

Horizontal infection control measures: Decolonization as Infection Prevention

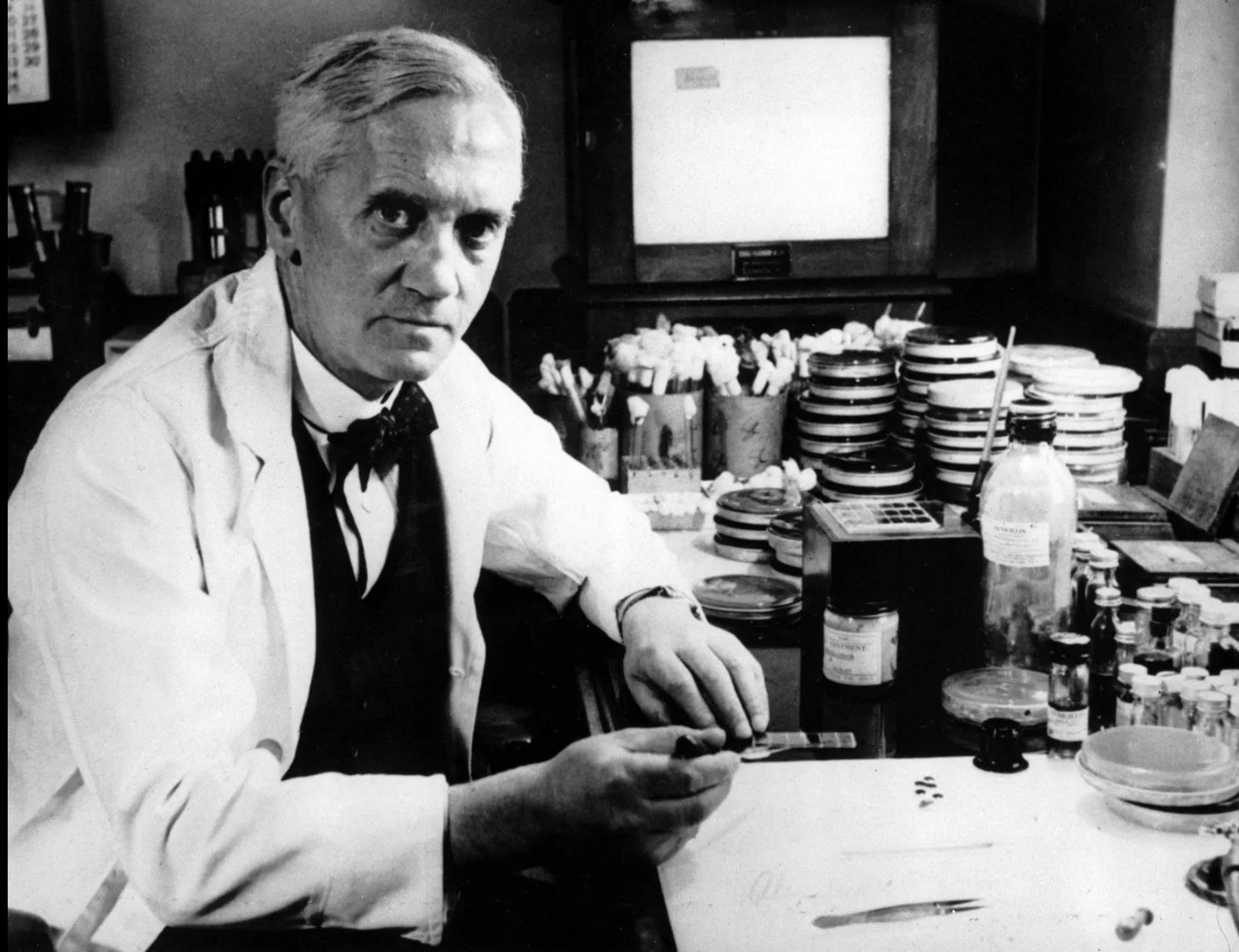
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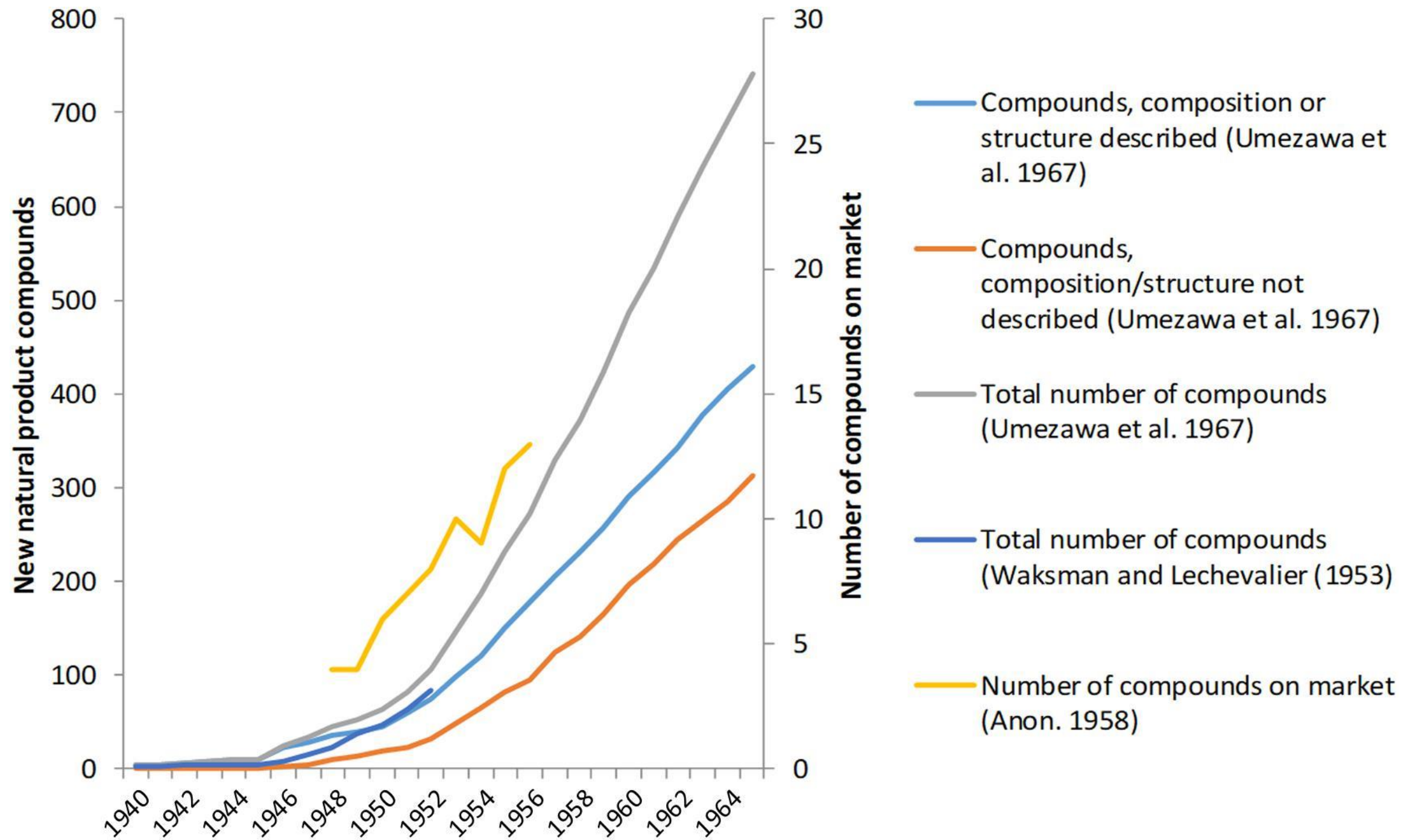
Topics to Be Discussed

- MDRO colonization in hospitals, SNFs
- Consequences of MDRO colonization
- Decolonization as prevention

