

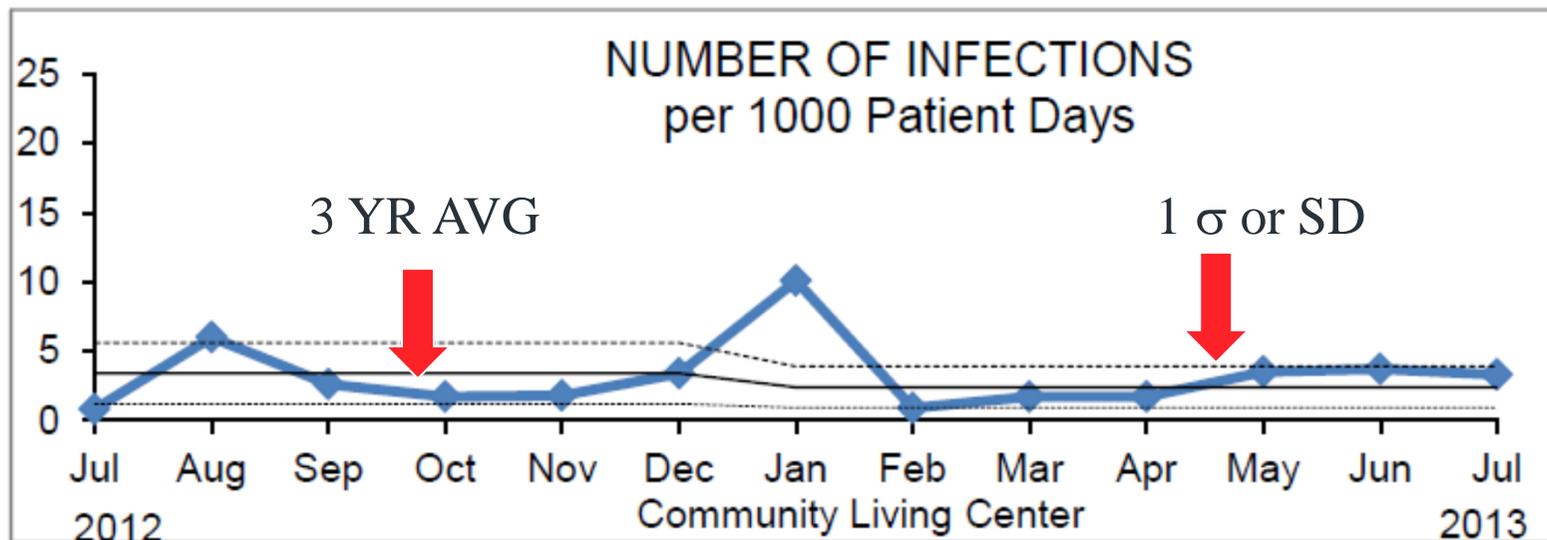
# **Multifaceted Approaches for MDRO Outbreak Control**

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# LTCF Surveillance

## When Do You Have an Outbreak?

### COMMUNITY LIVING CENTER



Month	July 12	Aug 12	Sept 12	Oct 12	Nov 12	Dec 12	Jan 13	Feb 13	Mar 13	April 13	May 13	June 13	Jul 13
# infx	1	7	3	2	2	4	12	1	2	2	4	4	4
Pt days	1164	1163	1149	1168	1121	1171	1181	1065	1169	1172	1141	1086	1191
Rate	0.8	6.0	2.6	1.7	1.8	3.4	10.1	0.9	1.7	1.7	3.5	3.7	3.3

Wiemken T. APIC Online Textbook, Chapter 6; Sellick JA. ICHE 14:649.  
Sellick JA. ICHE 1993;14:649

# Isolation Systems in LTCF

## What is Ideal?

- Effective
- Transmission-based
- Isolates all pts with transmission potential
- Avoids over-isolation
- Easily comprehended, implemented
- Compliance high
- Inexpensive
- Minimize interference pt care and comfort

# Preventing the Spread of MDROs

## Lots of Options!





**Vertical vs Horizontal**

# Infection Prevention Approaches

- Vertical
  - organism specific interventions
  - active surveillance testing (AST)
  - isolation carriers
  - specific antimicrobials
    - topical (mupirocin) agents, e.g., MRSA
    - oral (enteral decontamination) agents, e.g., GNB
- Horizontal
  - interventions directed to prevent all infections
  - standard precautions
  - hand hygiene
  - universal bathing - chlorhexidine (CHG)



# A Focus on Bundles

# Contact Isolation in LTCF VRE Colonization N (%)

	1997	1998	1999
<b>All</b>	<b>40 (2.2)</b>	<b>26 (1.4)</b>	<b>9 (0.5)</b>
<b>Hospitals</b>	<b>10 (6.6)</b>	<b>9 (5.5)</b>	<b>0</b>
<b>LTCF</b>	<b>30 (1.7)</b>	<b>17 (1.0)</b>	<b>9 (0.5)</b>

Ostrowsky et al. *N Engl J Med* 2001;344:1427.

# VRE in LTCF

## Contact Isolation Alone?

- Admission screening
- Strict isolation to room at all times (9%)
- Modified CDC recommendations (91%):
  - ✓ participate group activities if:
  - ✓ wash hands, continent stool,
  - ✓ contained body fluids
  - ✓ clean equipment (chairs) outside room
  - ✓ waterless disinfection workers/pts
- Hospitals - VRE infection/colonization decreased
- NH – fewer VRE + admissions, transmissions infection?

