# *PDR-Acinetobacter baumannii*: Can it be controlled?

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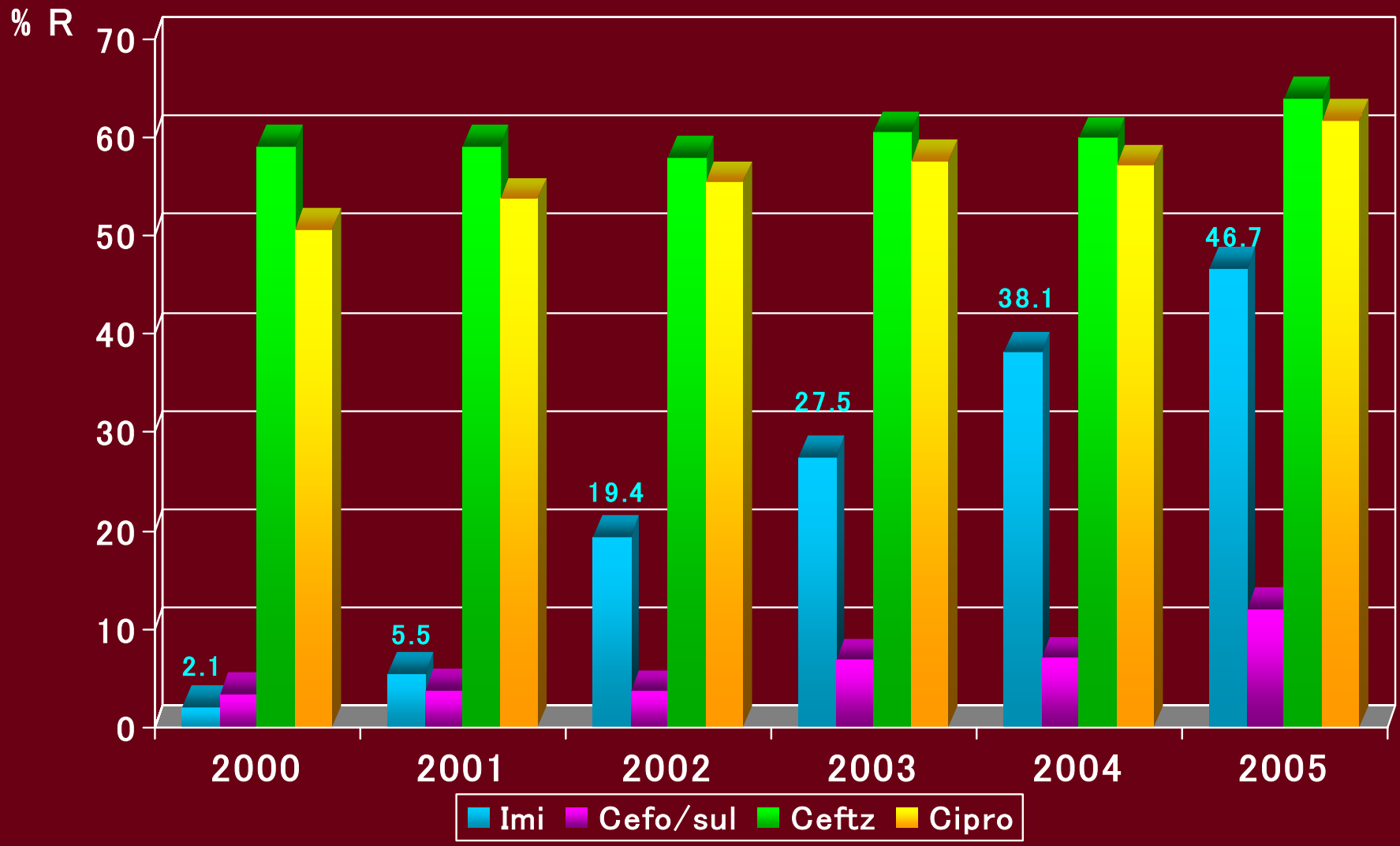
# Outlines

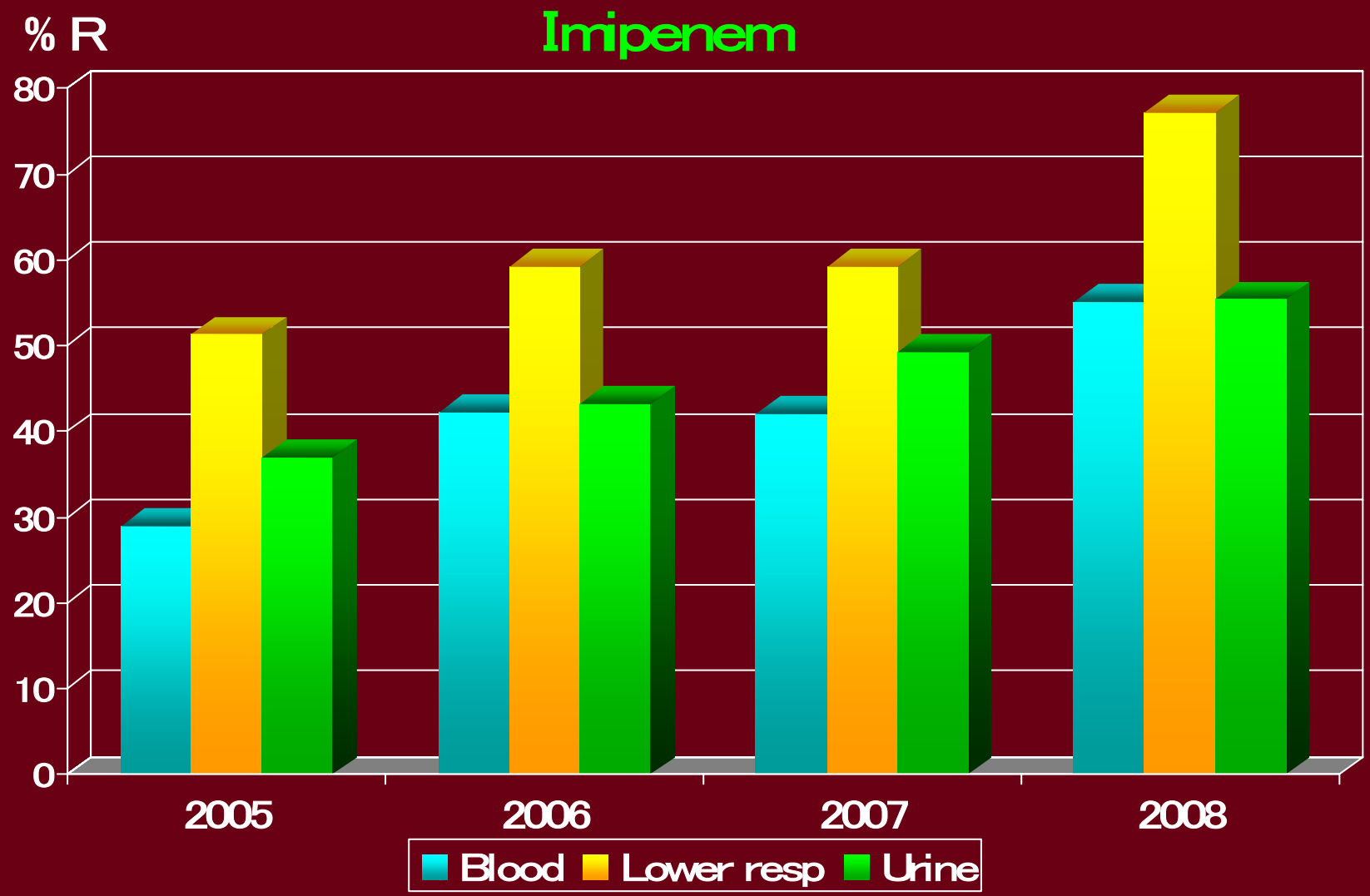
- Epidemiology of *MDR-Acinetobacter baumannii* in Thailand
- Is antimicrobial stewardship alone enough?
- Implementing an Infection Control Program and rationale for each component
- How to implement a successful infection control program in resource-limited settings?

# National Resistance of *A. baumannii*




Source: Thai NIH

# Percentage of Resistance of *A. baumannii complex*




Source: Thai NIH

# Risk factors and Outcomes of Carbapenem Resistance *A. baumannii*

- Increasing 3rd GC/ carbapenem consumptions.
- Patients being transferred from another hospital.
- Duration of 3rd GC/ carbapenem use.
- Environmental contamination.
- Mortality rate 38% among carbapenem resistant *A. baumannii* (CRAB) vs. 24% carbapenem sensitive *A. baumannii* (CSAB) (95% CI, 1.2-2.2).
- BSI is a predictor for mortality.
- Carbapenem resistance associated with higher antibiotic costs and admission costs.

**Apisarnthanarak A, et al. Predictors for mortality among *PDR-A. baumannii* infections in Thailand. Am J Infect Control, 2009; Jamulitrat S, et al. An outbreak of imipenem-resistant Acinetobacter baumannii at Songklanagarind Hospital: the risk factors and patient prognosis. J Med Assoc Thai, 2007.; Surasarang K, et al. Risk factors for multi-drug resistant *Acinetobacter baumannii* nosocomial infection. J Med Assoc Thai, 2007.**

# Antimicrobial Stewardship at Thammasat University Hospital

- **Educations to intern, residents, and staff**
  - Five-sessions education for all intern, residents and staff in the hospital
  - One on one feedback to externs, interns, and residents

- **Intervention target at specific units**
  - Structured teaching on medicine, surgery, and OB-GYN
  - Monthly education for medical students, interns, and residents
  - Presence of clinical pharmacist on medicine, surgery and OB-GYN units

- **Encourage Infectious Diseases consultation**

***Initiated in July 2003***

**Apisarnthanarak A, et al. Effectiveness of Educational and Antibiotic Control Program in a tertiary care hospital in Thailand, Clin Infect Dis, 2006**

# Bacterial Resistance Rates During the Pre and Post Intervention Periods

| Microorganism | Resistance rate % [a] | | Associated antibiotic class | Type of variation | R [b] | *P* |
|---|---|---|---|---|---|---|
| | Pre intervention period | Post intervention period | | | | |
| MRSA | 48 | 33.5 | Glycopeptides<br>3rd gen. Cephalo. | Decrease<br>Decrease | 0.55<br>0.93 | <.001<br><.001 |
| ESBL *E.coli* | 33 | 21 | 3rd gen. Cephalo. | Decrease | 0.74 | <.001 |
| ESBL *K.pneumoniae* | 30 | 20 | 3rd gen. Cephalo. | Decrease | 0.69 | <.001 |
| 3rdGC-resistant *A. baumanii* | 27 | 19 | 3rd gen. Cephalo. | Decrease | 0.78 | <.001 |
| Imipenem-resis *P. aeruginosa* | 5 | 4 | None | - | - | |
| MDR *A.baumanii* | 4 | 5 | None | - | - | |