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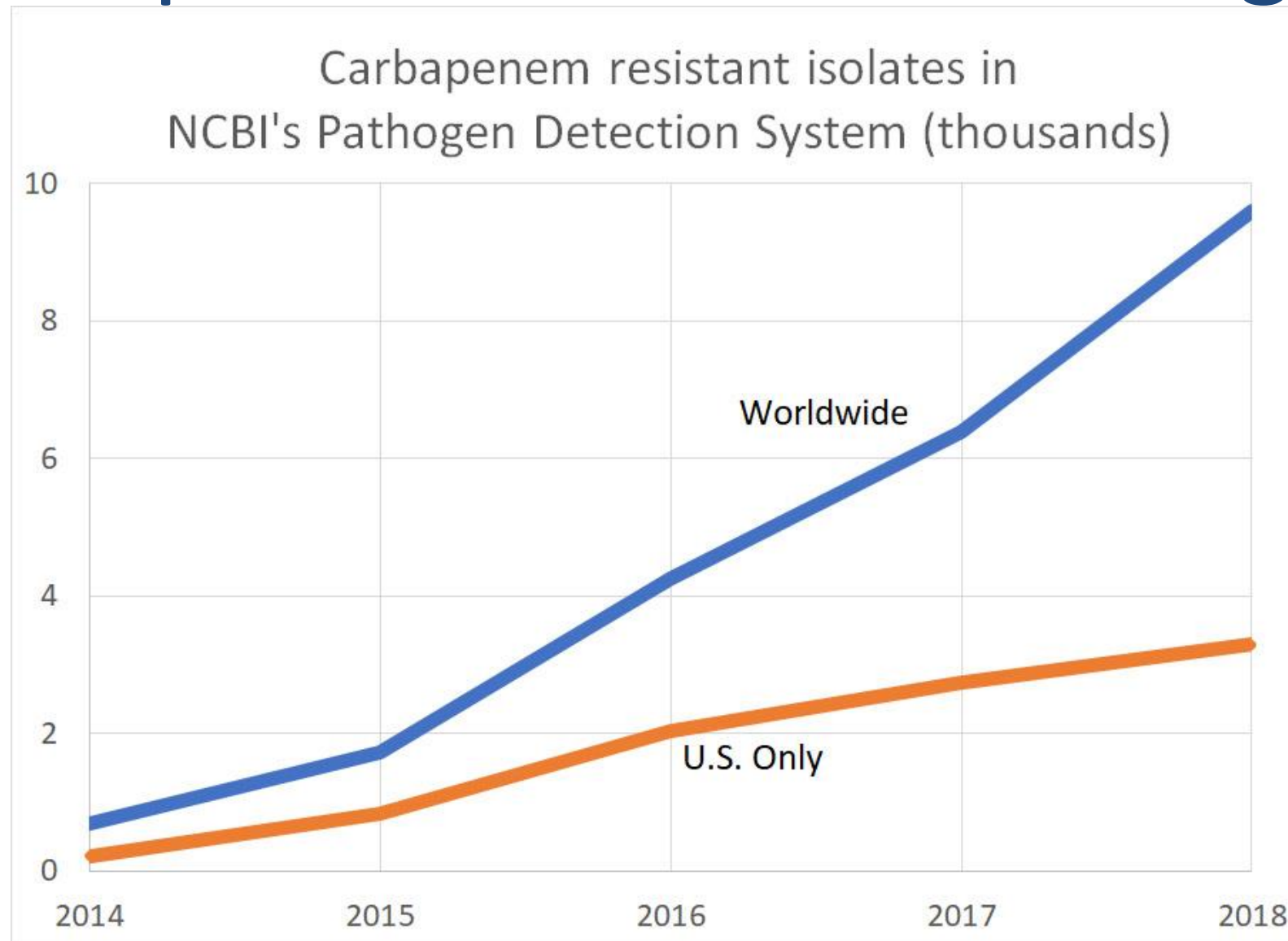
- MDRO colonization in hospitals, SNFs
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- Decolonization as prevention





Leisner JJ. *Front Microbiol* 2020; 11:976.

Prevalence of Carbapenem-Resistant Pathogens



<https://www.ncbi.nlm.nih.gov/pathogens/antimicrobial-resistance>

Prevalence of Penicillin-Resistant *S. aureus*

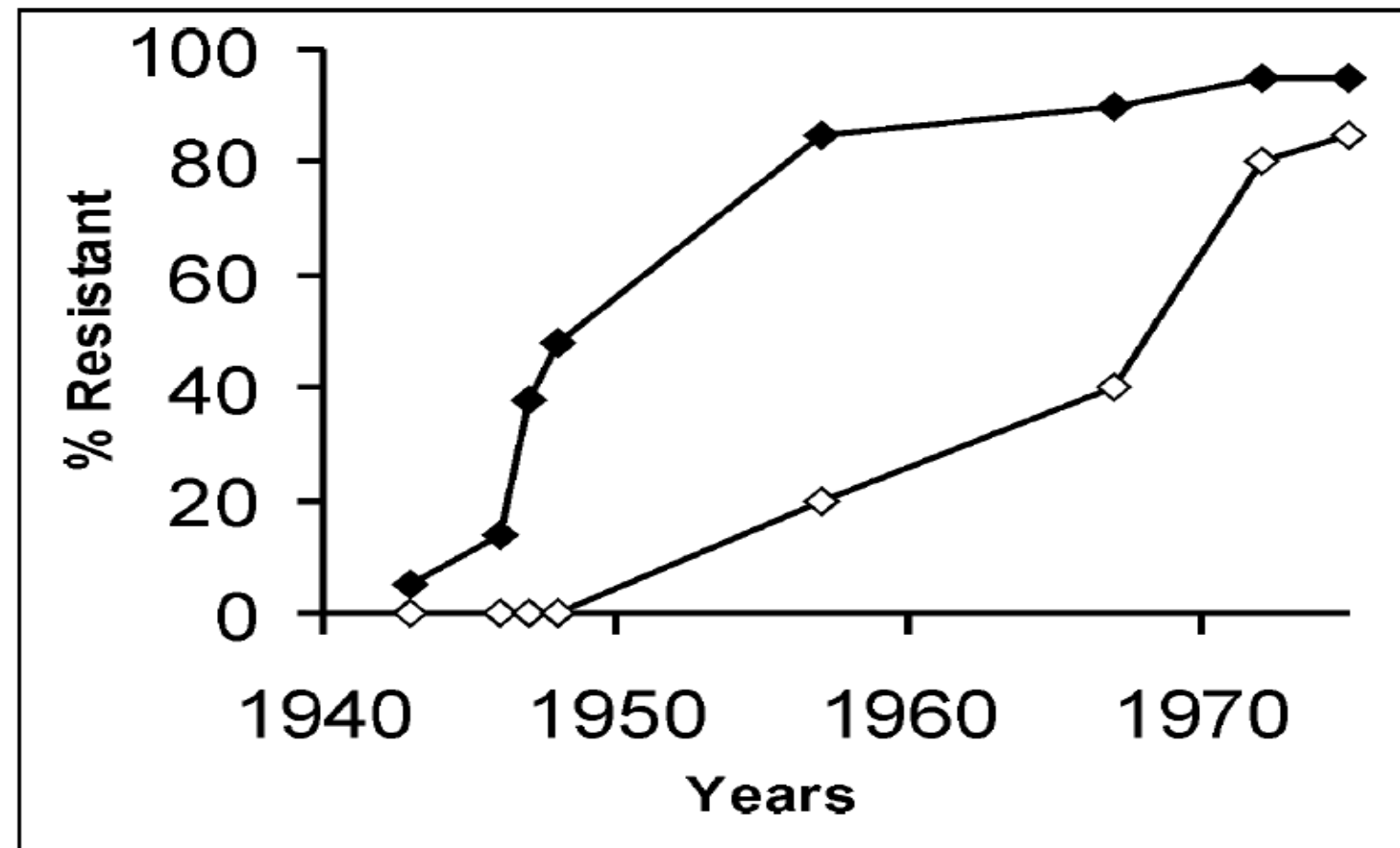


Figure. Secular trends of approximate prevalence rates for penicillinase-producing, methicillin-susceptible strains of *Staphylococcus aureus* in hospitals (closed symbols) and the community (open symbols).