**Ostrowsky et al. N Engl J Med 2001;344:1427.**

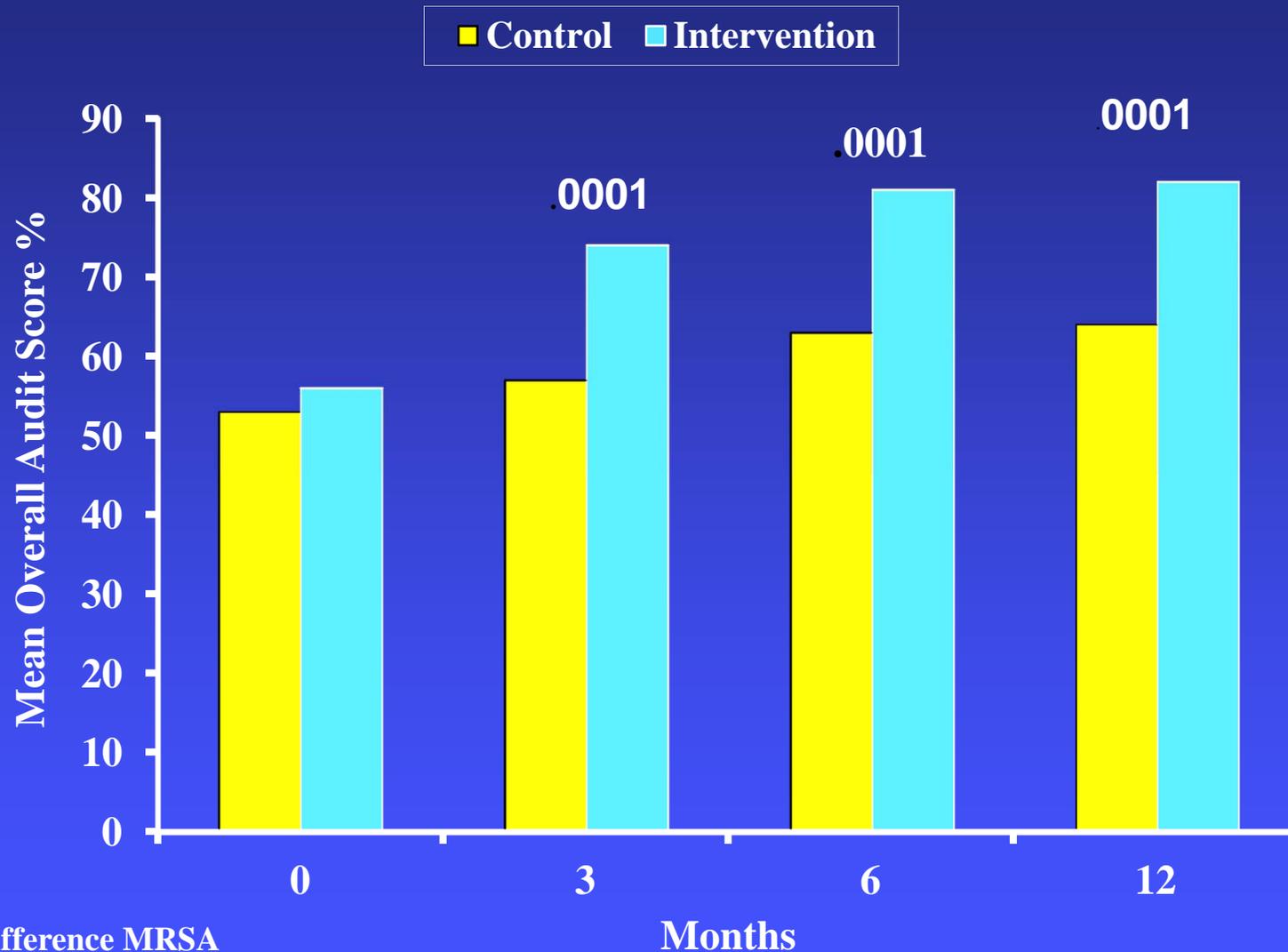
# MRSA in LTCF

## Impact Education & Audits

- Cluster randomized trial of 32 LTCF
- 10 standards addressed
  - wounds, catheters, enteral tubes
  - hand hygiene & PPE
  - sharps/waste
  - kitchen
  - environment & equipment
  - linens
- Education vs usual practice
  - written reports 0,3,6,12 months
  - lectures, practical demonstrations
  - appointment trained unit champions
- Primary outcome = MRSA prevalence
- Secondary outcome = change audit scores

**Baldwin NS et al. J Hosp Infect 2010;76:36-41.**

# Infection Control Practice Impact of Audits



No difference MRSA

Hand hygiene, environmental cleaning poor

# MRSA in LTCF

## Decolonization

- Cluster Randomized Control Trial
- Intervention 53 NH (2338) vs 51 NH (2412)
- All staff education standard precautions
- All residents screened, readmission, & 12 mo
  - nares, groin, wounds, catheter urine
- Intervention
  - decolonization
  - environmental disinfection

Bellini C et al. ICHE 2015;36:401

# MRSA in LTCF

## Decolonization

- Decolonization
  - nasal mupirocin tid x 5 days or bacitracin/neomycin
  - chlorhexidine
    - shower & dental prosthesis (daily)
    - shampoo days 1 & 5
    - oral rinse bid x 5 days
    - wounds stage 2 or 3 daily or povidone iodine
- Environmental disinfection
  - daily disinfection room 70% alcohol
  - change linens days 1 & 5
  - change clothes daily
- Re-culture 7 days post decolonization
  - two cultures negative 7 days apart

Bellini C et al. ICHE 2015;36:401

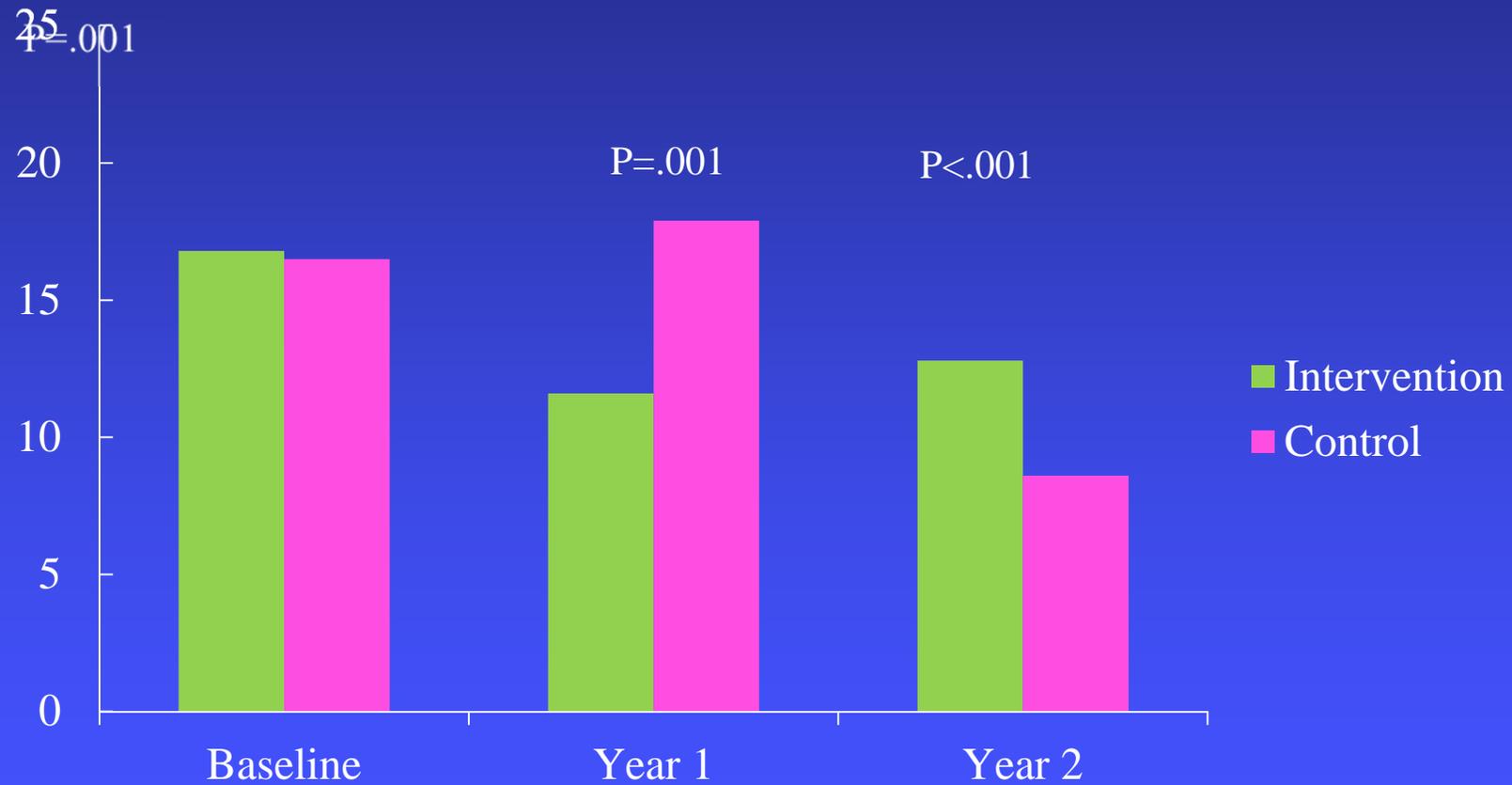
# MRSA in LTCF

## DERAIL Trial

- Randomized Control Trial in 3 LTCF (12 units)
- Contact isolation only if clinical cultures (+)
- Standardized infection control reporting and disinfection
- All residents screened by PCR nares on admission & discharge
- Control units – no intervention
- Intervention units (repeat 1 month later)
  - MRSA carriers
  - nasal mupirocin bid x 5 days
  - chlorhexidine bath once weekly
  - disinfection rooms, common areas, equipment once weekly
- Increasing mup resistance (retapamulin or minocycline + rif)
- Comingling of ward residents

Schora DM et al. AJIC 2014;42:S269

# MRSA in LTCF Decolonization



# MRSA in LTCF

## Decolonization

- Proportion screened – 89% both homes
- Completed study – 89% residents both homes
- No difference baseline characteristics
- Baseline MRSA colonization 8.9% (range 0-43%)
- No mupirocin resistance
- MRSA declined both groups (not significant)
  - Intervention            8.9 to 5.8%, p=.003
  - Control                    8.9% to 6.6%, p=0.02