[a] Calculated using the total number of strains.
[b] Linear regression analysis between evolution in the resistance rate and antibiotic use throughout the study

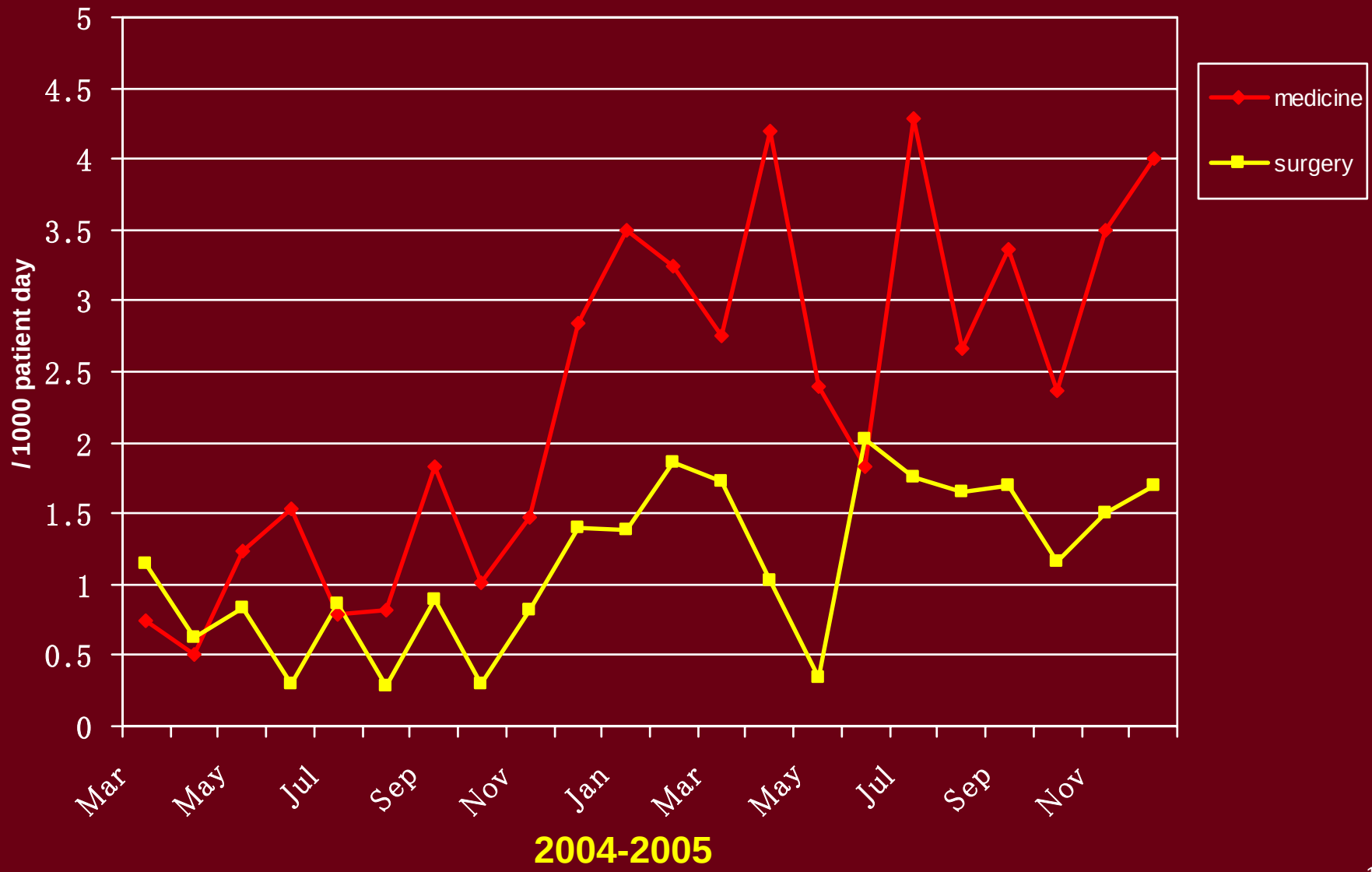
# Controlling Antibiotic Use and Resistance (Editorial Note)

*"…..To sustain or even further improve these results, lasting and repeated efforts will be needed. Integrating infection-control efforts into this education and antibiotic-control program is warranted."*

**Nouven JL, Clin Infect Dis, 2006**

# The emergence of *PDR-A. baumannii* outbreak: The need to emphasize on infection control program in Thailand

# Despite effective antimicrobial stewardship program, *PDR-A. baumannii* emerged….

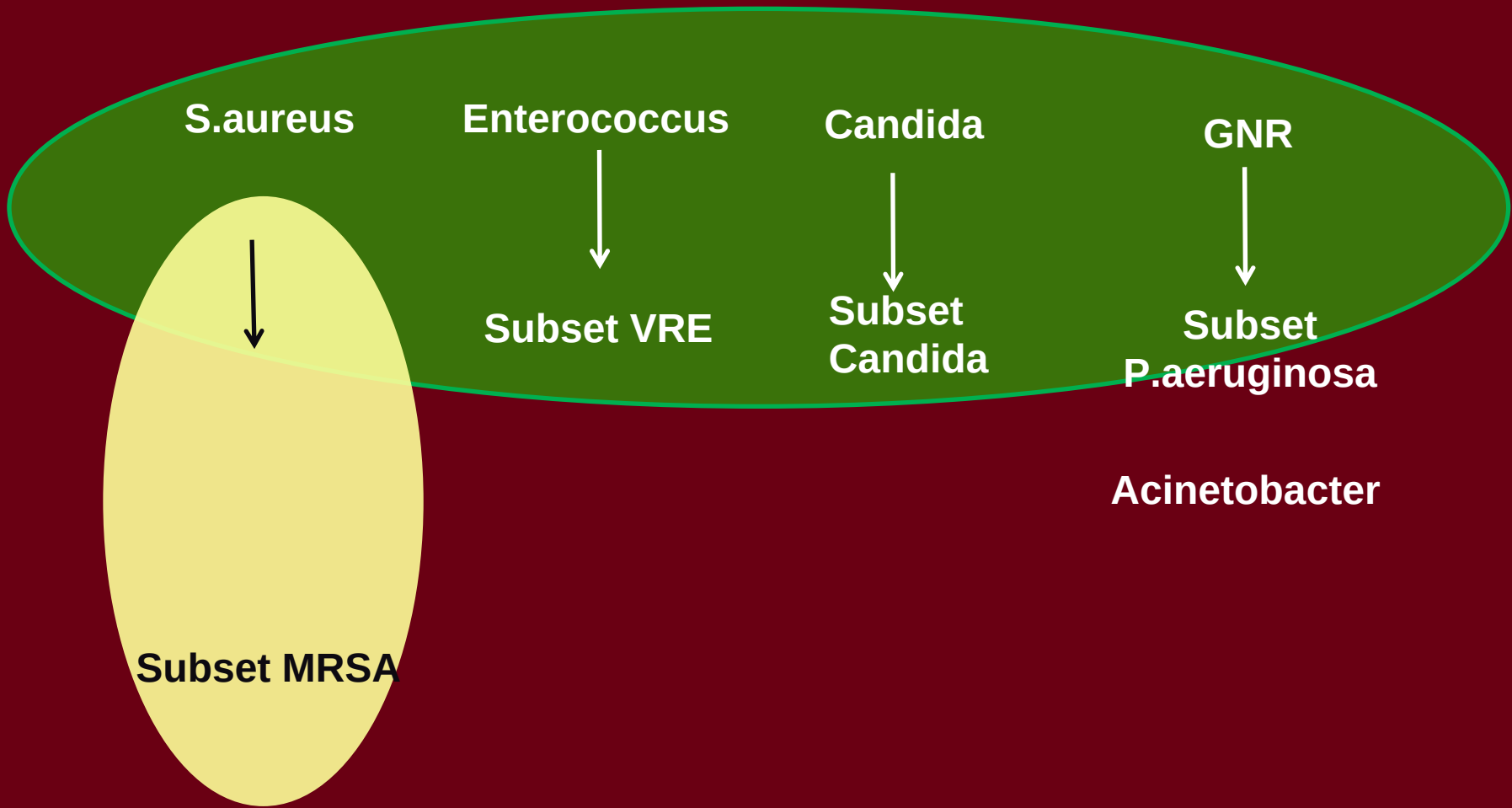


# What works!

- Most outbreaks were terminated with multi-faceted, comprehensive infection control programs
- Measures always include education, hand hygiene (5-moments), contact isolation, environmental cleaning, targeted active surveillance culture in high risk area, and antimicrobial control program
- Recent reports also suggested the role of 4% chlorhexidine total body wash

Dancer SJ. JHI 2009
Rodriguez-Bano J, AJIC 2009
Valencia R, ICHE 2009
Gill CJ, CID 2009
Borer A, JHI 2007
Chan PC, ICHE 2007

# Controlling healthcare associated Infection: Vertical vs. horizontal approach



# *Caveat will we begin to see Chlorhexidine resistant strains emerge*

*A. Borer [a,*], J. Gilad [a], N. Porat [b], R. Megrelesvilli [c], L. Saidel-Odes [a], N. Peled [d], S. Eskira [a], F. Schlaeffer [e], Y. Almong [c]*