6 of the 18 most alarming **antibiotic resistance threats** cost the U.S. more than **\$4.6 billion annually**



Vancomycin-resistant
Enterococcus
(VRE)

Carbapenem-resistant
Acinetobacter
species
(CRAsp)



Methicillin-resistant
Staphylococcus
aureus (**MRSA**)



Carbapenem-resistant
Enterobacterales
(CRE)



Multidrug-resistant (MDR)
Pseudomonas
aeruginosa



Extended-spectrum cephalosporin resistance in Enterobacterales suggestive of extended-spectrum β -lactamase (ESBL) production

www.cdc.gov/DrugResistance



U.S. Department of
Health and Human Services
Centers for Disease
Control and Prevention



Misuse of **ANTIBIOTICS** puts us all at risk.

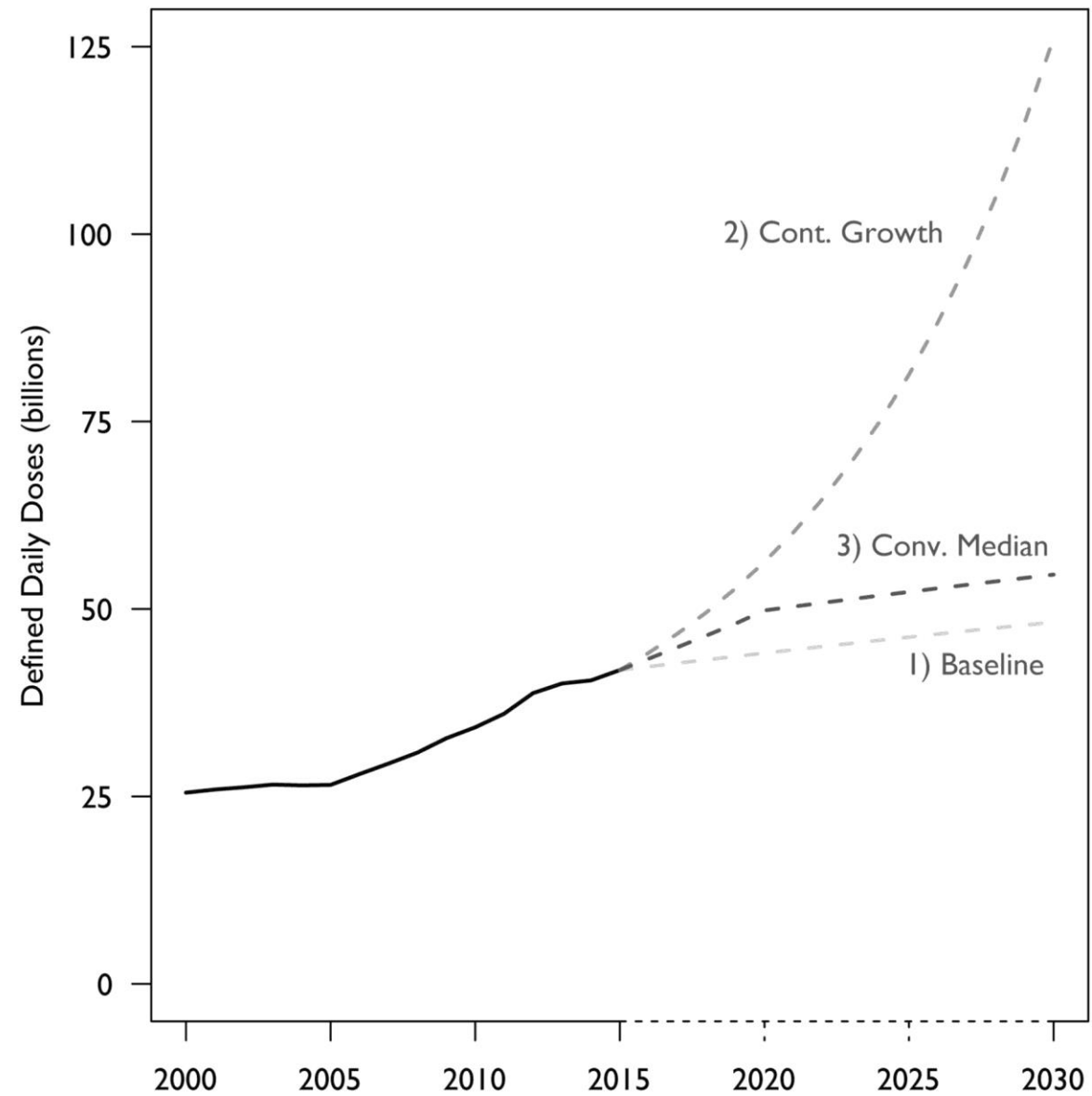
Taking antibiotics when you don't need them speeds up antibiotic resistance. Antibiotic resistant infections are more complex and harder to treat. They can affect anyone, of any age, in any country.

Always seek the advice of a healthcare professional before taking antibiotics.



**World Health
Organization**

Projected Antibiotic Consumption



Klein EY et al. *PNAS* 2018; 115: E3463-70

MDRO Colonization/Contamination

- Growing number of MDROs (more than just MRSA!)
- Carriage associated with higher infection risk
- Carriers commonly shed MDROs
 - HCW hands
 - Objects

MDRO Colonization/Contamination

- Contamination of objects hard to remove
- Decolonization is time consuming
 - screen, treat
- Need a broad solution, one that prevents transmission and reduces infections in carriers