Bellini C et al. ICHE 2015;36:401

# **KPC Outbreak in LTACH Bundle Approach**

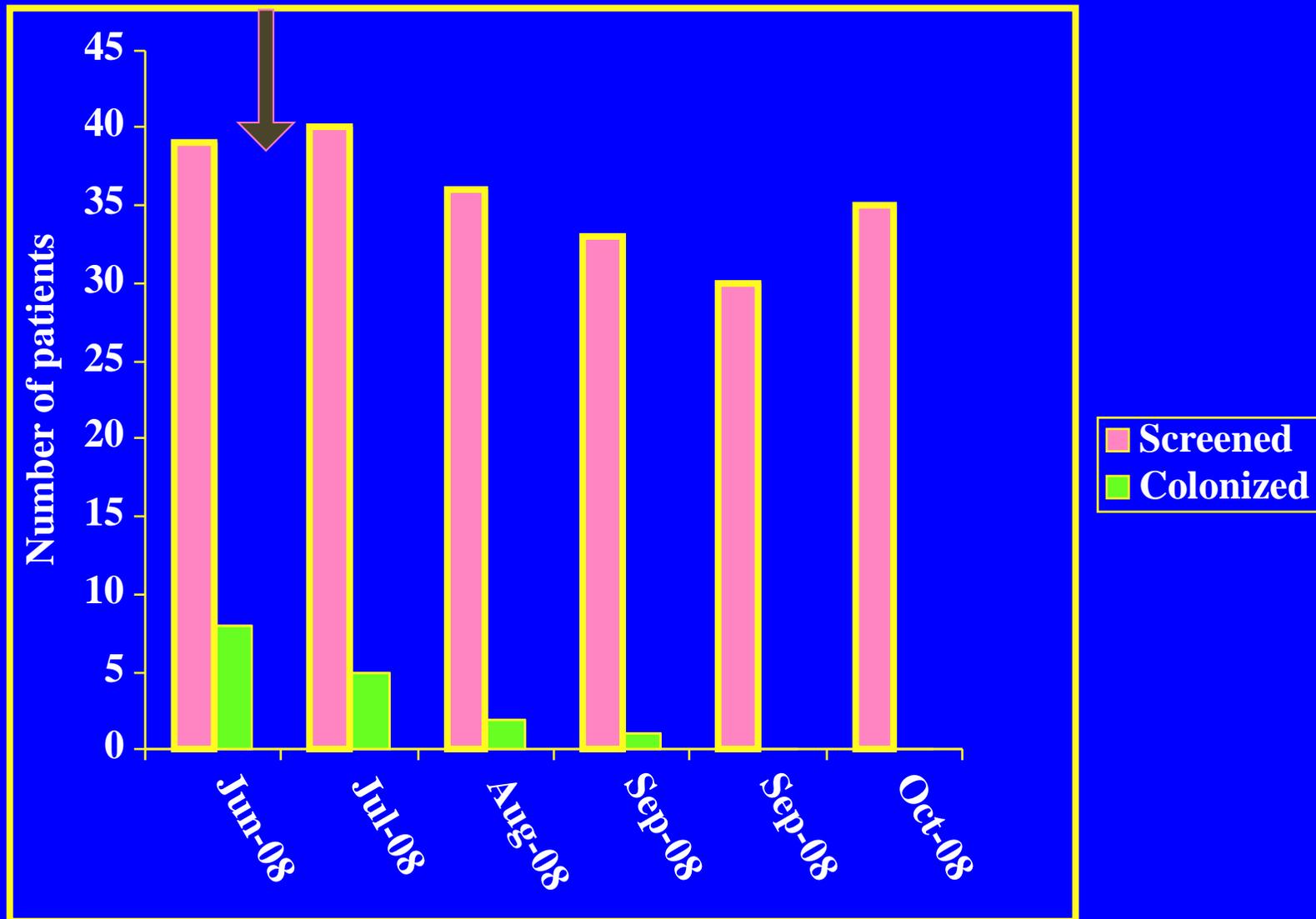
- **Quasi-experimental single center study**
- **Colonization prevalence 21%**
  - I or R ertapenem or imipenem
  - confirm KPC by MHT & PCR
  - clonality by PFGE
- **Patient screening**
  - all pts 2% chlorhexidine baths daily & audited
  - admission cultures nares, rectum, wounds, devices
  - rectal point prevalence surveys on 5 occasions

**Munoz-Price LS et al. ICHE 2010;31:341-347.**

# KPC LTACH Outbreak Bundle Approach

- **Isolation**
  - contact isolation high risk patients regardless KPC status
    - **tracheostomy, dialysis, known MDRO**
  - contact isolation low risk patients if KPC+
  - cohort or single rooms
  - designated equipment
- **Enhanced environmental cleaning/training**
  - quaternary ammonium wipes and sprays (no buckets)
  - clean all surfaces close to patient
  - do KPC rooms at the end of the day
  - environmental cultures one week after implementation
- **KPC training – physicians, nurses, aides, therapists**

# KPC Outbreak in LTACH Bundle Approach



Munoz-Price LS et al. ICHE 2010;31:341.

# CR-AB in LTACH Bundle Approach

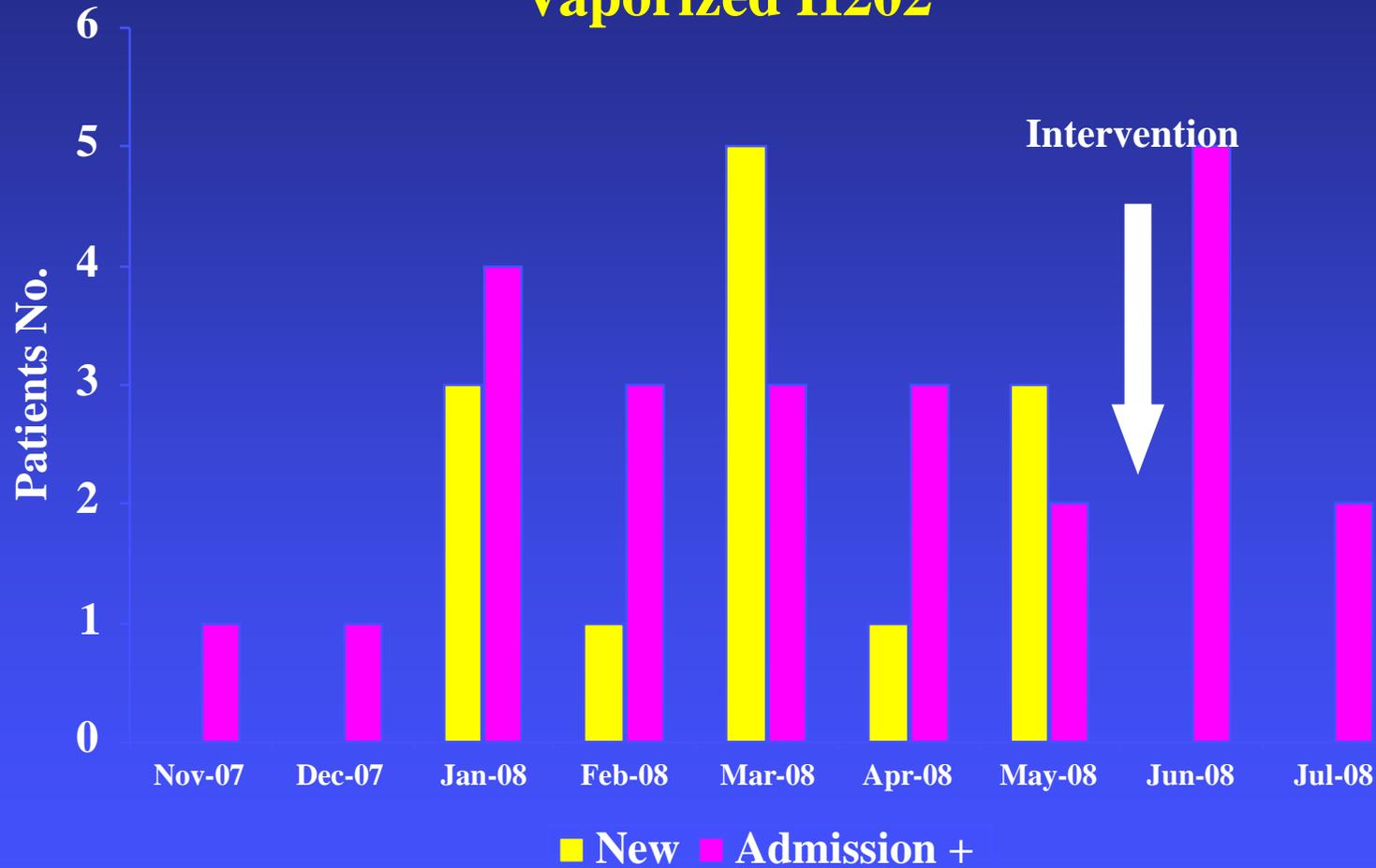
- Jan 2008 - MDR *A. baumannii*
- CRAB 10/13 pts, mortality 14%
  - wounds, blood, sputum, urine
  - pulsatile wound cleaning stopped
- Initial interventions (Feb-May 2008)
  - weekly staff meetings
  - hand hygiene & PPE
  - droplet & contact isolation
  - environmental cleaning
  - point prevalence survey