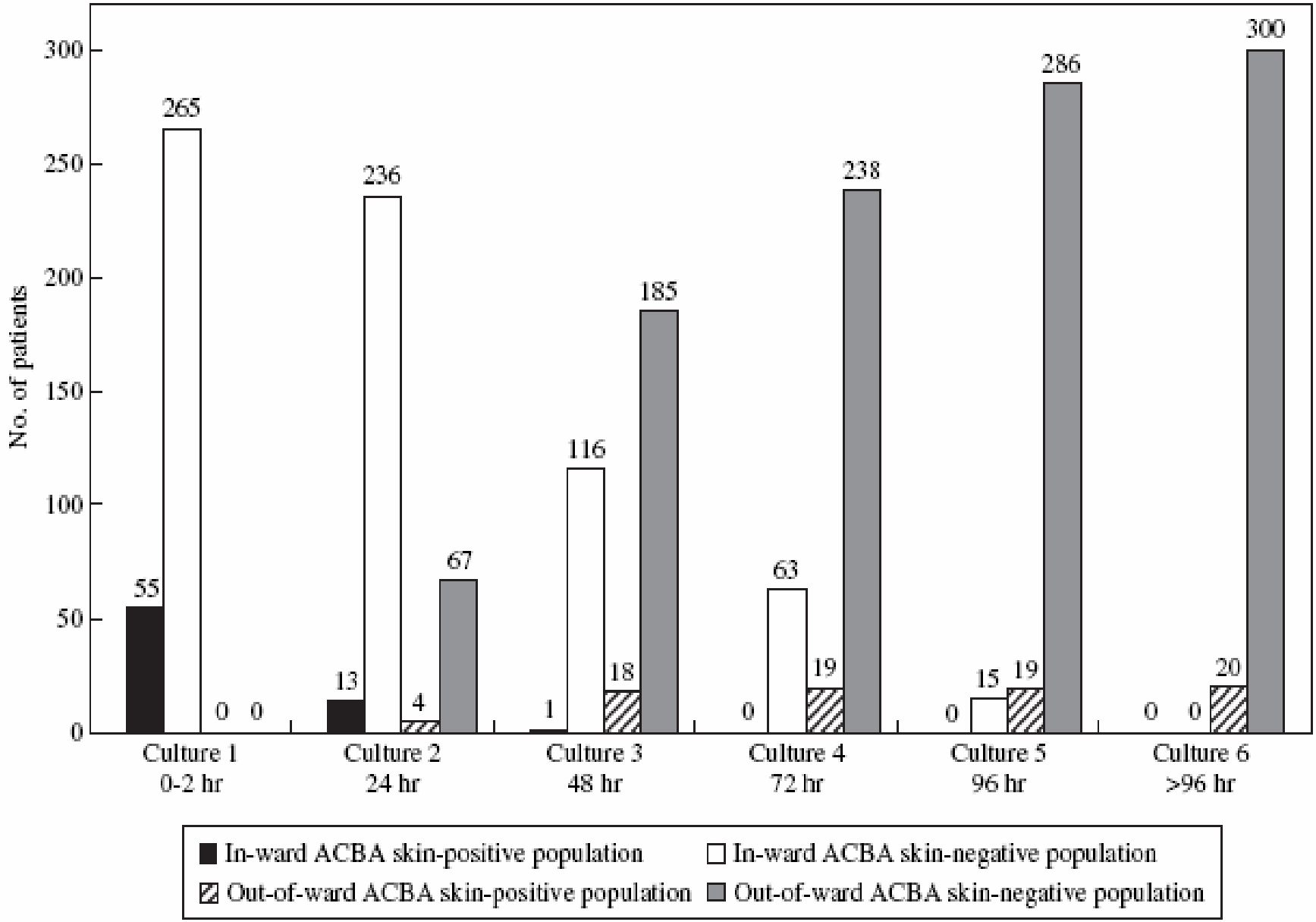



Figure 2 Patient population changes and *Acinetobacter baumannii* (ACBA) skin colonisation by time of culture. In-ward population: colonised and non-colonised ACBA patient population in the medical intensive care unit. Out-of-ward population: patients discharged from the unit either colonised or non-colonised at time of discharge.

# Use of Hydrogen Peroxide Vapour

Infect Control Hosp Epidemiol. 2010 Dec;31(12):1236-41. Epub 2010 Oct 25.

## Use of vaporized hydrogen peroxide decontami…ult… Acinetobacter baumannii infection at a long-ter…

Ray A, Perez F, Beltramini AM, Jakubowycz M, Dimick P, Jacobs MR, Roman K, Bonon…

**OBJECTIVES:** To describe vaporized hydrogen peroxide (VHP) as an adjuvant in the co…i infec… hospital (LTACH) and to describe the risk factors for acquisition of MDR A. baumannii in…

**DESIGN:** Outbreak investigation, case-control study, and before-after intervention trial.

**SETTING:** A 54-bed LTACH affiliated with a tertiary care center in northeastern Ohio.

**METHODS:** Investigation of outbreak with clinical and environmental cultures, antimicrob…of rep… type strains, and case-control study; and intervention consisting of comprehensive infect…tion.

**RESULTS:** Thirteen patients infected or colonized with MDR A. baumannii were identifie…testing… carbapenem-resistant. MDR A. baumannii was found in wound samples, blood, sputum, …A. ba… associated pneumonia was the most common clinical syndrome caused by the pathoger…atient… found in 8 of 93 environmental samples, including patient rooms and a wound care cart; …. Env… immediately after VHP decontamination and both 24 hours and 1 week after VHP decon…TACH… When patients colonized with MDR A. baumannii reoccupied rooms, environmental contamination recurred.

**CONCLUSION:** Environmental decontamination using VHP combined with comprehensive infection control measures interrupted nosocomial transmissi… LTACH. The application of this novel approach to halt the transmission of MDR A. baumannii warrants further investigation.

# Implementation of IC Program

- Active surveillance (tracheal aspirate and/or rectal swab) in ICU patients.
- Repeat surveillance cultures weekly.
- Cohort and contact isolation.
- Hand hygiene intervention
- Environmental cleaning
- Monitoring of Infection Control adherence

# Gown change every shift

ประจำเดือน มิถุนายน

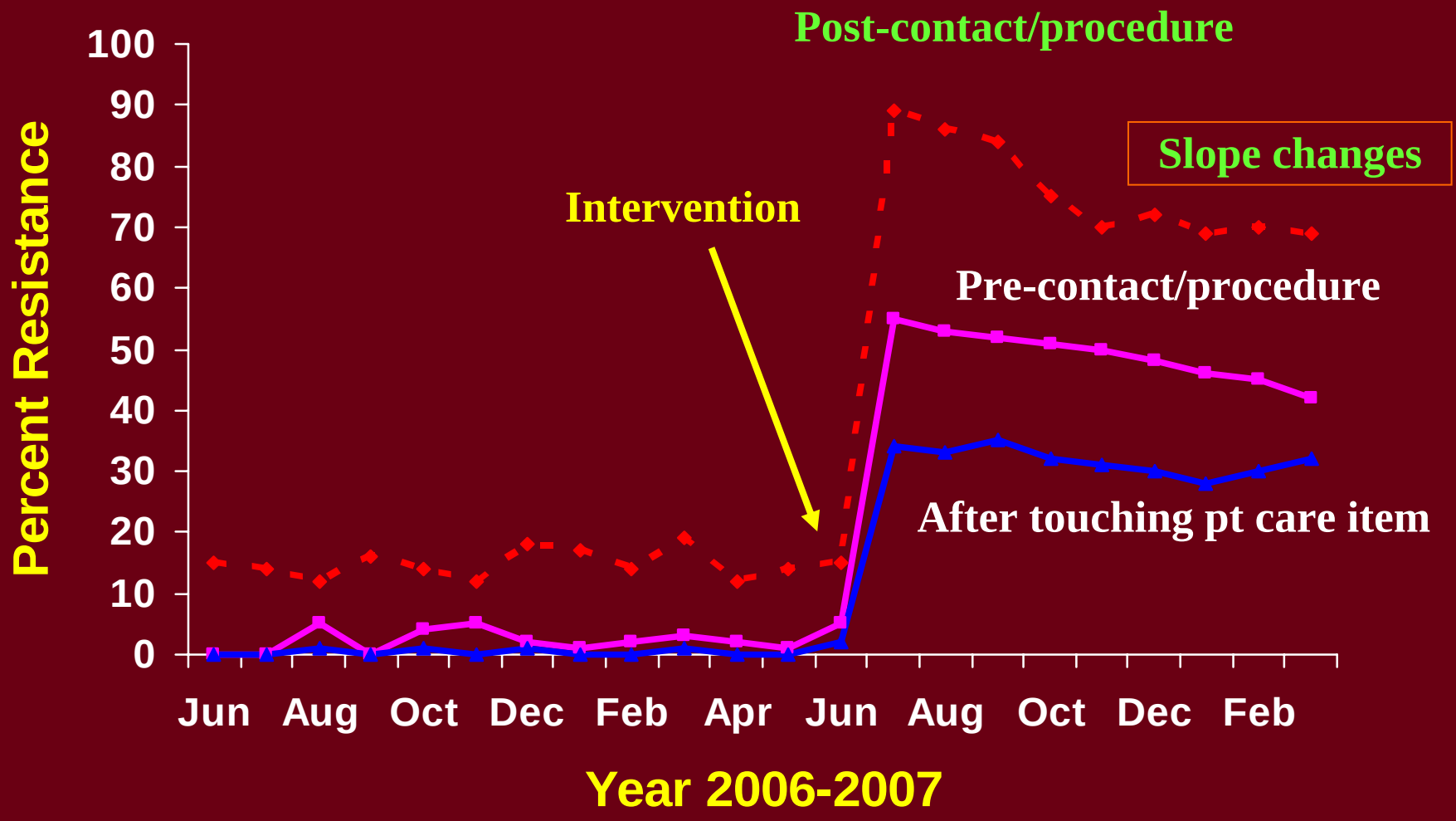
| ประเภทบุคลากรการแพทย์ | ก่อน | หลัง | ข้อสังเกตุจากการฝึกระ |
|---|---|---|---|
| แพทย์ | 0.00 % | 16.67 % | |
| พยาบาล | 0.00 % | 40.00 % | |
| เจ้าหน้าที่อื่นๆ | 0.00 % | 0.00 % | |
| รวม | 0.00 % | 12.50 % | |

อัตราการฉีดวัคซีนของบุคลากรการแพทย์ ปี 2556

ประจำเดือน กรกฎาคม

| ประเภทบุคลากรการแพทย์ | ก่อน | หลัง | ข้อสังเกตุจากการฝึกระวัง |
|---|---|---|---|
| แพทย์ | 43 % (7) | 86 % (7) | |
| พยาบาล | 10 % (10) | 60 % (10) | |
| เจ้าหน้าที่อื่นๆ | 17 % (6) | 67 % (6) | |
| รวม | 22 % (23) | 70 % (23) | |

# Hand Hygiene Compliance Rate



# Characteristics of patients in intervention units during the entire study periods (Cont.)

| Characteristics | Period 1 | Period 2 | Period 3 |
|---|---|---|---|
| | n= 1,357 | n= 1,273 | n= 1,441 |
| Source of *A. baumannii* infection and colonization | | | |
| Bloodstream | 14 (27) | 4 (24) | 3 (23) |
| Urinary tract | 4 (7) | 1 (6) | 1 (8) |
| Pulmonary | 31 (59) | 11 (64) | 8 (61) |
| Other | 4 (7) | 1 (6) | 1 (8) |
| Admissions rate (mean admission per day) | 3.7 | 3.5 | 3.9 |
| APACHE-II score, mean±SD | 17 ± 5 | 17 ±4 | 18 ±5 |
| Total number of patient-day | 14,650 | 14,456 | 15,410 |
| Daily occupancy, mean days±SD | 20.2 ±1.4 | 21 ±2.4 | 20 ±2.4 |
| Duration of hospital stay, mean days±SD | 10.4 ± 4.7 | 11.5 ±3.5 | 10.6 ±3.5 |
| Patients with contact isolation, mean patients/d ±SD | 8.8 ±1.9 | 5.5 ±2.1 | 3.8 ±1.2 |