MDRO Colonization in Hospitals

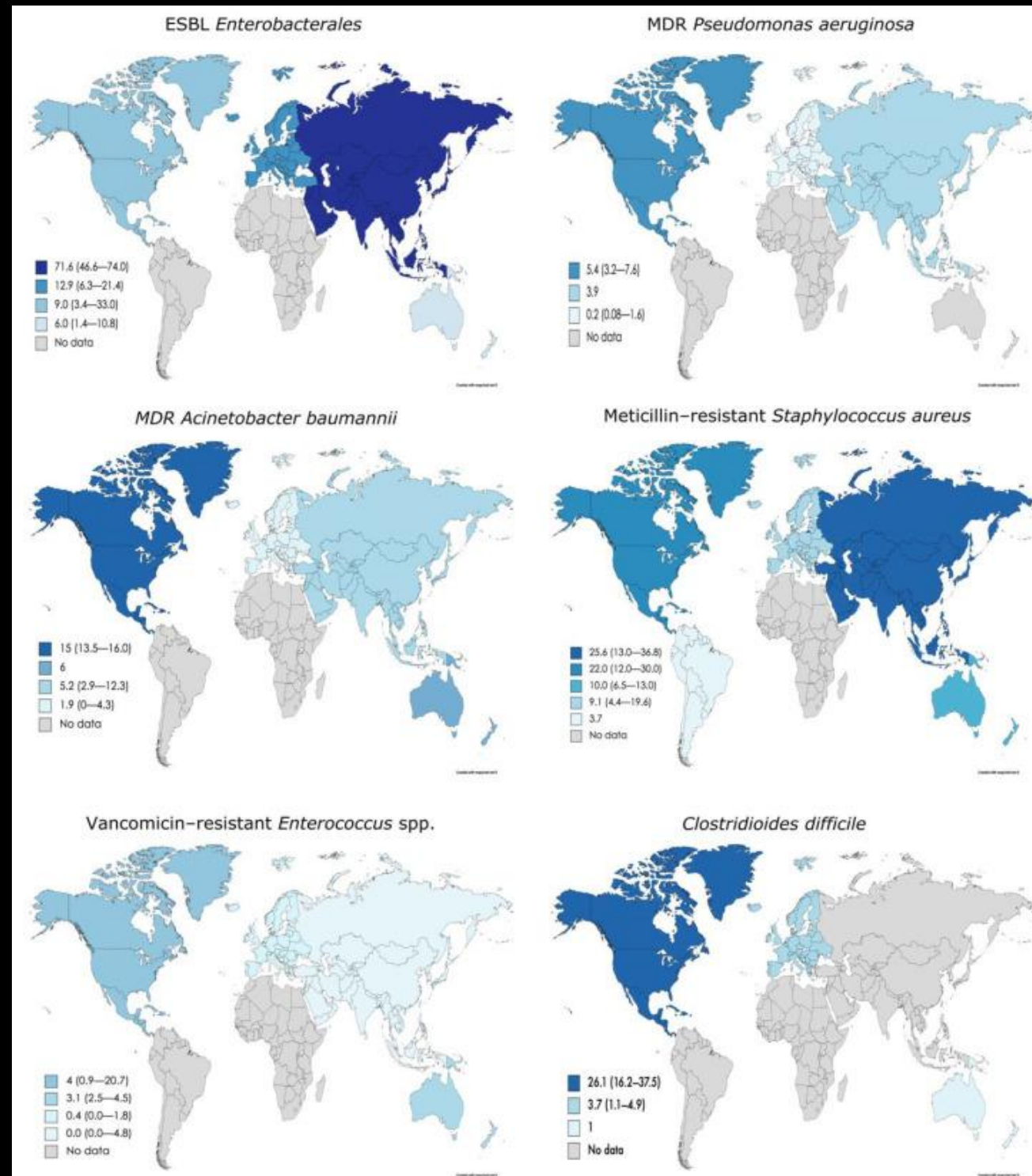
- MDRO colonization in hospitals is increasing
- 5 - >20% of hospitalized patients have ≥ 1 MDRO
- MDRO colonization in ICU > non-ICU
- Active surveillance for MDROs reveals many MRDO-colonized patient that were previously *not* identified

<https://www.cdc.gov/infectioncontrol/guidelines/mdro/epidemiology.html>

Hachimi A et al. *PAMJ-Clinical Med* 2021; 5: 1

Kapsar T et al. *BMC Antimicrob Resistance and Infect Control* 2015; 4: 31

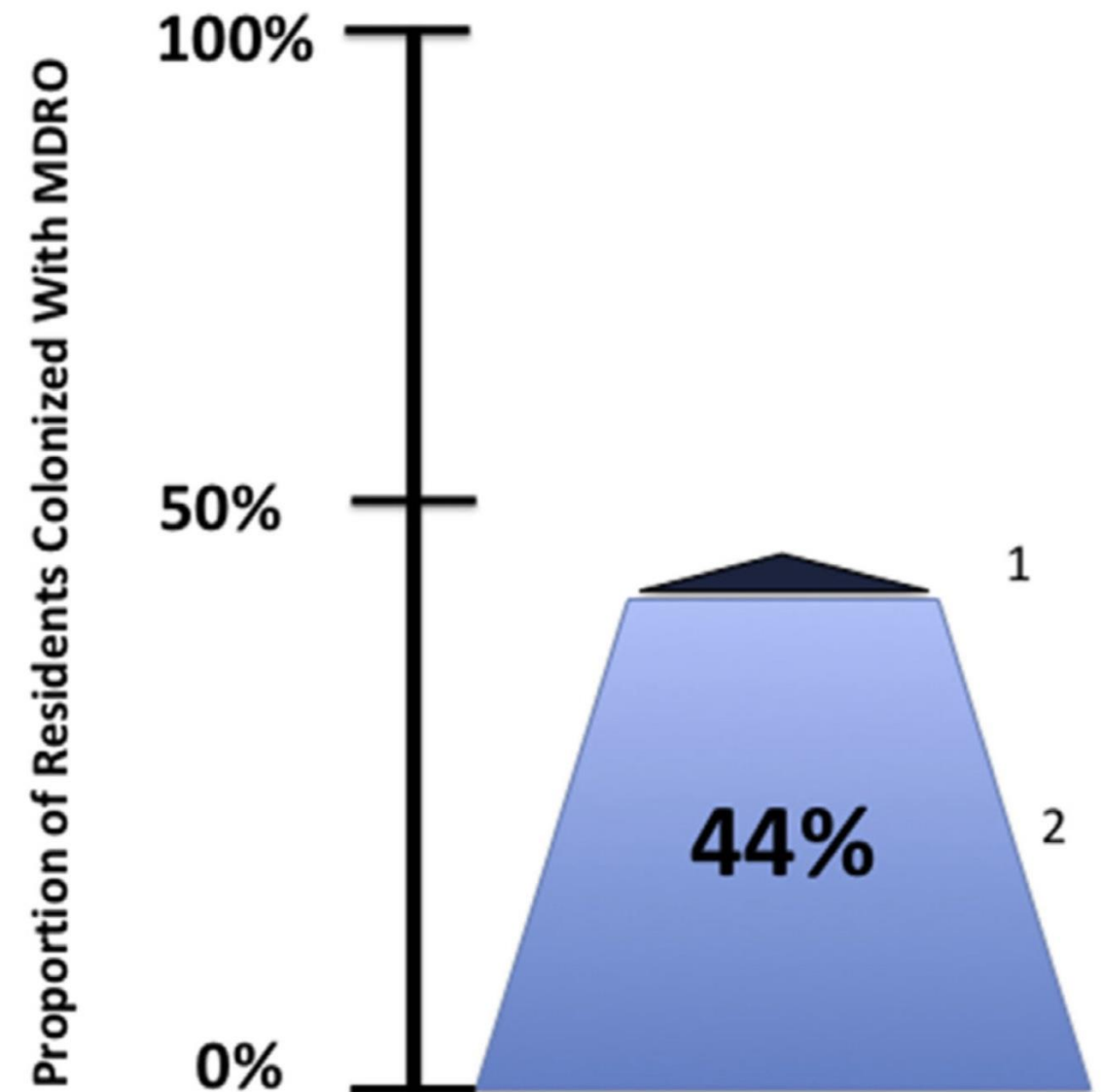
Prevalence of MDRO colonization in LTCFs



Rodriguez-Villodres A et al.
Antibiotics 2021; 10: 680

“Iceberg” Effect of Colonization

- Survey of 28 SoCal NHs
- 48% of residents MDRO colonized
 - 4% known to be MDRO colonized based on previous care/medical records
 - 44% detected only by active surveillance cultures



Topics to Be Discussed

- MDRO colonization in hospitals, SNFs
- **Consequences of MDRO colonization**
- Decolonization as prevention