Ray A et al. ICHE 2010:31:1236

# CR-AB in LTACH Bundle Approach

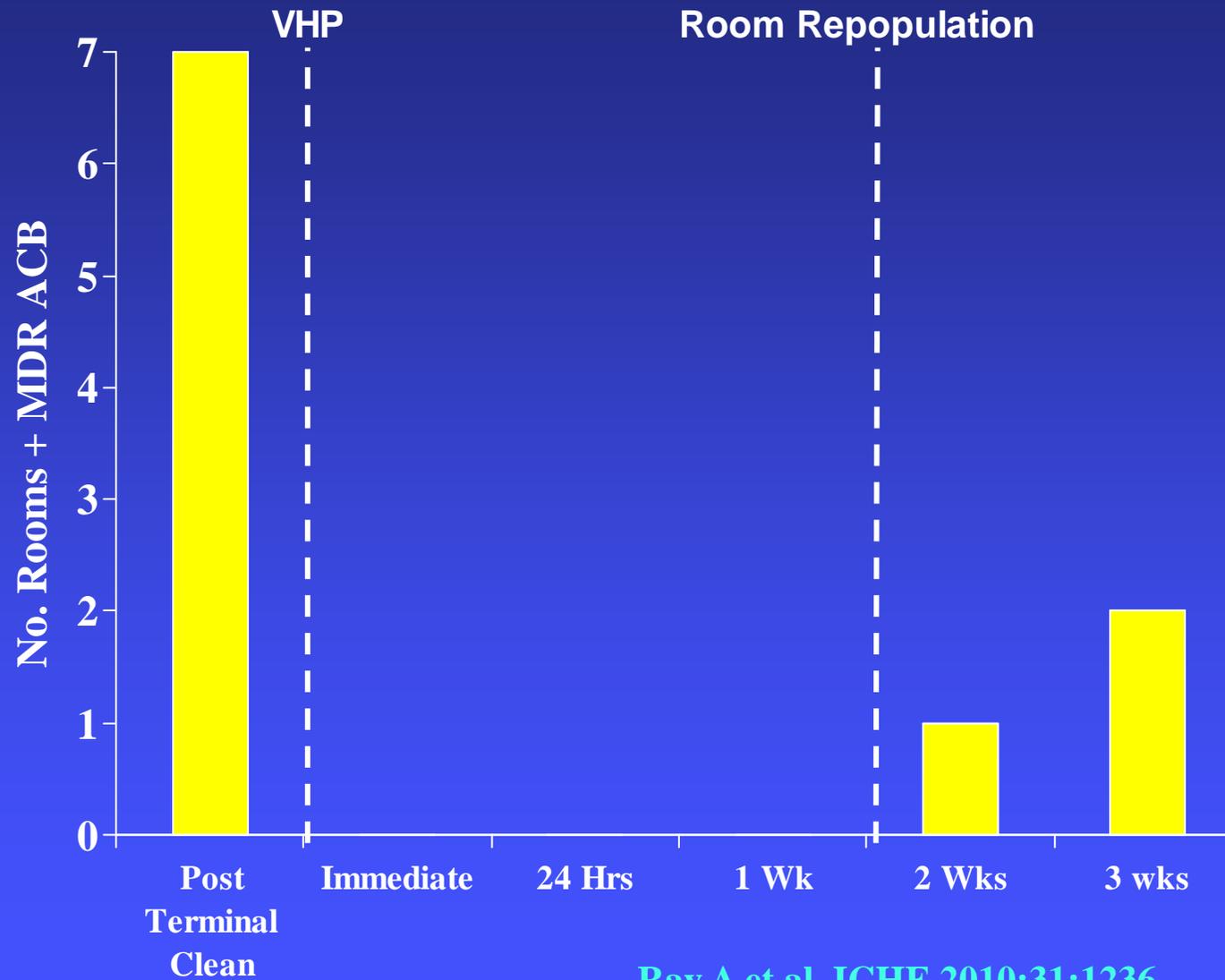
- **Ward closed 4/7/2010**
- **Environmental survey (8/93 samples CRAB +)**
  - **rooms bedside table, bedrails, call buttons (7/8)**
  - **charts, computers, medication carts**
  - **pt & environmental isolates monoclonal by PCR**
- **H2O2 vapor decontamination**
  - **environmental cleaning**
  - **environmental cultures 0, 24 hrs, 1-2 wks**
- **Active surveillance thereafter**
  - **wounds, respiratory, peri-rectal**

## MDR *A. baumannii* Outbreak in LTCAH Vaporized H2O2



Ray A et al. ICHE 2010;31:1236.

# Enviromental MDR ACB Effect of Vaporized H2O2



Ray A et al. ICHE 2010;31:1236.

# CRE Outbreak in LTACH March 2009-February 2011

- CRE transmissions (n=99)
  - possible (n=65)
  - probable (n=34)
  - bacteremia (21%)
- Organisms
  - *K. pneumoniae* (91%)
  - *E. aerogenes* (4%)

Chitnis A et al. ICHE 2012;33:992

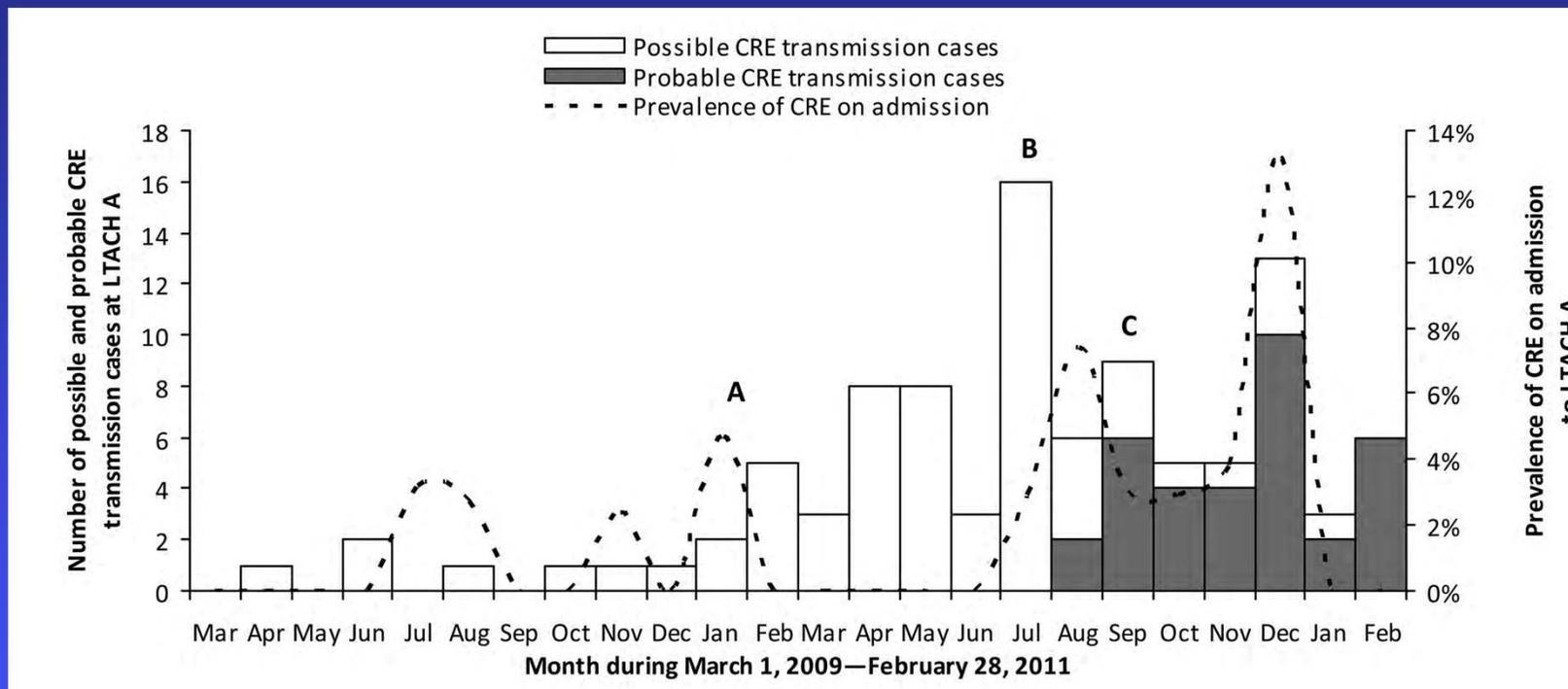
# CRE Outbreak in LTACH March 2009-February 2011

