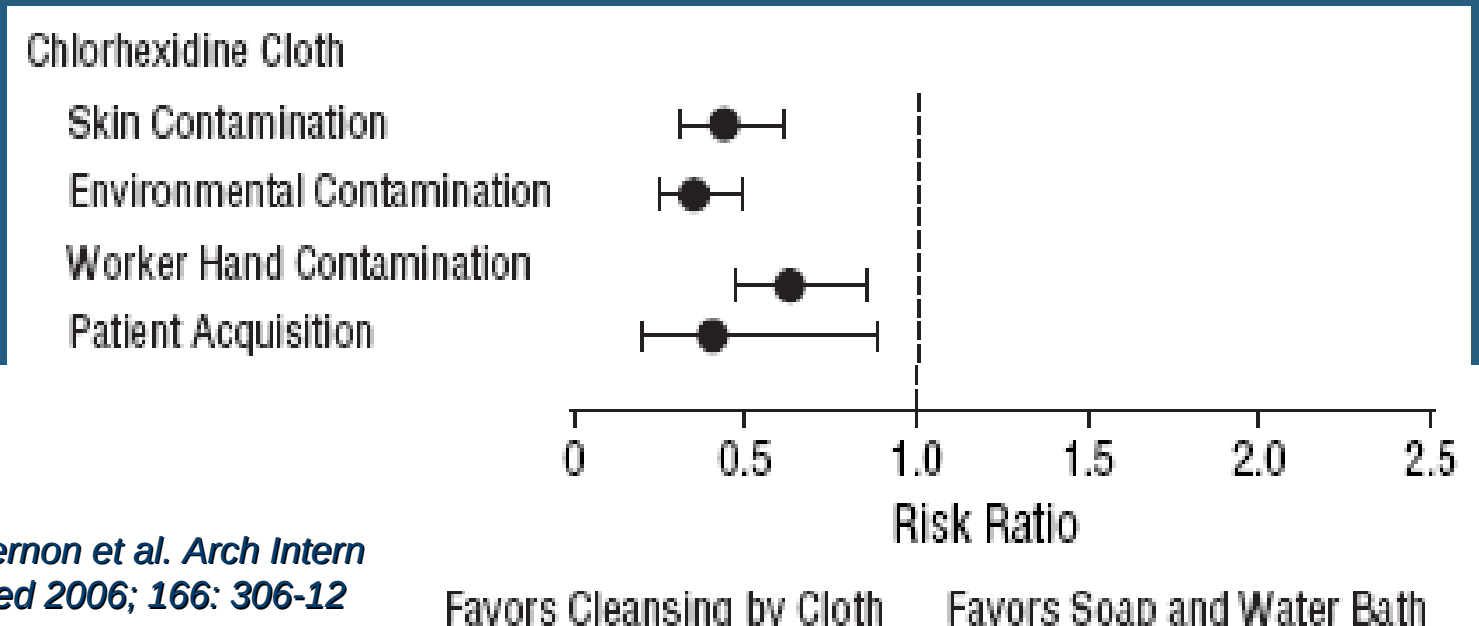
A Compendium of Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals

Deborah S. Yokoe, MD, MPH; Leonard A. Mermel, DO, ScM; Deverick J. Anderson, MD, MPH; Kathleen M. Arias, MS, CIC; Helen Burstin, MD; David P. Calfee, MD, MS; Susan E. Coffin, MD, MPH; Erik R. Dubberke, MD; Victoria Fraser, MD; Dale N. Gerding, MD; Frances A. Griffin, RRT, MPA; Peter Gross, MD; Keith S. Kaye, MD; Michael Klompas, MD; Evelyn Lo, MD; Jonas Marschall, MD; Lindsay Nicolle, MD; David A. Pegues, MD; Trish M. Perl, MD; Kelly Podgorny, RN, MS, CPHQ; Sanjay Saint, MD; Cassandra D. Salgado, MD, MS; Robert A. Weinstein, MD; Robert Wise, MD; David Classen, MD, MS

Includes measurement and definitions, reviews data for process and outcome measures, and infrastructure recommendations.
Subject areas include: SSI, BSI, VAP, UTI, C. difficile and MRSA

The Future? Source Control with Chlorhexidine

- Prospective, sequential group, single arm trial compared soap/water baths to cloths impregnated with 2% CHG in 1787 MICU pts
- 2.5 log reduction in VRE colonies on pt skin
- Less VRE contamination of HCW hands (RR=0.6) & environmental contamination (RR=0.3)
- VRE acquisition decreased from 26 to 9 colonizations per 1000 pt days (RR=0.4)



Vernon et al. Arch Intern Med 2006; 166: 306-12

Source control with chlorhexidine

- 6 ICUs in 4 centers
- Quasi experiemental design
- MRSA acquision decreased 32% (5.04 cases / 1000 eligible pt days vs 3.44, p=0.046)
- VRE acquisition decreased 50% (4.35 cases / 1000 eligible pt days vs 2.19 cases, p=0.008)
- Incident BSI decreased 21% (10.92 cases per 1000 pt days vs 8.66 cases, p=0.046)
- Progression to VRE bacteremia among VRE colonized patients (RR 3.35; 95% CI 1.13-9.87; P=0.035).

Climo et al. CCM 2009

Conclusions

- Guidelines for MDROs such as MRSA and VRE are well developed while those for GNRs are not because data are limited.
- The individual elements of guidelines work: Hand hygiene, isolation, cohorting, environmental cleaning, surveillance and feedback of data