MDRO Colonization and Infection Risk

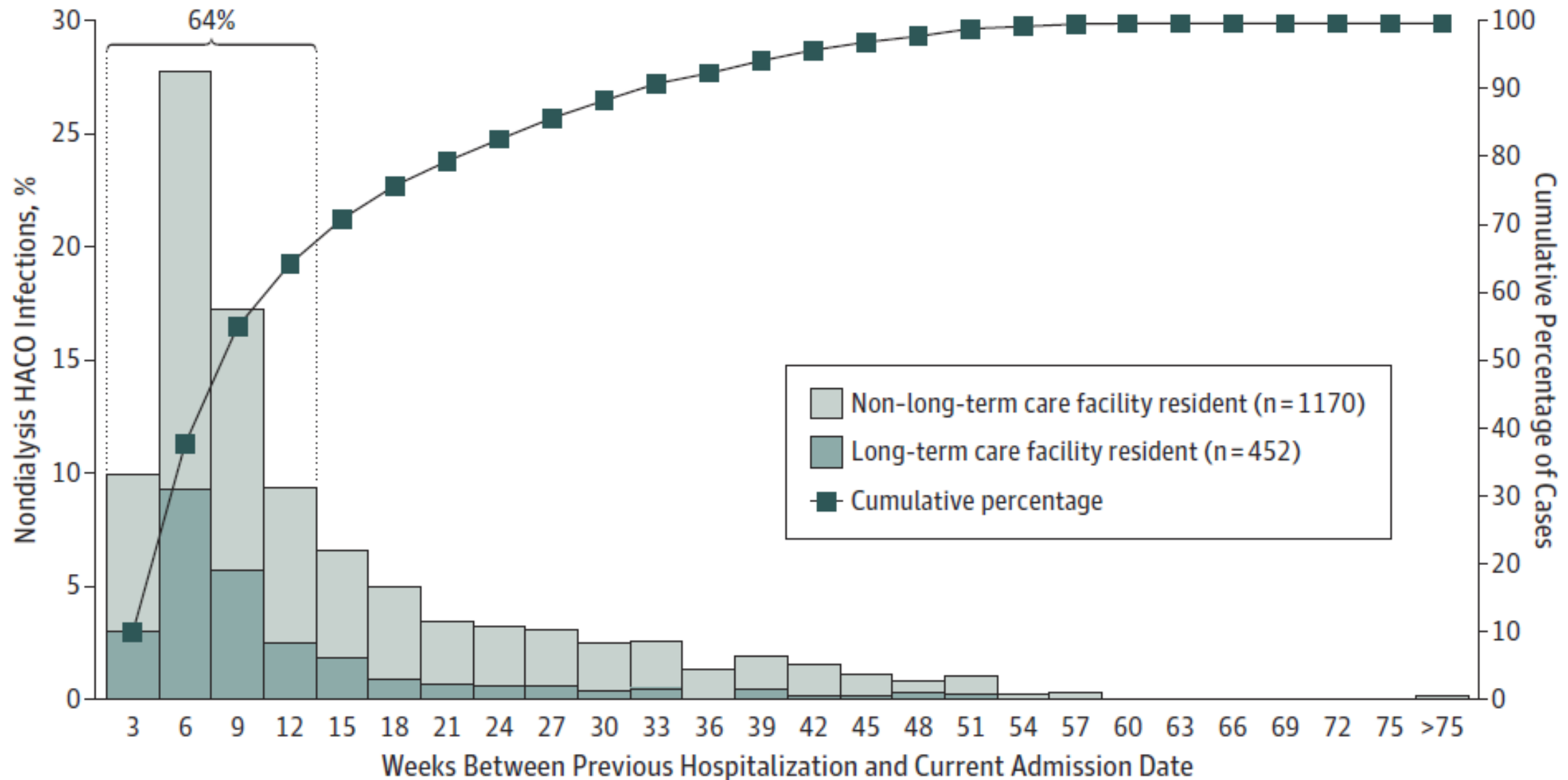
- MRSA *colonization* in hospitalized pt's assd with ~30% MRSA *infection* risk
- VRE colonization a risk factor for VRE infection
 - 5 – 10 x increased risk compared to non-VRE colonized pt's
- ESBL colonization a risk factor for ESBL infection
 - OR = 9.6 [95% CI 2.9 - 33.3

Milstone AM A et al. *Clin Infect Dis* 2011; 53: 853-59

Amberpet R et al. *J Lab Physicians* 2018; 10:89-94

Massart N et al. *Eur J Clin Microbiol Infect Dis* 202; 29: 889-95

Post-Discharge MRSA Infection Risks



Source Control

- Numerous resistant pathogens
- Shedding is common and persistent
- Contamination hard to remove
- Need a broad, simple solution
- Impact carriers not just prevent new carriers

Topics to Be Discussed

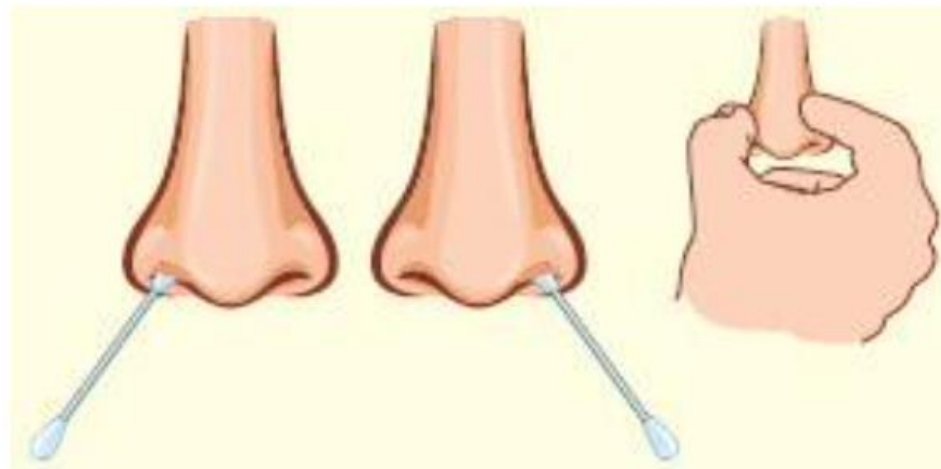
- MDRO colonization in hospitals, SNFs
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Patient Instructions: *Staphylococcus aureus* Decolonization

Please follow the instructions below to decolonize for *Staphylococcus aureus*.

Nasal Ointment – Bactroban (Mupirocin 2%)

1. You will be provided with prescription for Bactroban or may be provided with a tube of the nasal ointment.
2. Use enough ointment to coat the inside of the nostril every time you apply the ointment.
3. Put ointment on the tip a cotton swab.
4. Apply ointment to inside of one nostril.
5. Gently press nostril together and release several times (for about a minute) to spread the ointment in the nostril.
6. Repeat process in the other nostril using the other end of the cotton swab or a new swab.



Advantages of Decolonization

- Broad vs targeted intervention
- Obviates screening
- Embedded in routine bathing activities
- Reduces shedding
- Reduces contamination
- Reduces transmission
- Reduces infection

Prevention of Colonization and Infection by *Klebsiella pneumoniae* Carbapenemase-Producing Enterobacteriaceae in Long-term Acute-Care Hospitals

Mary K. Hayden,^{1,2} Michael Y. Lin,¹ Karen Lolans,² Shayna Weiner,¹ Donald Blom,¹ Nicholas M. Moore,³ Louis Fogg,⁴ David Henry,⁵ Rosie Lyles,⁶ Caroline Thurlow,¹ Monica Sikka,¹ David Hines,⁷ and Robert A. Weinstein^{1,6}; for the Centers for Disease Control and Prevention Epicenters Program

50% decline in acquisition

56% decline in bacteremia

What is Decolonization?