- Micro data reviewed for carbapenem<sup>R</sup>
- July 2009
  - MHT all carbapenem<sup>R</sup> Enterobacteriaceae
- January 2010
  - all admissions placed in contact isolation
  - screened in urine & sputum by 3 days
  - CRE (+) remain in isolation for entire stay
- July 2010
  - all admissions screened by rectal swab
  - audit HH & PPE with monthly education HCW
  - reinforce surface cleaning & disinfection

# CRE Outbreak in LTACH March 2009-February 2011

- September 2010
  - all CRE (-) pts biweekly rectal swabs
- December 2010
  - cohort CRE separate ward & dedicated nursing
  - daily staff meetings
- February 2011
  - all CRE tested by PFGE & PCR *bla*<sub>KPC</sub>
- March 2011
  - daily audits HCW HH, PPE, device need & use
- April 2011
  - biweekly conference calls, dedicated equipment & ICU staff

# CRE Transmission in LTACH



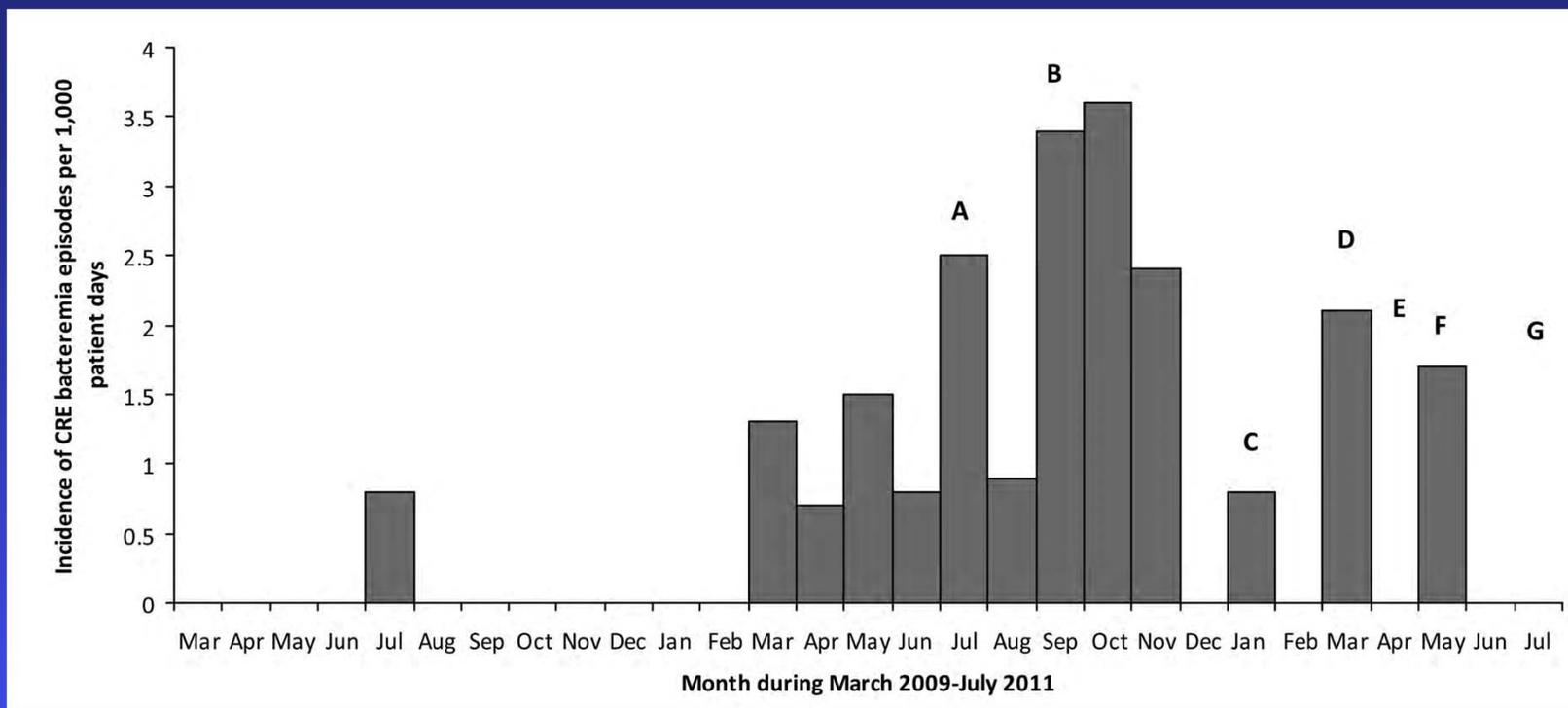
A = urine & sputum cultures

B = rectal cultures

C = rectal swabs biweekly point prevalence surveys

**Chitnis A et al. ICHE 2012;33:984**

# Incidence CRE Bacteremia in LTACH



A = HH & PPE audits

B = Biweekly point prevalence surveys

C = Cohort ward/dedicated staff for CRE

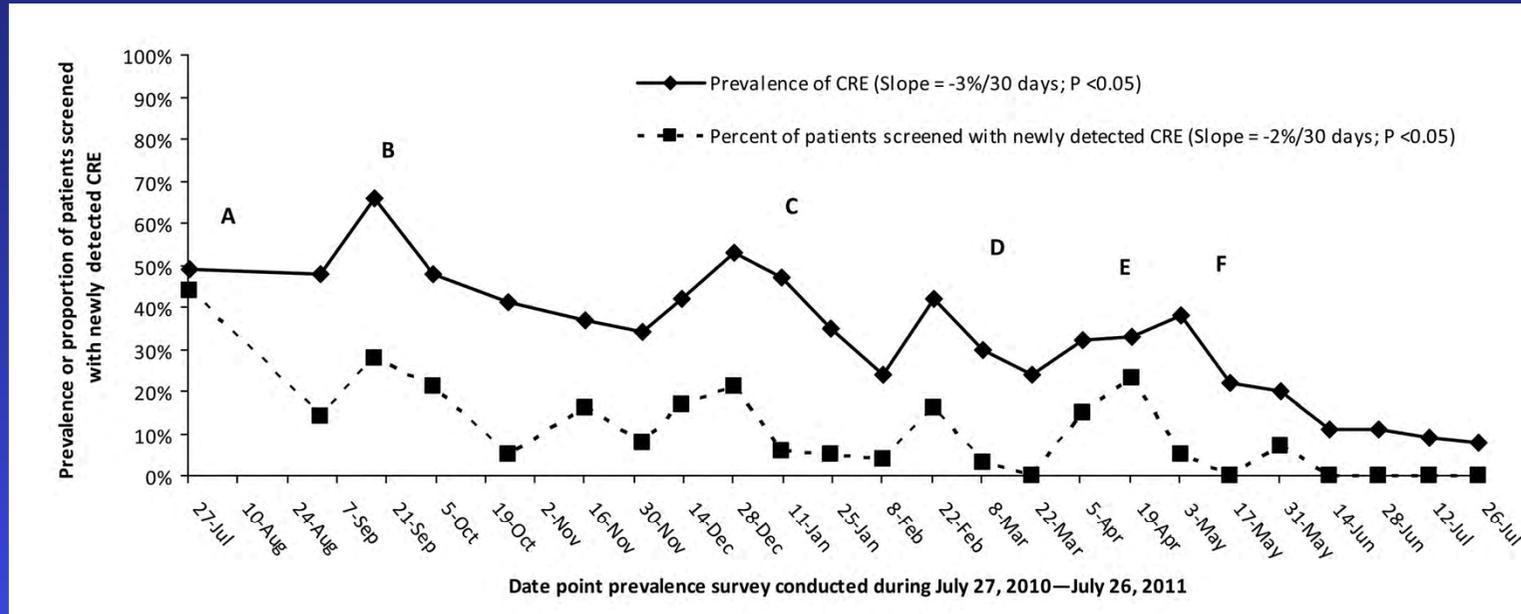
D = Daily audits device need

E = Weekly conference calls public health

F = Dedicated ICU nurses & equipment non-ICU CRE pts

G = Outbreak stops

# New CRE Detected by Biweekly Surveillance



A = HH & PPE audits

B = Biweekly point prevalence surveys

C = Cohort ward/dedicated staff for CRE

D = Daily audits device need

E = Weekly conference calls public health