# Patient colonized or infected with *PDR-Acinetobacter baumannii*, infection control compliance monitoring, and outcomes in intervention units

| Variable | Period 1 | Period 2 | Period 3 |
|---|---|---|---|
| **Environmental cleaning** | | | |
| No. of observations | ….. | 166 | 165 |
| Mean no. of observations per week±SD | ….. | 3±0.6 | 3±0.4 |
| Environmental cleaning rate, mean±SD | ….. | 0.85±0.08 | 0.83±0.09 |
| **Hand hygiene adherence** | | | |
| No. of observations | 154 | 166 | 165 |
| Hand hygiene adherence rate before and after contact, mean±SD | 0.31±0.07 | 0.75±0.08 | 0.54±0.01 |
| Hand hygiene adherence rate before and after contact and glove&gown use, mean±SD | 0.24±0.02 | 0.63±0.02 | 0.51±0.09 |

# Patient colonized or infected with *PDR-Acinetobacter baumannii*, infection control compliance monitoring, and outcomes in intervention units

| Variable | Period 1 | Period 2 | Period 3 |
|---|---|---|---|
| **Outcomes** | | | |
| Rate of PDR- *Acinetobacter baumannii* acquisitions, isolate per 1000 patient-days at-risk | ….. | 15.9 | 11.9 |
| Rate of PDR- *Acinetobacter baumannii* infection and colonization (/1000 patient-days) | 3.6 | 1.2 | 0.85 |
| Monthly antibiotic cost for PDR- *A. baumannii* treatment (USD) | 3,762±605 | 1,722±96 | 1,278±87 |
| Hospitalization cost for each patient (USD) | 366±100 | 252±96 | 204±88 |

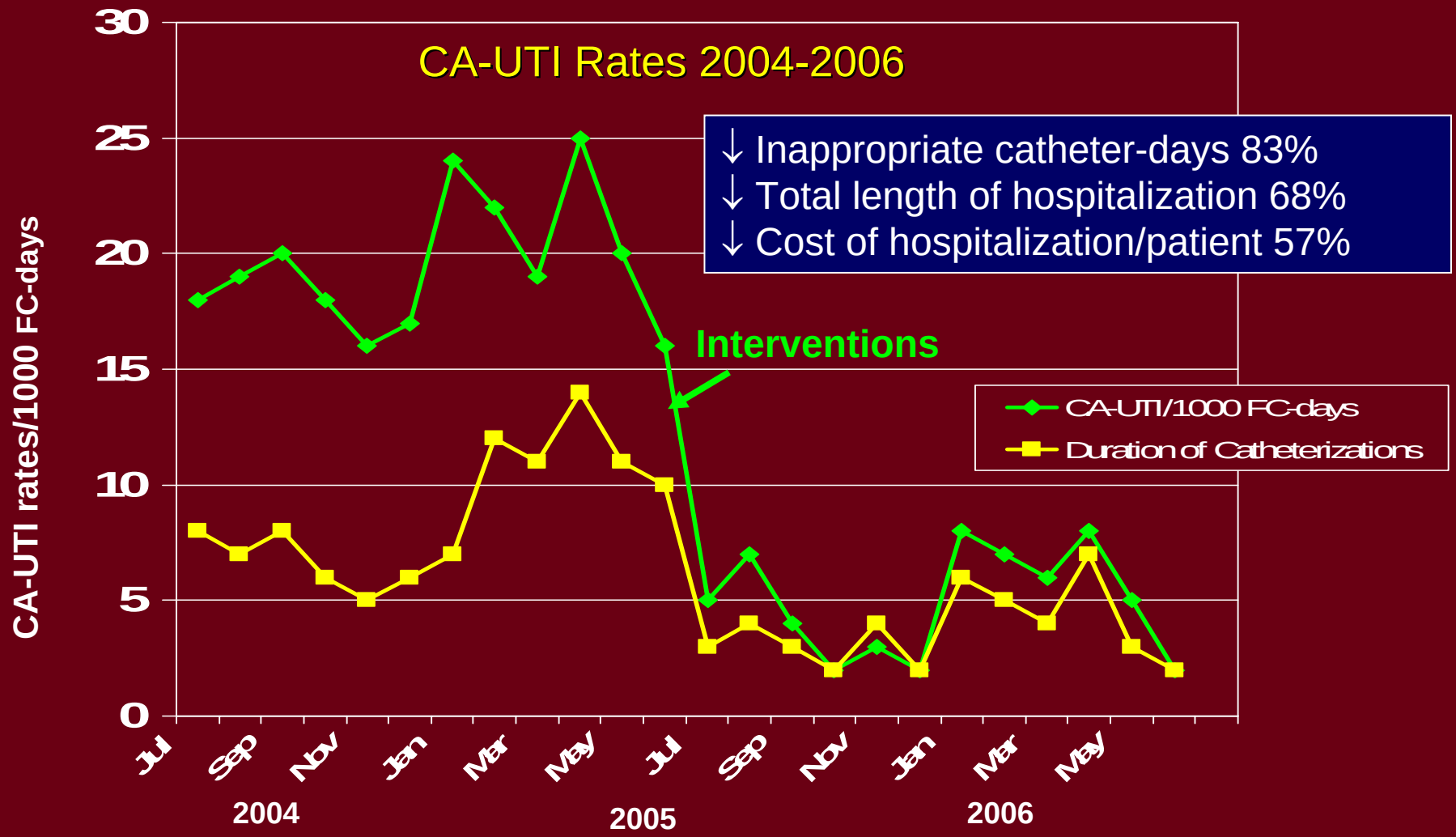
# Cost-Benefit of the Interventions

- Total cost for ASCs $19,862.
- Compared to period 1, the monthly ATB cost reduced by 36-42% in period 2 and 3. ($3,762 vs. $1,776 vs. $1,278)
- Compared to period 1, hospitalization cost reduced by 25-36% in period 2 and 3. ($366 vs. $254 vs. $204)

Apisarnthanarak A, et al. A multi-faceted infection control intervention to reduce *PDR-A. baumannii* in three ICUs in a Thai tertiary care center. Clin Infect Dis, 2008

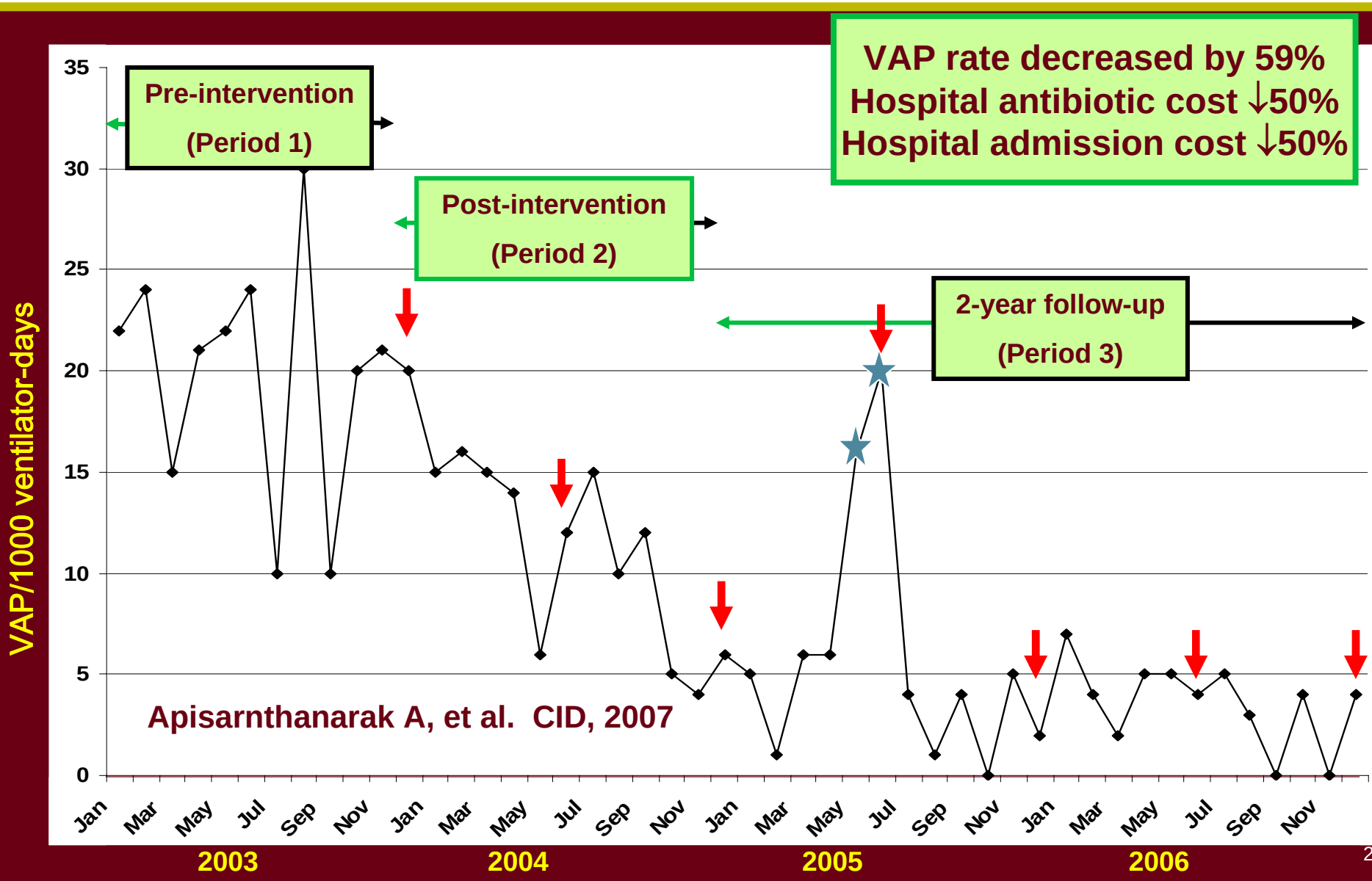
# Concurrent Initiative to Reduce Nosocomial Infections