- Use of topical antiseptics to reduce the bacterial bioburden on the body to prevent carriage and infection
- Commonly
 - Chlorhexidine (CHG) for skin and wound bathing
 - Mupirocin or iodophor for nasal use
- Used in vulnerable times, high risk populations
- Active against MDROs
- CHG and iodophor used in healthcare for 60+ years
- Strong safety record

Chlorhexidine Guidance

- Dental – gingivitis, periodontal disease
- Central line skin prep
- Surgical skin prep
- Surgical pre-operative bathing
- Wound cleanser
- ICU bathing to reduce microbial burden and infection

ICU Decolonization Evidence Summary

Author	Study Year	Study Type	Hospital	ICU	N	Findings	Publication
Vernon	10/02-12/03	Observational	1	1	1,787	65% less VRE acquisition 40-70% less VRE on skin, HCW hands, environment	Arch Intern Med 2006; 166:306-312
Climo	12/04-1/06	Observational	4	6	5,293	66% less VRE BSI 32% less MRSA acquisition 50% less VRE acquisition	Crit Care Med 2009; 37:1858-1865
Bleasdale	12/05-6/06	Observational	1	2	836	61% less primary BSI	Arch Intern Med 2007; 167(19):2073-2079
Popovich	9/04-10/06	Observational	1	1	3,816	87% less CLABSI 41% less blood contaminants	ICHE 2009; 30(10):959-63
Climo	8/07-2/09	Cluster RCT	6	9	7,727	23% less MRSA/VRE acquisition	N Engl J Med 2013; 368:533-42
Milestone	2/08-9/10	Cluster RCT	5	10	4,947	36% less total BSI (as treated)	Lancet. 2013; 381(9872):1099-106
Huang	1/09-9/11	Cluster RCT	43	74	122,646	37% less MRSA clinical cultures 44% less all-cause BSI	N Engl J Med 2013 368:2255-2265

Preceding Decolonization Trials

- **REDUCE MRSA ICU Trial**¹
 - 43 hospital cluster randomized trial, 75,000 patients
 - Universal decolonization with chlorhexidine (CHG) baths and nasal mupirocin → 44% lower bacteremia, 37% lower MRSA
- **ABATE Infection Trial**²
 - 53 hospital cluster randomized trial, 339,000 patients
 - In patients with medical devices, 37% reduction in MRSA and VRE, 32% reduction in all-cause bloodstream infection
- **CLEAR Trial**³
 - Individual RCT of 2,121 recently hospitalized MRSA carriers
 - Serial decolonization led to 30% reduction in MRSA infection
 - NNT ~30 to avoid one infection or hospitalization

¹ Huang S et al. N Engl J Med 2013;368:2255-2265

² Huang S et al. Lancet 2019;393(10177):1205-1215

³ Huang S et al. N Engl J Med 2019; 380(7):638-50

ORIGINAL ARTICLE

Decolonization in Nursing Homes to Prevent Infection and Hospitalization

L.G. Miller, J.A. McKinnell, R.D. Singh, G.M. Gussin, K. Kleinman, R. Saavedra, J. Mendez, T.D. Catuna, J. Felix, J. Chang, L. Heim, R. Franco, T. Tjoa, N.D. Stone, K. Steinberg, N. Beecham, J. Montgomery, D.A. Walters, S. Park, S. Tam, S.K. Gohil, P.A. Robinson, M. Estevez, B. Lewis, J.A. Shimabukuro, G. Tchakalian, A. Miner, C. Torres, K.D. Evans, C.E. Bittencourt, J. He, E. Lee, C. Nedelcu, J. Lu, S. Agrawal, S.G. Sturdevant, E. Peterson, and S.S. Huang

ABSTRACT

BACKGROUND

Nursing home residents are at high risk for infection, hospitalization, and colonization with multidrug-resistant organisms.

METHODS

We performed a cluster-randomized trial of universal decolonization as compared with routine-care bathing in nursing homes. The trial included an 18-month baseline period and an 18-month intervention period. Decolonization entailed the use of chlorhexidine for all routine bathing and showering and administration of nasal povidone-iodine twice daily for the first 5 days after admission and then twice daily for 5 days every other week. The primary outcome was transfer to a hospital due to infection. The secondary outcome was transfer to a hospital for any reason.

The authors' full names, academic degrees, and affiliations are listed in the Appendix. Dr. Miller can be contacted at lgmiller@ucla.edu or at the Division of Infectious Diseases, Lundquist Institute for Biomedical Innovation at Harbor-UCLA Medical Center, David Geffen School of Medicine at UCLA, 1124 W. Carson St., Box 466, Torrance, CA 90509.

This article was published on October 10, 2023, at [NEJM.org](https://www.nejm.org).



The PROTECT Trial:

A Cluster Randomized Clinical Trial of Decolonization of Nursing Homes Residents to Prevent Infection and Hospitalization: Focus on Microbiologic Outcomes

Loren G. Miller MD MPH

Lundquist Institute at Harbor-UCLA Medical Center, Torrance CA
for the PROTECT Trial Team



Decolonization Trials

- Targeted Prevention
 - Recurrent *S. aureus* infection ¹
 - Pre-operative *S. aureus* carriers ²⁻³
- Universal Prevention
 - ICU ⁴⁻⁶
 - Non-ICU ⁷
 - Post-discharge ⁸

¹ Liu C CID 2011;52:285-92 (IDSA Guideline)

² Bode LGM NEJM 2010;362:9-17

³ Perl T NEJM 2002;346:1871-7

⁴ Climo M NEJM 2013;368:533-42

⁵ Milstone A Lancet 2013;381:1099-106

⁶ Huang SS et al. NEJM 2013;368:2255-65

⁷ Huang SS et al. Lancet 2019;393(10177):1205-15

⁸ Huang SS et al. NEJM 2019;380(7):638-50

Need to Prevent Nursing Home Infections

- 3 million healthcare-associated infections (HAIs) estimated to occur in nursing homes (NHs) annually in U.S.
- Each year, U.S. NH HAIs associated with:
 - 150,000 hospital admissions
 - 380,000 deaths

<https://health.gov/sites/default/files/2019-09/hai-action-plan-ltcf.pdf>

Strausbaugh LJ, Joseph CL. ICHE 2000; 21(10):674-9.

Magaziner J et al. JAGS. 1991; 39(11):1071-8.

Heudorf U et al. Euro Surveill. 2012; 17(35).

McKinnell JA et al. CID 2019; 69(9):1566-73.

Need to Prevent Nursing Home Infections

- NHs care for the highly vulnerable:
 - elderly age
 - high risk comorbid conditions
 - high multidrug-resistant organism (MDRO) prevalence
 - MRSA, VRE, ESBL producing gram-negatives, CRE
 - limited self hygiene
- 65% of nursing home residents harbor an MDRO

Strausbaugh LJ, Joseph CL. ICHE 2000; 21(10):674-9.

Magaziner J et al. JAGS. 1991; 39(11):1071-8.

Heudorf U et al. Euro Surveill. 2012; 17(35).

McKinnell JA et al. CID 2019; 69(9):1566-73.

The PROTECT Trial

Trial Design

- 28 nursing home cluster randomized trial
- Orange County and Los Angeles County nursing homes
- 18-month baseline, 18-month intervention period

Arm 1: Routine Care

- Usual practice for showering/bathing

Arm 2: Decolonization

- CHG bathing for all residents (on admit, then per routine)
- Nasal iodophor x 5d bid, facility-wide every other week

<https://clinicaltrials.gov/ct2/show/NCT03118232>

Funded: AHRQ

Intervention: Replacing Soap with CHG

- Liquid CHG for showering
 - 4% rinse off CHG
- CHG cloths for bed bathing
 - 2% leave on CHG