F = Dedicated ICU nurses & equipment non-ICU CRE pts

G = Outbreak stops

# CRE in LTACHs

## Transmission & Prevention

- 4 LTACHs - KPC outbreak
- Bundle Intervention (2012-2013)
  - admission screening rectal swabs
  - point prevalent survey every other week
  - daily 2% chlorhexidine baths all residents
  - hand hygiene monitoring
  - education KPC & infection prevention
- Carriage (primary outcome)
  - rectal carriage screened - ertapenem disk
  - KPC confirmed by PCR *bla*<sub>KPC</sub>
- Clinical cultures
  - *Klebsiella* or *E. coli* I or R to imipenem

Hayden MK et al. Clin Infect Dis 2015;60:1153

# CRE in LTACHs

## Transmission & Prevention

- Cohorting
  - LTACHs A - C mixed cohort & shared staff
  - LTACH B - single rooms & shared staff
  - LTACH D – designated ward & staff
- Transmission Model (Markov)
  - cohort ward or single rooms limit transmission

Hayden MK et al. Clin Infect Dis 2015;60:1153;  
Haverkate M et al. ICHE 2015;36:1148

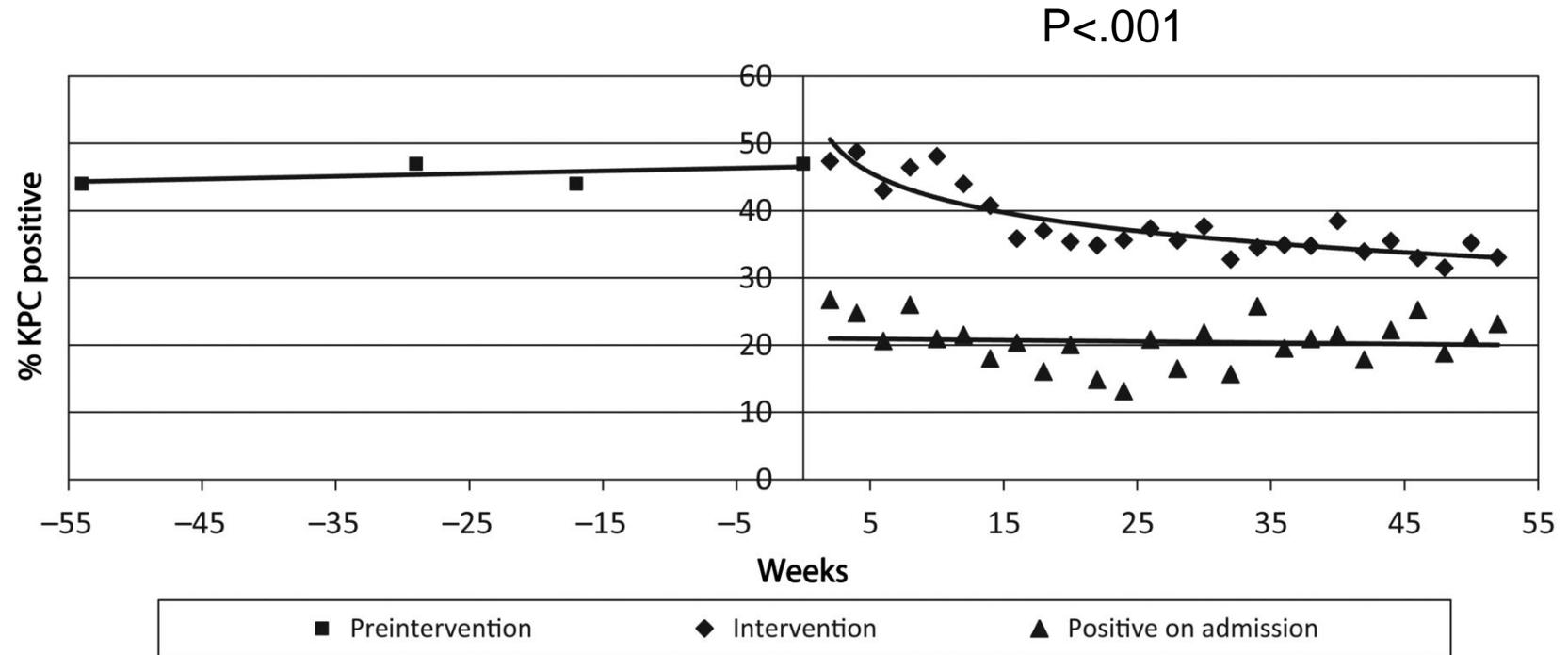
# CRE in LTACHs

## Adherence to Bundle

Adherence Measure	No. Adherent/No. Opportunities	% Adherence	95% CI
Collection of admission surveillance swabs <sup>a</sup>	2872/3152	91.1	90.1–92.1
Collection of every other week surveillance swabs	5072/5316	95.4	94.8–96.0
KPC-positive patient-days on a cohort floor or in a private room <sup>b</sup>	17 921/19 295	92.9	92.5–93.2
HCW hand hygiene adherence at room entrance	365/1499	24.4	22.2–26.6
HCW hand hygiene adherence at room exit	1304/1843	70.8	68.6–72.8
Donning gloves and gown before room entry <sup>c</sup>	387/489	79.1	75.3–82.5