# Urinary Tract Infection Intervention

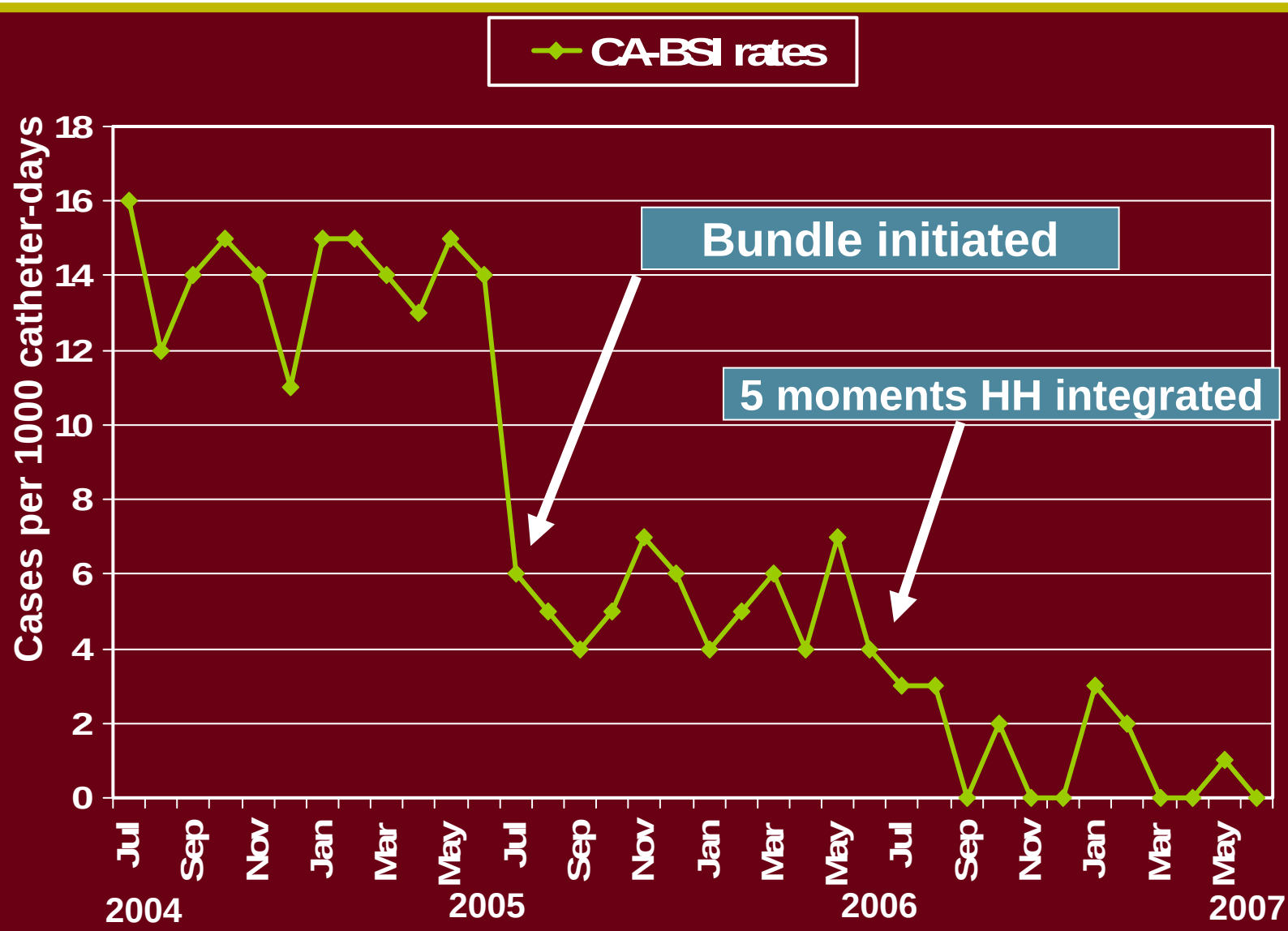



Apisarnthanarak A, et al. Effectiveness of multifaceted hospital wide quality improvement program featuring intervention to remove IUC in a tertiary care center in Thailand. ICHE, 2007

# Implementing VAP Bundle



# Implementing CA-BSI Bundle



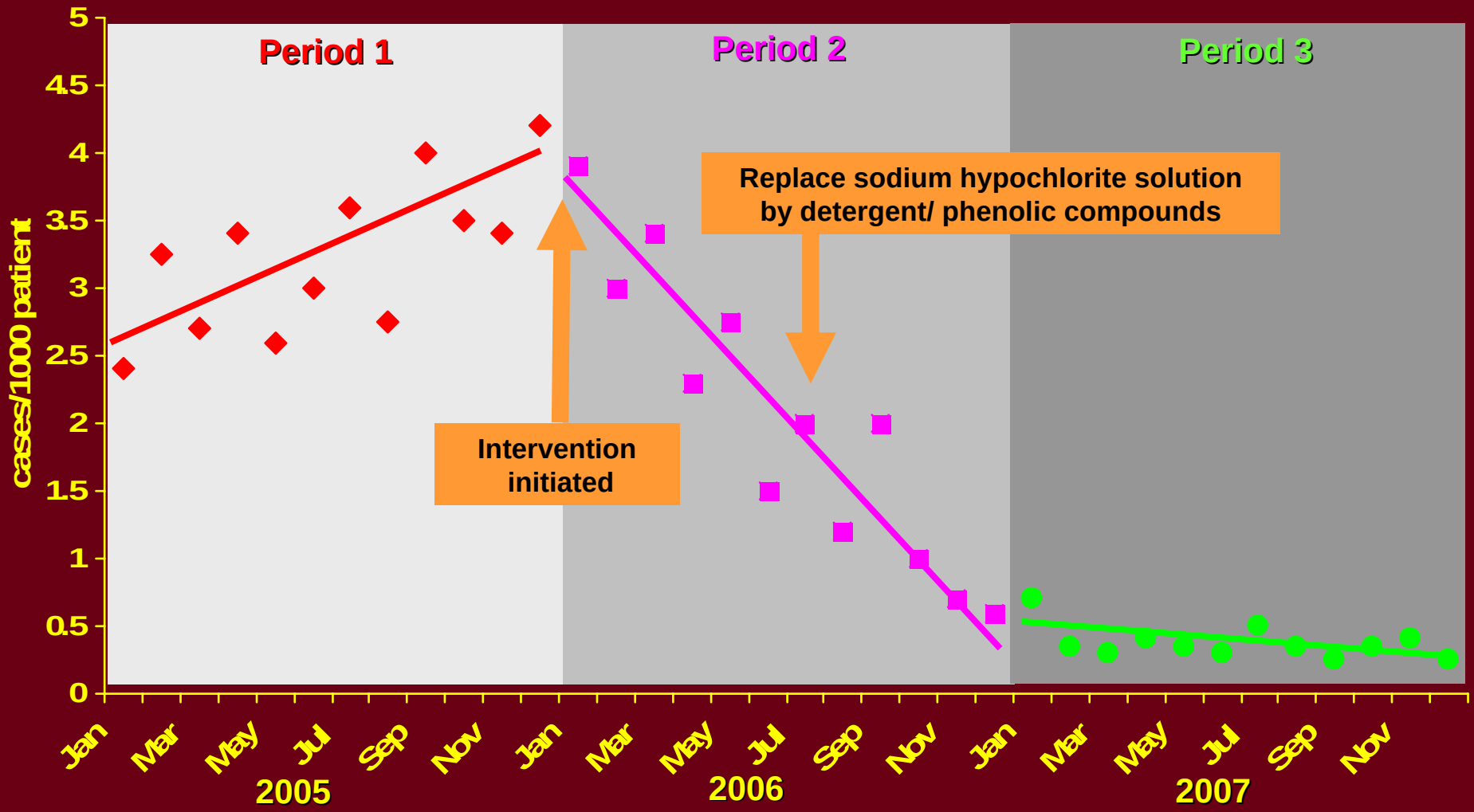

Apisarnthanarak A, et al. Effectiveness of CA-BSI bundle. AJIC, 2010

# Impact of Concurrent Interventions to Reduce Healthcare-Associated Infection

| Characteristic | Period 1 (n = 1115) | Period 2 (n = 1050) | Period 3 (n = 1204) |
|---|---|---|---|
| Organism associated with CA-BSI*,‡ | | | |
| Methicillin-susceptible *Staphylococcus aureus* | 21 (24) | 8 (25) | 2 (28) |
| Methicillin-resistant *S aureus* | 18 (20) | 7 (21) | 2 (28) |
| Coagulase-negative *Staphylococcus* spp | 26 (30) | 10 (32) | 2 (28) |
| MDR-*Acinetobacter baumannii*‡ | 23 (23) | 4 (12)† | 1 (14)† |
| *Pseudomonas aeruginosa* | 7 (15) | 2 (7) | 0 (0)† |
| ESBL-producing *Escherichia coli* | 7 (8) | 3 (9) | 0 (0)† |
| ESBL-producing *Klebsiella pneumoniae* | 4 (5) | 1 (5) | 0 (0)† |

**Intervention to reduce NI clearly impacted the incidence of *MDR-A. buamannii* within 1 year**

# After the intervention…..




Apisarnthanarak A, et al. A multi-faceted infection control intervention to reduce *PDR-A. baumannii* in three ICUs in a Thai tertiary care center. Clin Infect Dis, 2008

# Why Active Surveillance?

- Infections caused by *PDR-A. bua* lly represent the tip of th k.
- Th :12
-

"Modified ASC would be practical in some settings where "Patient being transferred from another hospital is a risk factor for PDR-A. baumannii"


Chan P
Mulin B, Clin Microbiol Infect Dis, 95
McDonald LC, et al. PIDJ, 98
Webster CA, et al. Eur J Clin Microbiol Infect Dis, 98

# Which is the most appropriate site for surveillance *A. baumannii?*

JOURNAL OF CLINICAL MICROBIOLOGY, Nov. 1997, p. 2819–2825 Vol. 35, No.
0095-1137/97/$04.00+0


## Distribution of *Acinetobacter* Species on Human Skin: Comparison of Phenotypic and Genotypic Identification Methods

HARALD SEIFERT,[1]* LENIE DIJKSHOORN,[2] PETER GERNER-SMIDT,[3] NATASCHA PELZER,[1] INGELA TJERNBERG,[4] AND MARIO VANEECHOUTTE[5]

*Institute of Medical Microbiology and Hygiene, University of Cologne, 50935 Cologne, Germany[1]; Department of Medical Microbiology, Leiden University Hospital, 2300 RC Leiden, The Netherlands[2]; Department of Clinical Microbiology, Statens Seruminstitut, 2300 Copenhagen, Denmark[3]; Department of Medical Microbiology, Malmö University Hospital, University of Lund, 205 02 Malmö, Sweden[4]; and Department of Clinical Chemistry, Microbiology and Immunology, Blok A, University Hospital Ghent, 9000 Ghent, Belgium[5]*

Received 2 April 1997/Returned for modification 10 July 1997/Accepted 27 August 1997

TABLE 2. Rates of colonization of various body sites of patients and controls with *Acinetobacter* spp.