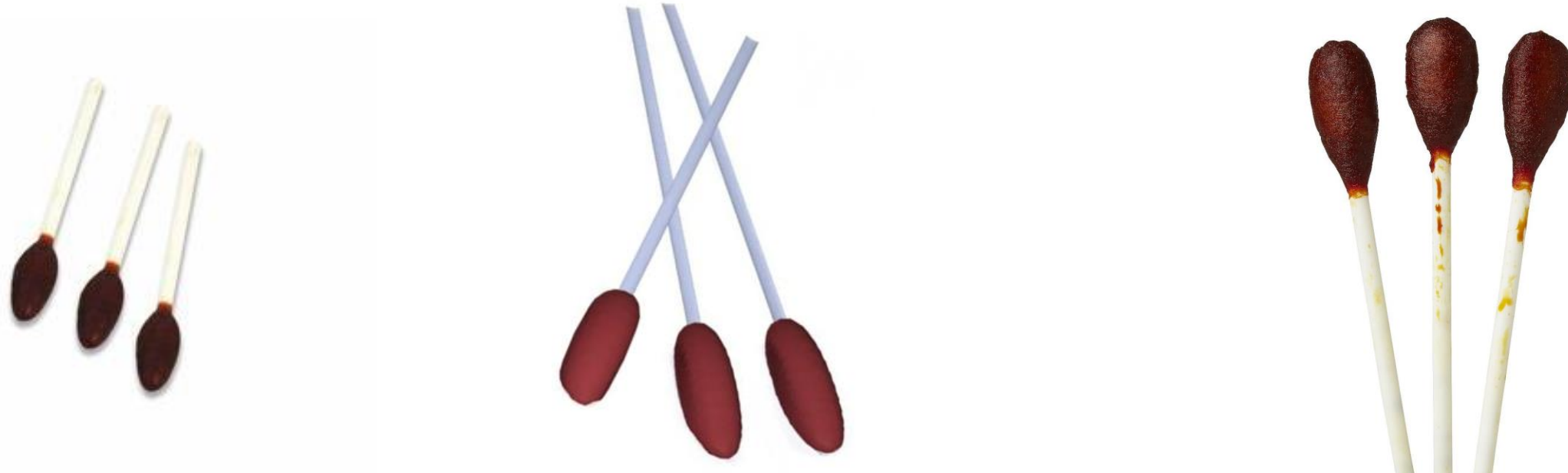
4% rinse off for shower



2% cloths for bath

Intervention: Nasal Decolonization

- 10% povidone-iodine swabs (iodophor) to each nostril
- Twice daily for entire facility
- On admission and M-F every other week



Implementation Aids

Prevent infections during each nursing home stay
BATHE or SHOWER with Chlorhexidine (CHG) soap

STAFF

Bathe with CHG to remove germs and prevent infection
 CHG works better than soap and water
 CHG is a protective bath
 CHG cloths are less drying than soap
 Apply as shown below

REMINDE

- Your enthusiasm helps residents understand why CHG is important
- Bathing on admission removes germs to protect the resident and nurse
- CHG works for 24 hours to kill germs
- Firmly massage CHG onto skin
- Clean 6 inches of lines, drains, and tubes
- Safe on surface wounds, rashes, and blisters
- Use only CHG-compatible lotions and creams
- If barrier protection needed, then apply barrier protection

SHOWERING with CHG soap

- Rinse body with warm water
- Wash hair and face with CHG soap
- Avoid getting into eyes and ears

Clean all skin areas with attention

- Neck
- All skin folds
- Skin around all devices (lines, tubes, drains)
- Wounds unless deep or large
- Armpit, groin, between fingers

Avoid eyes, mouth, & ear canals

project **PROTECT**

Decolonization Do's and Don'ts

DO

- Begin decolonization on admission to remove germs as soon as possible
- Use chlorhexidine (CHG) for all bathing/showering needs for all residents
- Use 2% no-rinse CHG cloths for bed baths or 4% rinse-off liquid CHG for showers
- Use CHG for regular bathing during resident's entire nursing home stay
- Thoroughly massage CHG onto skin for best effect
- Use CHG on lines, tubes, drains, and over non-gauze dressings
- Use CHG on superficial wounds and rashes to remove germs
- Use nasal iodophor treatment twice a day for a 5-day period every other week
- Report iodophor/CHG related events to treating physician and nursing director

DO NOT

- Get CHG into eyes or ears
- Wipe off after applying CHG cloths. Let air dry.
- Flush CHG cloths. Place in trash.
- Continue protocol after discharge
- Use protocol on residents <18 years old
- Use iodophor and/or CHG on resident if resident is allergic

REFER TO NURSING PROTOCOL FOR STEP-BY-STEP INSTRUCTIONS

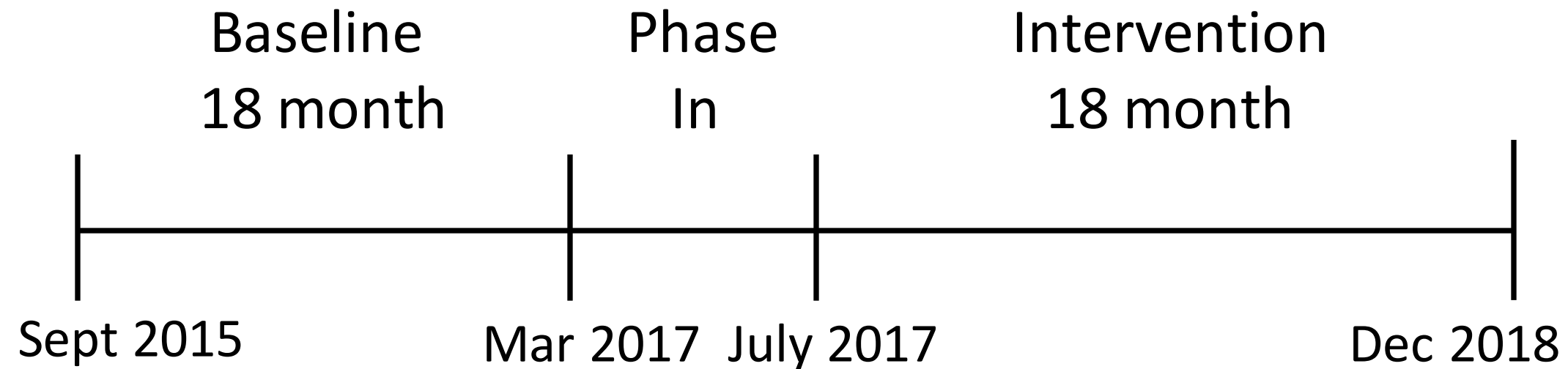
General Questions
 (949) 824-1455
 PROTECTTrial@gmail.com

project **PROTECT**

PROTECTING NURSING HOME RESIDENTS FROM INFECTIONS AND READMISSIONS

Group 2: Universal Decolonization Toolkit Binder

Baseline and Intervention Periods



Allows a “difference in differences” evaluation where intervention data from each participating NH is compared to its own baseline period, and those changes are compared across study groups. This helps account for unmeasured or imbalanced confounders

Outcomes: Publicly Reported Data

Primary Outcome

- Hospital transfers due to infection
(% of discharges to a hospital due to infection)

Secondary Outcome

- All hospital transfers (% of discharges to a hospital)

Additional Outcomes (secondary manuscripts)

- MDRO prevalence (MRSA, VRE, ESBL, CRE)¹
- Outcomes stratified by long vs short stay residents
- Emergency department visits due to infection