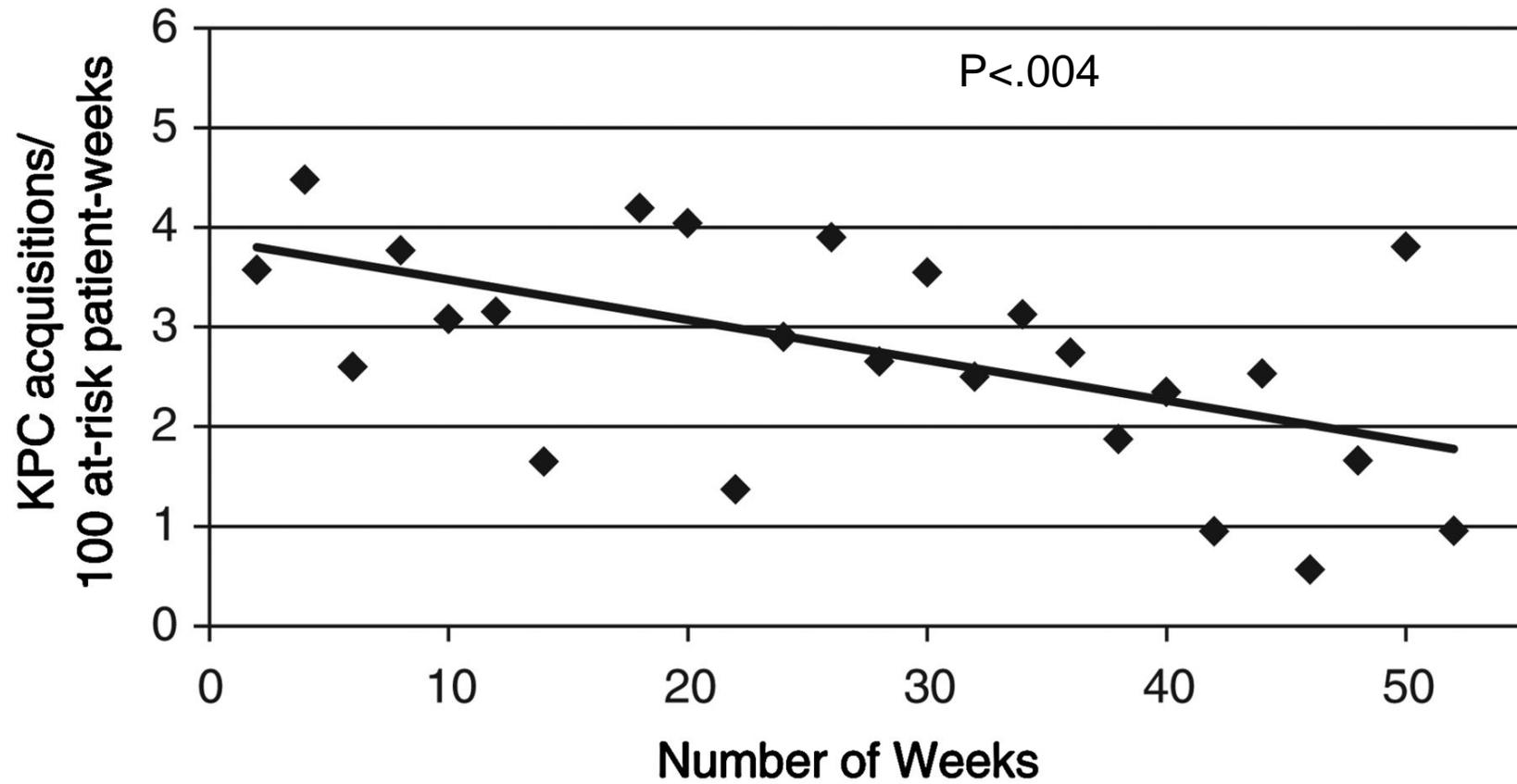
Hayden MK et al. Clin Infect Dis 2015;60:1153

**Prevalence rate of Klebsiella pneumoniae carbapenemase-producing Enterobacteriaceae (KPC) rectal colonization during the preintervention and intervention periods.**



**Hayden MH et al. Clin Infect Dis. 2015;60:1153-1161**

**Incidence rate of Klebsiella pneumoniae carbapenemase-producing Enterobacteriaceae (KPC) rectal colonization during the intervention period.**



Hayden MK et al. Clin Infect Dis. 2015;60:1153-1161

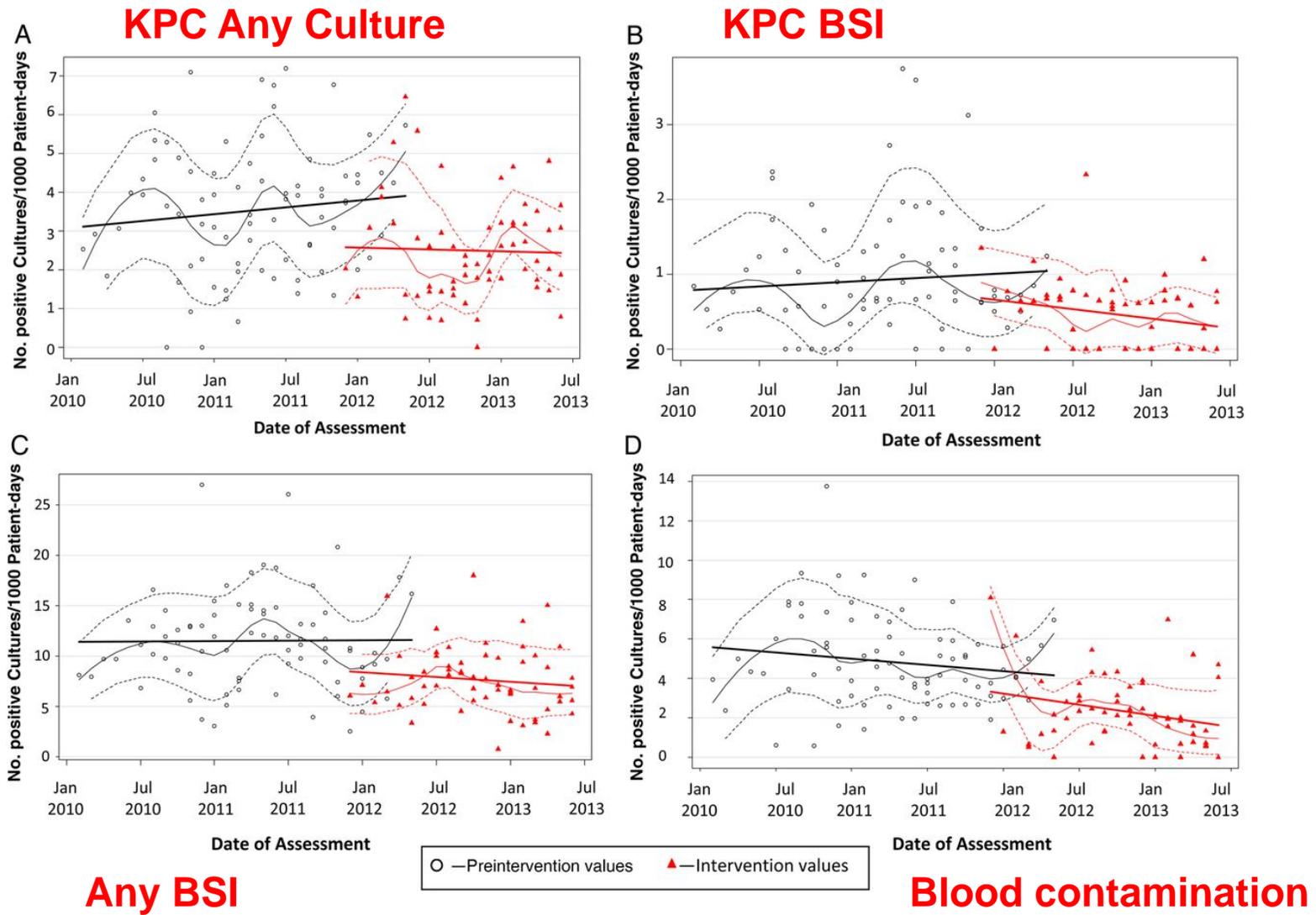
# CRE in LTACHs Impact Bundle on Cultures

**Table 3. Effect of Intervention Bundle on Clinical Cultures and Blood Culture Contamination**

Outcome	Preintervention <sup>a</sup>			Intervention <sup>a</sup>			Change in Event Rate	<i>P</i> Value
	No. of Events	Events/1000 Patient-days	95% CI	No. of Events	Events/1000 Patient-days	95% CI		
KPC in any clinical culture	656	3.7	3.4–4.0	285	2.5	2.2–2.8	–1.2	.001
KPC bloodstream infection	165	0.9	.8–1.1	48	0.4	.3–.5	–0.5	.008
Bloodstream infection due to any pathogen	2004	11.2	10.7–11.7	870	7.6	7.1–8.1	–3.6	.006
Contaminated blood culture	865	4.9	4.5–5.2	261	2.3	2.0–2.6	–2.6	.03

**Hayden MK et al. Clin Infect Dis 2015;60:1153**

Effect of the intervention bundle on clinical culture outcomes.