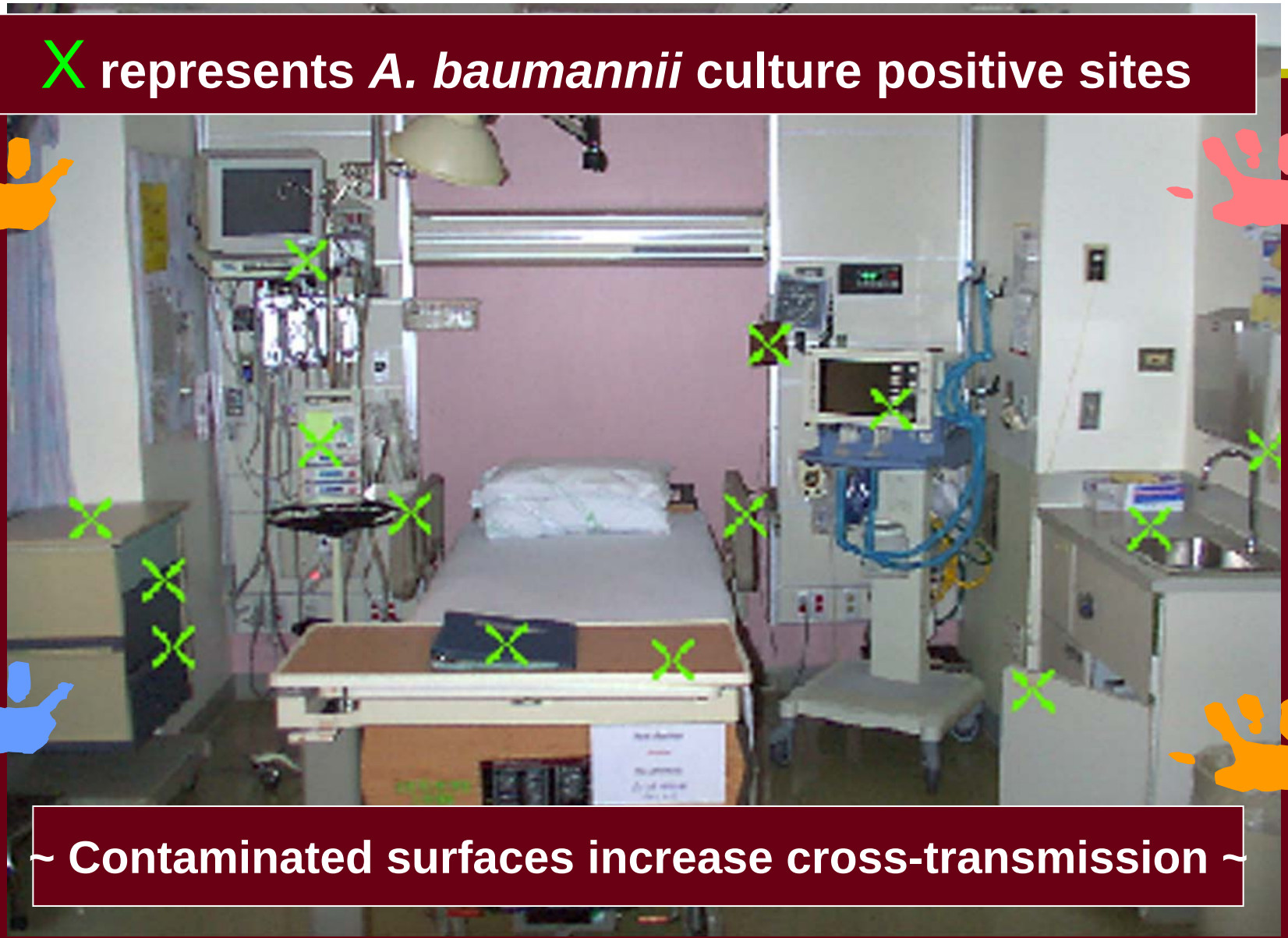
| Body site | No. (%) of patients or controls colonized with *Acinetobacter* spp. | | |
|---|---|---|---|
| | Patients | Controls | Both groups |
| Forehead | 13 (33) | 5 (13) | 18 (23 |
| Ear | 14 (35) | 3 (8) | 17 (21 |
| Nose | 13 (33) | 3 (8) | 16 (20 |
| Throat | 6 (15) | 0 (0) | 6 (8) |
| Axilla | 13 (33) | 1 (3) | 14 (18 |
| Hand | 13 (33) | 8 (20) | 21 (26 |
| Groin | 15 (38) | 5 (13) | 20 (25 |
| Perineum | 8 (20) | 1 (3) | 9 (11 |
| Toe web | 16 (40) | 3 (8) | 19 (24 |
| Total no. (%) of sites colonized | 111 (31) | 29 (8) | 140 (19 |

TABLE 1. Distribution of different *Acinetobacter* spp. identified by phenotypic properties after isolation from the skin and mucous membranes of patients and controls

| Genomic species (DNA group)[a] | No. (%) of *Acinetobacter* strains isolated from: | | |
|---|---|---|---|
| | Patients | Controls | Both groups |
| *A. baumannii* (2)[b] | 2 (1) | 1 (3) | 3 (1.5) |
| *Acinetobacter* sp. 3 | 18 (12) | 2 (6) | 20 (11) |
| *A. junii* (5) | 6 (4) | 3 (10) | 9 (5) |
| *A. johnsonii* (7) | 34 (22) | 6 (20) | 40 (21) |
| *A. lwoffii* (8/9)[c] | 69 (44) | 18 (58) | 87 (47) |
| *Acinetobacter* sp. 10 | 1 (1) | 0 (0) | 1 (0.5) |
| *A. radioresistens* (12) | 22 (14) | 0 (0) | 22 (12) |
| Unidentified | 3 (2) | 1 (3) | 4 (2) |
| Total no. of isolates | 155 | 31 | 186 |

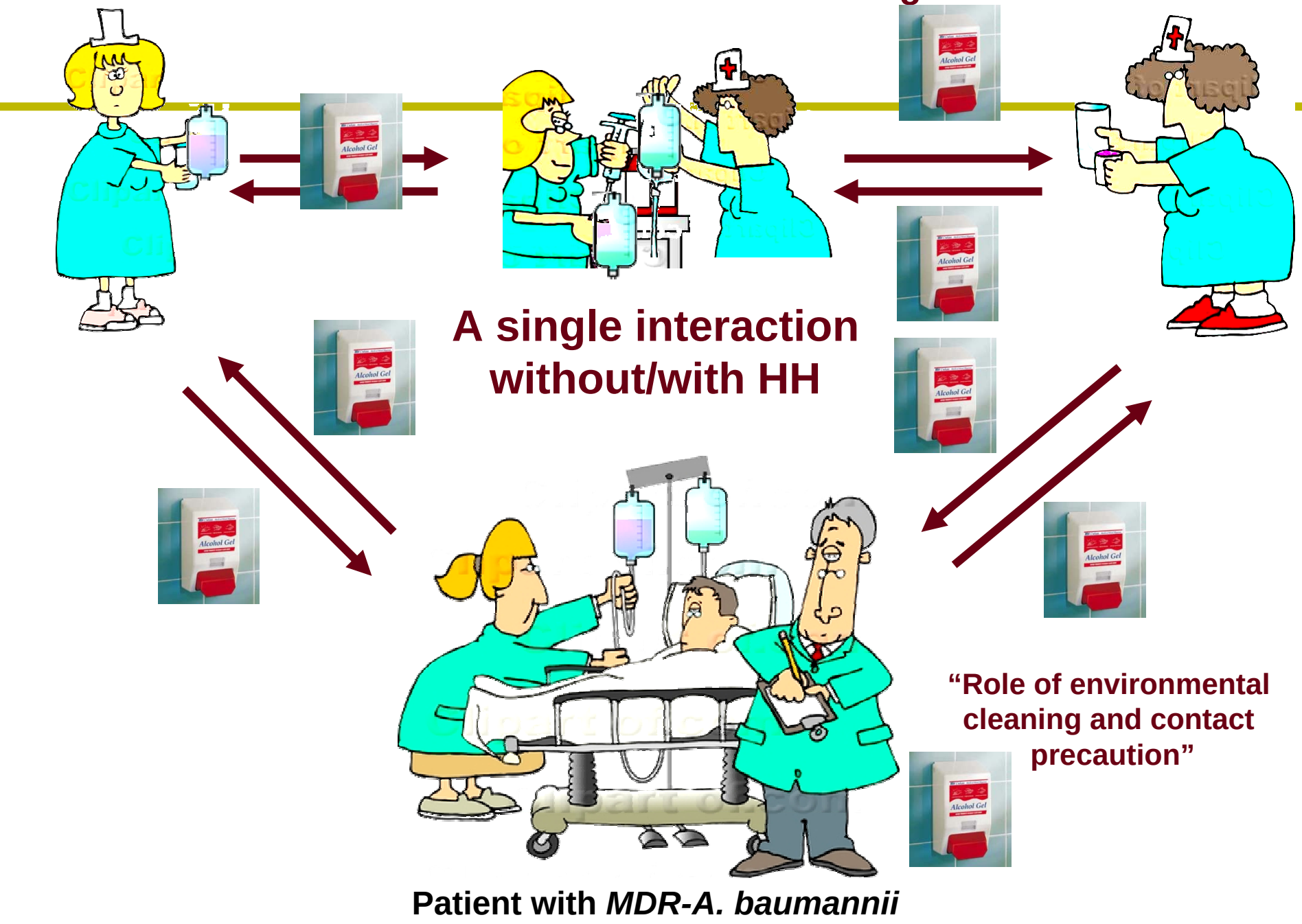
# The Inanimate Environment Can Facilitate Transmission

X represents *A. baumannii* culture positive sites



~ Contaminated surfaces increase cross-transmission ~

# “Role of environmental cleaning”




**A single interaction without/with HH**

**“Role of environmental cleaning and contact precaution”**

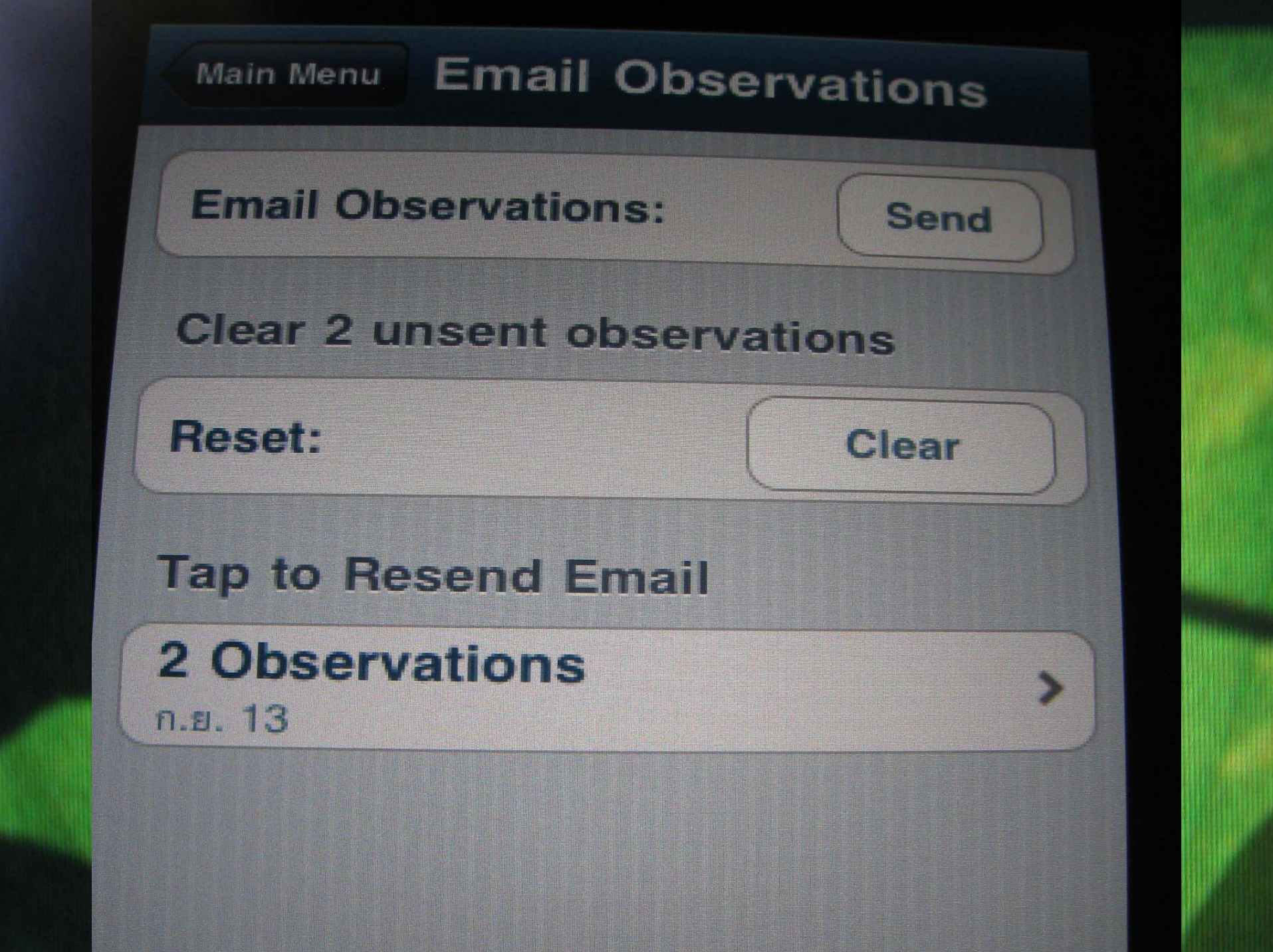
**Patient with *MDR-A. baumannii***

# Interactions

| From | To | Interventions |
|---|---|---|
| 1. HCW's Hand | Environment | HH |
| 2. Environment | HCW's Hand | HH |
| | | Environment cleaning |
| 3. HCW's Hand | Patient | HH |
| | | Contact Isolation |
| 4. Patient | HCWs Hand | HH |
| | | Contact isolation |
| | | Environment cleaning |

**HH = Hand hygiene**

# Monitoring for 5 Moment Hand Hygiene


Main Menu
Email Observations
Email Observations:
Send
Clear 2 unsent observations
Reset:
Clear
Tap to Resend Email
2 Observations
ก.ย. 13

# Why Sodium Hypochlorite?

- Several studies have utilized sodium hypochlorite to control *MDR-A. baumannii* outbreak successfully.
- Floor cleaning with detergent did not effect the NI rates.
- Quaternary ammonium compound was reported to be inadequate to clean bathroom and toilets.

**Denton M, et al. JHP, 2004**
**Pimental JD, et al. JHP, 2005**
**Das I, et al. JHP, 2002**
**Danforth D, et al. JHP, 2007**

# Adverse Effect from Sodium Hypochlorite

- Damage HCW's skin

- Damage hospital floor

# Descending Order of Resistance to Germicidal Chemicals

**Bacterial spores**

*B. subtilis*

Clostridium sporogenes

**Mycobacteria**

*M. tuberculosis* var. *bovis*

**Non-lipid or small viruses**

Polio virus, rhinovirus, norovirus

**Fungi**

Trichophyton, Candida

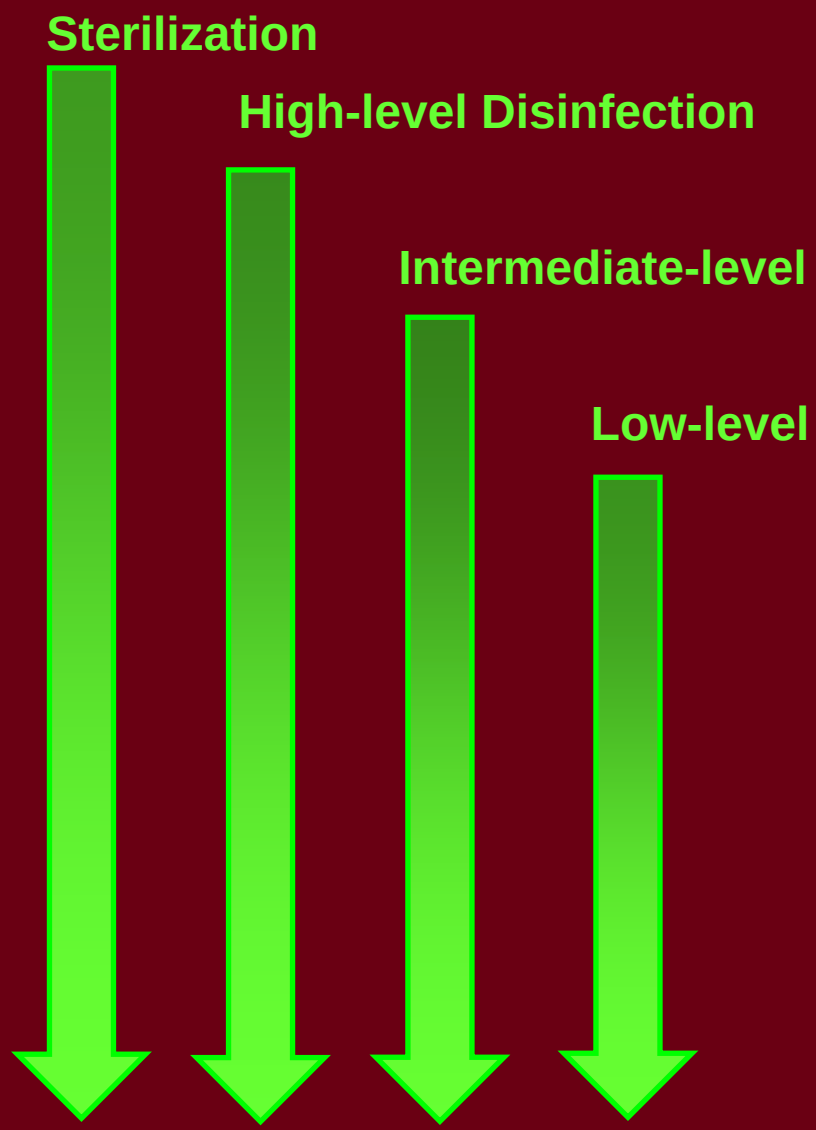
Cryptococcus

**Vegetative bacteria**

Pseudomonas, staphylococci (MRSA), enterococci (VRE)

**Lipid or medium-sized viruses**

HBV, HIV, HCV, HSV, CMV, Ebola



# Creating cohort area to limit transmission of *PDR-A. baumannii* in a medical unit

- October 2007, first case of *PDR-A. baumannii* was detected in a medical unit. The nurse to patient ratio was 1: 8 in this medical unit.
- IC measured were implemented within 24 hours including 1) enhanced contact isolation, 2) ASCs, 3) environmental cleaning, 3) enhanced hand hygiene program
- During period 1 (4-28 October), 6 cases of *PDR-A. baumanii* were detected by ASCs; infection and colonization rate 2.4/1000 patient-days & acquisition rate 6/1000 patient-days.

**Apisarnthanarak A, et al. Creating cohort area to limit transmission of *PDR-A. baumannii* in a medical unit. CID, 2009**