Hayden MK et al. Clin Infect Dis. 2015;60:1153-1161

# Preventing CRE in Post-Acute Care National Program – Israel

- Prospective cohort interventional study
  - nationwide outbreak since 2006; CR-KP (22%)
  - CRE carriers (10%) transferred to LTCF
  - Goal ↓ new acquisitions ↓ LTCF reservoir
- Israeli National Program (2008-2011)
  - 13 post-acute care hospitals (PACHs) 2,451 beds
  - annual site visits, policies & resources
  - weekly reports - transfers, compliance & CRE acquisitions
  - assessment CRE risk factors
  - develop guidelines for PACH – AST & isolation for CRE
  - cross-sectional rectal surveys for CRE carriage
    - Screen imipenem 1 µg/L, PCR for CRE by *bla*<sub>KPC</sub> and *bla*<sub>NDM</sub>

# Israeli National Guidelines CRE

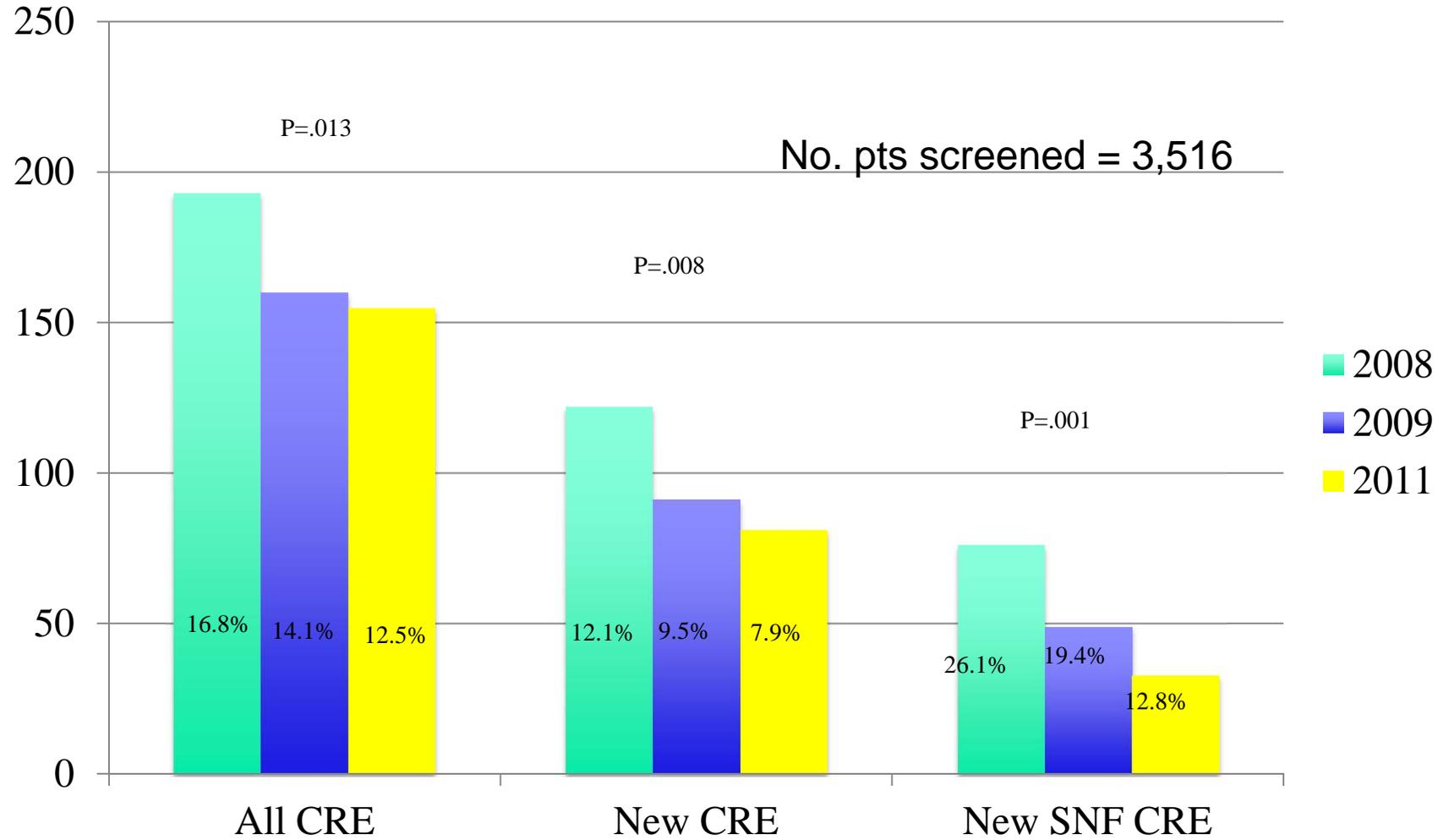
Variable	SNF/Subacute/Vents	Rehabilitation Wards
Room assignment	Private room/cohorting	Not required
Dedicated nursing	Not required	Not required
Gloves/Gowns	On room entry	Standard precautions
Admit Screen Hi Risk*	Required	Not routinely required
Screening pt contacts	Required	Required
Group activities	Allowed	Allowed
Stop isolation protocol	Yes	Yes
Mandatory reporting	Yes	Yes

High Risk = transfer other facilities or hospitalization within 6 months.

## Compliance IC Guidelines -16 Elements

variable	2008	2010	2011	<i>P</i>
Infection control consultant	62	85	92	.055
ABHR site of care	15	54	85	<.001
Antiseptic soap	15	92	85	<.001
Compliance audits	0	46	77	<.001
Standard precautions – glove use	31	69	92	<.001
Contact isolation – gowns + gloves	46	92	100	.001
Admission screening cultures	15	69	77	.002
Contacts screening	38	78	100	.001
Standard protocol DC isolation	15	46	100	<.001
Total IC score max = 16 (mean)	6.8	11.6	14.0	<.001

## Change in CRE Rectal Carriage (N%)



# Association IC Score, Ward Risk, & CRE

New CRE Carriage (%)	IC Score Low (3-12)	IC Score High (13-16)	<i>P</i>
Ward Risk			
Low	5.3 (34/638)	2.2 (17/770)	.002
High	17.4 (180/1033)	11.7 (63/539)	.003
Total	12.8 (214/1671)	6.1 (80/1309)	<.001

**Multivariable Analysis – Adjusted Ward Risk**

	<u>OR (95%CI), p value</u>
ABHR on site	0.63 (0.44-0.93, .019)
Appropriate glove use	0.74 (0.57-0.96, .023)
CRE screening policy	0.69 (0.52-0.93, .014)

# Significance

- Nationwide intervention
- Improved compliance infection control procedures
- Implemented AST & isolation of CRE carriers
- Isolation procedures adapted for LTCF goals of care
- ↓ CRE rates & ↓ new acquisitions in LTCF
- Limitations
  - study design - no control group
  - no adjustment for patient factors/complexity
  - no measurement of compliance
  - rectal cultures alone – underestimate CRE carriage?

# MDRO in Post-Acute Care Infection Control Bundles

	Ostrowsky	Baldwin	Bellini	Schora	Munoz-Price	Ray	Chitnis	Hayden	Ben-David
hand hygiene	X	X			X	X	X	X	X
PPE	X	X			X	X	X	X	X
contact isolation	X				X	X	X		X
cohorting					X		X	X	X
admission screening	X		X	X	X	X	X	X	X
PP surveys	X		X	X	X	X	X	X	X
cleaning	X	X	X	X	X	X	X		
skin disinfection			X	X	X			X	
surface cultures					X	X			
devices		X			X				
feedback audits		X					X	X	X
education		X			X	X	X	X	X
champions		X							

# MDRO Outbreaks in LTCF

## Control Measures

- Most uncontrolled studies & LTCAHs
- Isolation adjusted based on situation
- Horizontal prevention (all patients)
  - hand hygiene and PPE
  - environmental cleaning & disinfection
- Vertical measures (organism specific)
  - detection
  - assess efficacy of measures
  - feedback & education
  - role of decolonization unclear
- Colonization & infection can be reduced