# Developing IC Intervention Need to Understanding Human Behavior

VDO Clips

# Toilet without Intervention

# Toilet with Intervention

# Toilet with Intervention

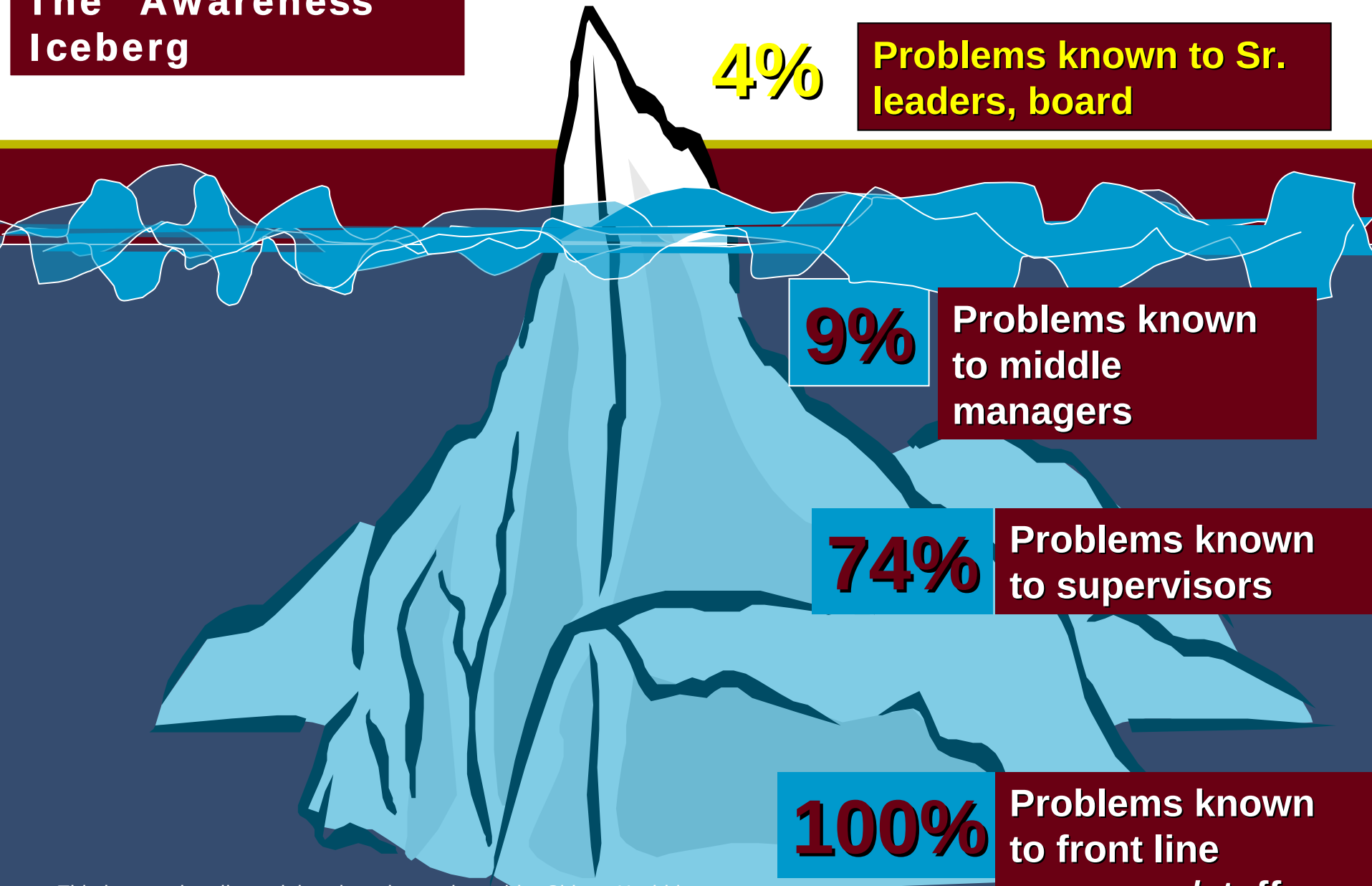
# Will you wash you hand, if you see your hand like these pictures?

**We need to have faith for believing that it is possible to IC Compliance**

"Positive Deviance"

VDO Clip

# The "Awareness" Iceberg




This internationally acclaimed study conducted by Sidney Yoshida, was initially presented at the International Quality Symposium, Mexico city, 1989. It indicated how management's failure to understand its processes and practices from the perspective of its customers, suppressed the company's profits by as much as 40%.



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Front line workers: experts at the work they do, decide HOW to do work, & foster self-discovery among peers; owners

Leadership and middle managers support and filter ideas, and remove barriers for implementation of practices from frontline workers

PD



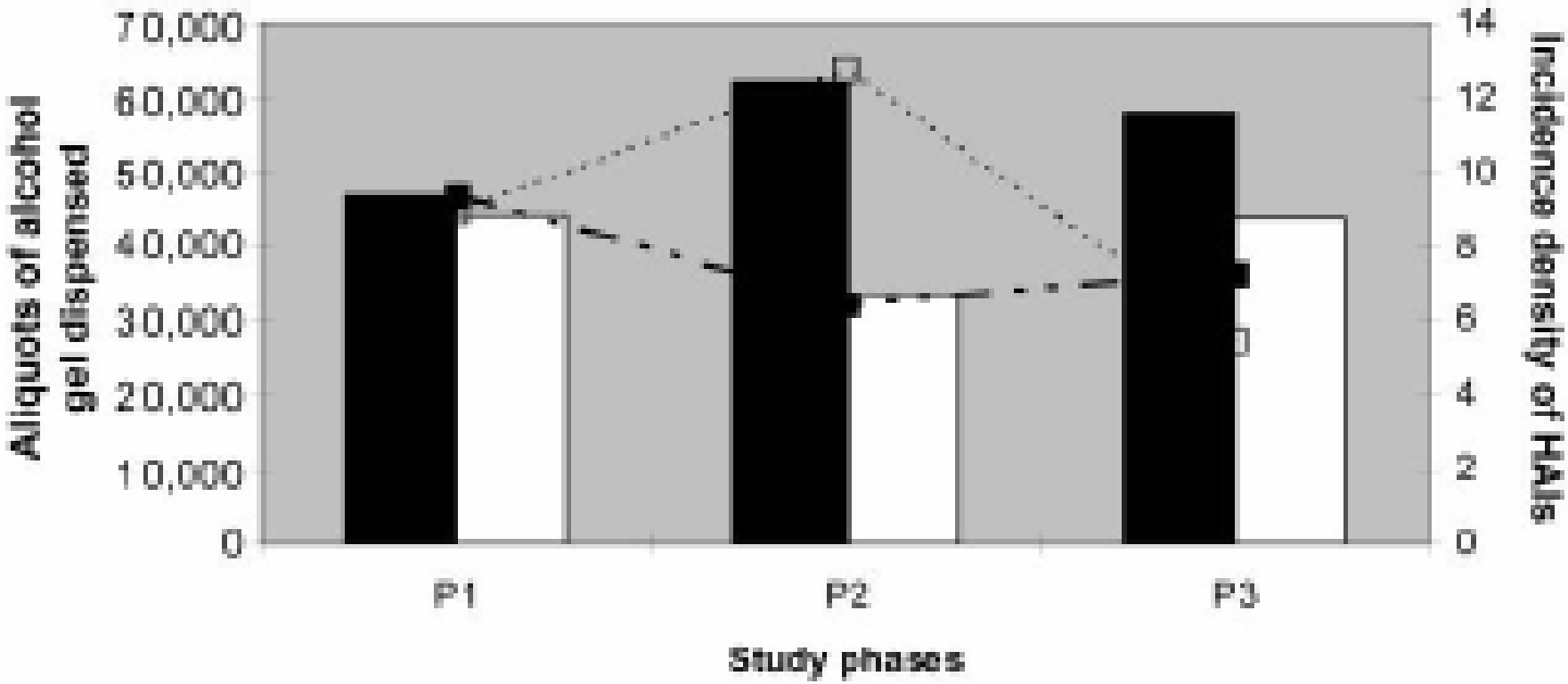
48

# Steps for PD implementation

1: Don’t presume you have the answer.
2: Don’t think of it as a dinner party.
3: Let them do it themselves.
4: Identify conventional wisdom.
5: Identify and analyze the deviants.
6: Let the deviants adopt deviations on their own.
7: Track results and publicize them.
8: Repeat steps 1 through 7.

# Positive deviance (PD)

*"PD program was implemented by identifying colleagues that were highly compliant with hand hygiene. All HCWs attended PD meetings. At these meetings, we have representative HCW from each shift. During the meetings the PD discuss problems that they notice (e.g., Dr. X did not handwash their hands during the patient examination). We discuss ways to stimulate talking to noncompliant individuals in a positive manner. No humiliation is permitted. The positive deviants are also given the opportunity to express their feeling, to discuss among them what needs to be changed, what needs to be improved, what is to be taken as a good example. We encourage them to invite another positive deviant to the next meeting."* *Alex Marra, MD*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50,000
40,000
30,000
20,000
10,000
0
Aliquots of alcohol gel dispensed
14
12
10
8
6
4
2
0
Incidence density of HAIs
P1
P2
P3
Study phases
East SDU: alcohol gel aliquots dispensed/1,000 patient-days
West SDU: alcohol gel aliquots dispensed/1,000 patient-days
East SDU: incidence density of HAIs/1,000 patient-days
West SDU: incidence density of HAIs/1,000 patient-days


COHORT SECTION

# Creating cohort area to limit transmission of *PDR-A. baumannii*

- During period 2 (November 07-January 08): a cohort area was created in an assigned section, educational session on HH adherence and real-time feedback on IC processes. One nurse/shift was assigned to the cohort area.

- The infection and colonization rate 0/1000 patient-days ($P = 0.05$). *PDR-A. baumannii* acquisition rate was 1/1000 patient-days ($P < 0.001$).

**Apisarnthanarak A, et al. Creating cohort area to limit transmission of *PDR-A. baumannii* in a medical unit. CID, 2009**

# What Zero Looks Like: Eliminating Hospital-Acquired Infections

Related Information
› Prevent Surgical Site Infections

In January 2005 Thammasat University Hospital, a 500-bed teaching hospital in central Thailand, began a three-year project to eliminate pandrug-resistant *Acinetobacter baumannii* (PDRAB), a Gram-negative bacteria intrinsically resistant to most antibiotics that is a significant source of HAIs in Thailand, particularly in ICUs. After an initial data analysis, a team led by Anucha Apisarnthanarak, MD, devised an action plan in the hospital's three ICUs consisting of the following:

- Gowns and gloves used during all patient care, plus scrupulous hand hygiene both before and after patient contact in all ICUs;
- Screening for PDRAB upon ICU admission and every seven days until discharge;
- Cohorting of colonized or infected patients; and
- Sanitizing surfaces with 1:100 solution of sodium hypochlorite (later changed to detergents and ammonia due to the corrosive effect on skin and surfaces).

The hospital encouraged compliance using educational sessions, wall posters, and monthly feedback to staff. Infection control specialists monitored both caregivers and housekeepers as they went about their jobs. The result: four months — two of them consecutive — with zero colonization or infection. Overall, the rate was reduced from 3.6 cases per 1,000 patient days before the intervention to 0.85 cases at the end of 2007.

Since then, Apisarnthanarak and his team have continued the protocol, minus the active screening, and infection rates have remained stable. The effort, he says, shows that "in a resource-limited setting where there is not much technology, simple and easily implemented infection control can reduce even the most drug resistant microorganism."

# In which settings do these strategies work?

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**These strategies might not work in hospitals settings that cannot follow Ningtingale's suggestion.**

# Examples of those settings

# What to do to Control *MDR-Acinetobacter* in Resource-Limited Settings?

## Resource-full

- Molecular epidemiology
- Environmental culture
- Active Surveillance
- Enhanced environmental cleaning
- Enhanced isolation precaution
- Antibiotic management

## Resource-Limited

- Stratified unit specific infection rate
- Line listing and/or case-control study (identify common source outbreak)
- Implement emergency measure for highly alert pathogen
- Initial environmental culture (per finding from line listing)
- Modified ASC
- Enhanced isolation precaution
- Environmental cleaning
- Antibiotic management program

# Conclusions

- Infection Control intervention is crucial to help reduce MDR-microorganisms in developing country.
- Infection Control component must be modified to fit each setting & infrastructure.
- Integration of multi-faceted infection control program can successfully reduce MDR-microorganisms.
- Monitoring of adherence to infection control component is important to help sustain reduction of MDR-microorganisms.
- Additional studies on infection control interventions and behavior science to reduce MDR-microorganisms are needed.

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Thank you for your attention