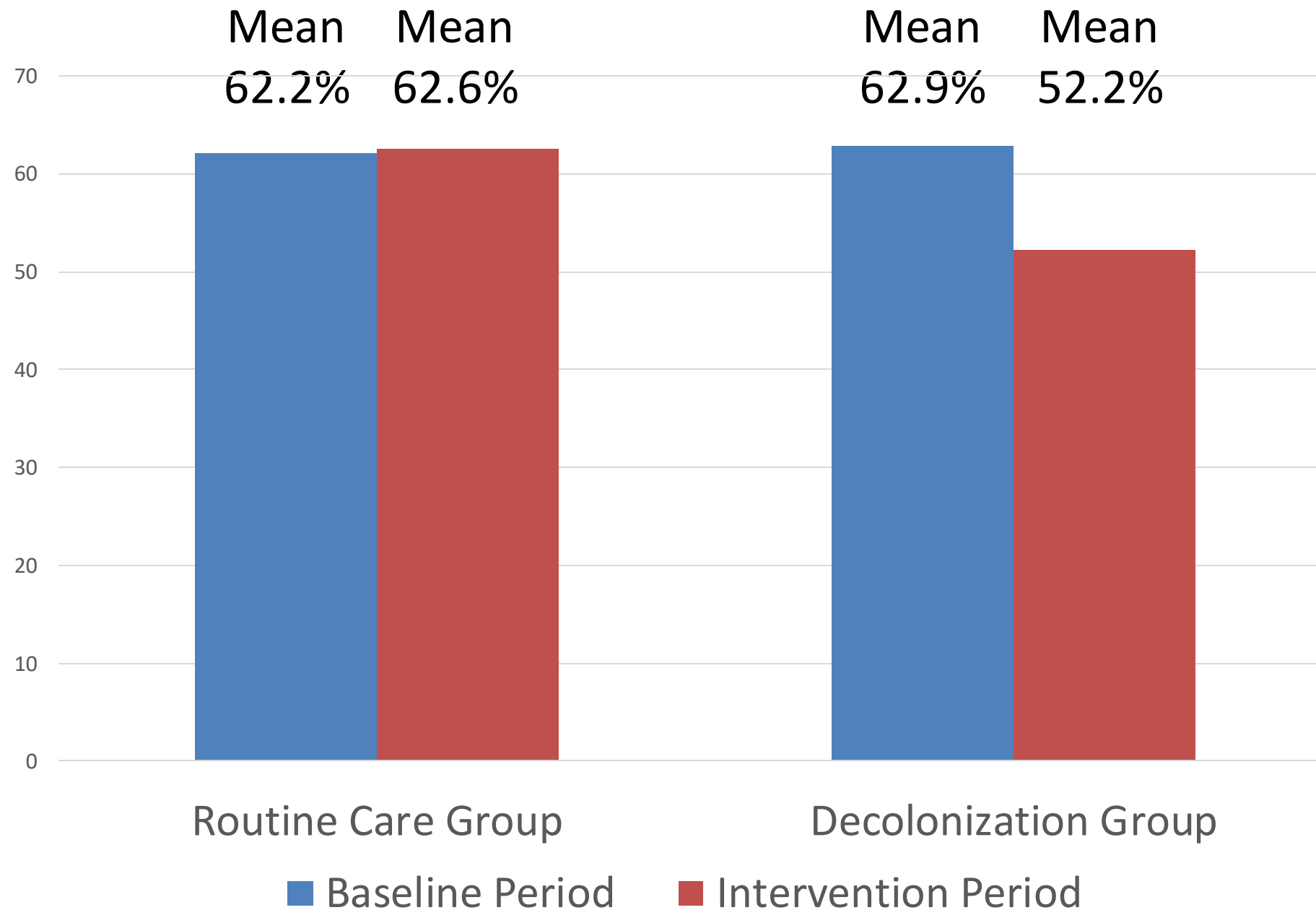
Analysis

- Main results are as-randomized, unadjusted
- Difference in differences approach
 - Compared baseline to intervention period within facility and then compared aggregated results across arms
 - Generalized linear mixed models assessing the difference in differences of each outcome using an arm by period interaction term and clustering by NH
- Two outcomes
 - Significance level set at 0.025 due to multiple comparisons
 - Powered for 15% difference in infection, 8% difference in hospitalization

Characteristics of PROTECT Facilities

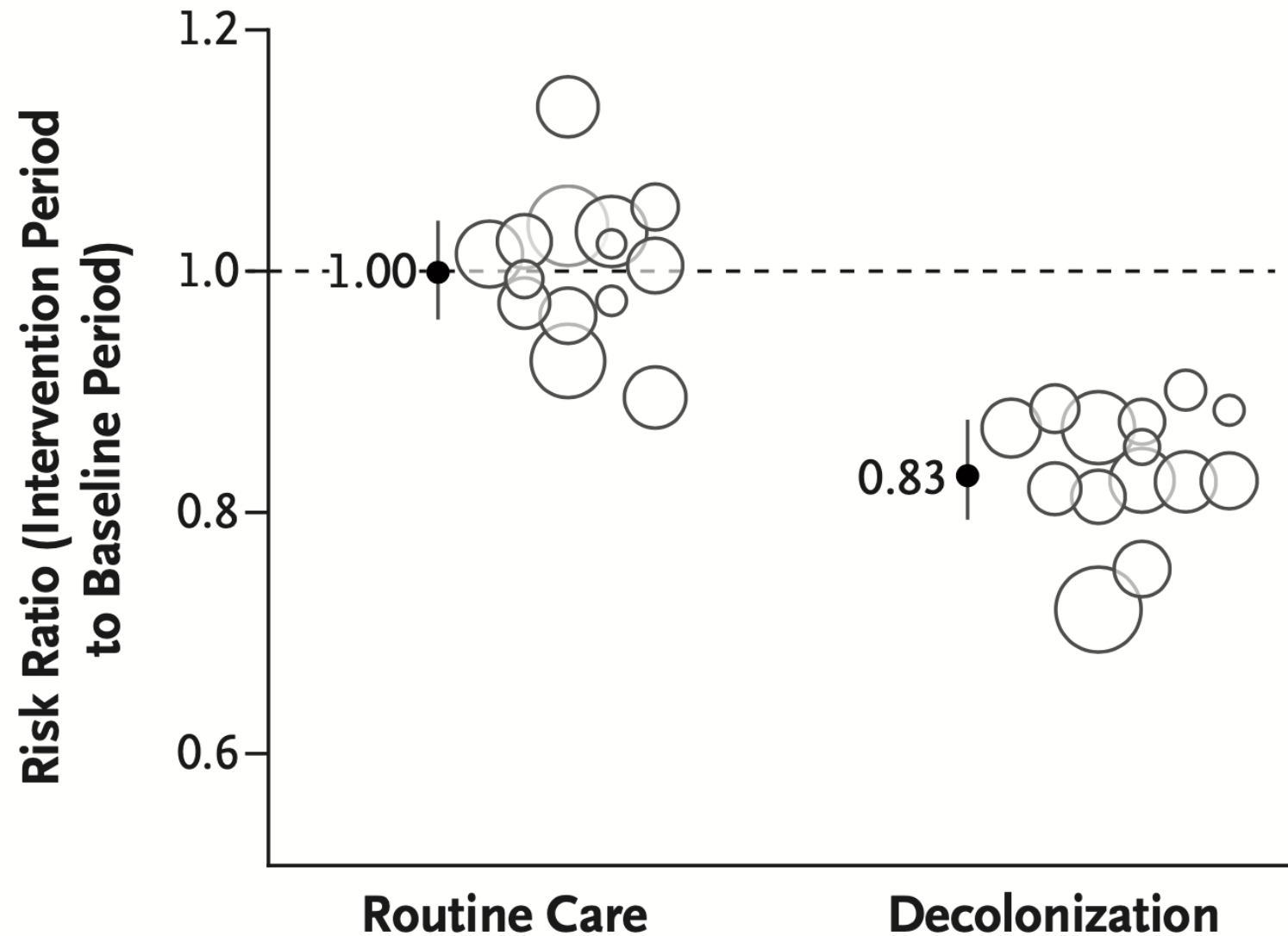
Variable	Decolonization Arm	Routine Arm
	Median (Range)	
Number of Facilities	14	14
Mean Age	76.6 (72, 79)	75.6 (71, 81)
% Male	42 (38, 47)	44 (37, 53)
Mean Licensed Beds	99 (59, 195)	99 (69, 299)
Average Daily Census	104 (57, 215)	101 (71, 232)
Length of Stay	205 (185, 298)	219 (203, 257)
Elixhauser Comorbidity Score	3.6 (2.8, 4.7)	3.6 (3.0, 4.9)
% Diabetes	37 (30, 41)	41 (34, 46)
% Chronic Lung Disease	23 (18, 33)	22 (19, 25)
% Renal Failure	20 (15, 24)	20 (18, 25)

Primary Outcome: % of Hospitalizations Due to Infection, by Group



% Hospital Transfers Due to Infection

A Transfer to a Hospital Due to Infection



Intervention vs Baseline (RR)

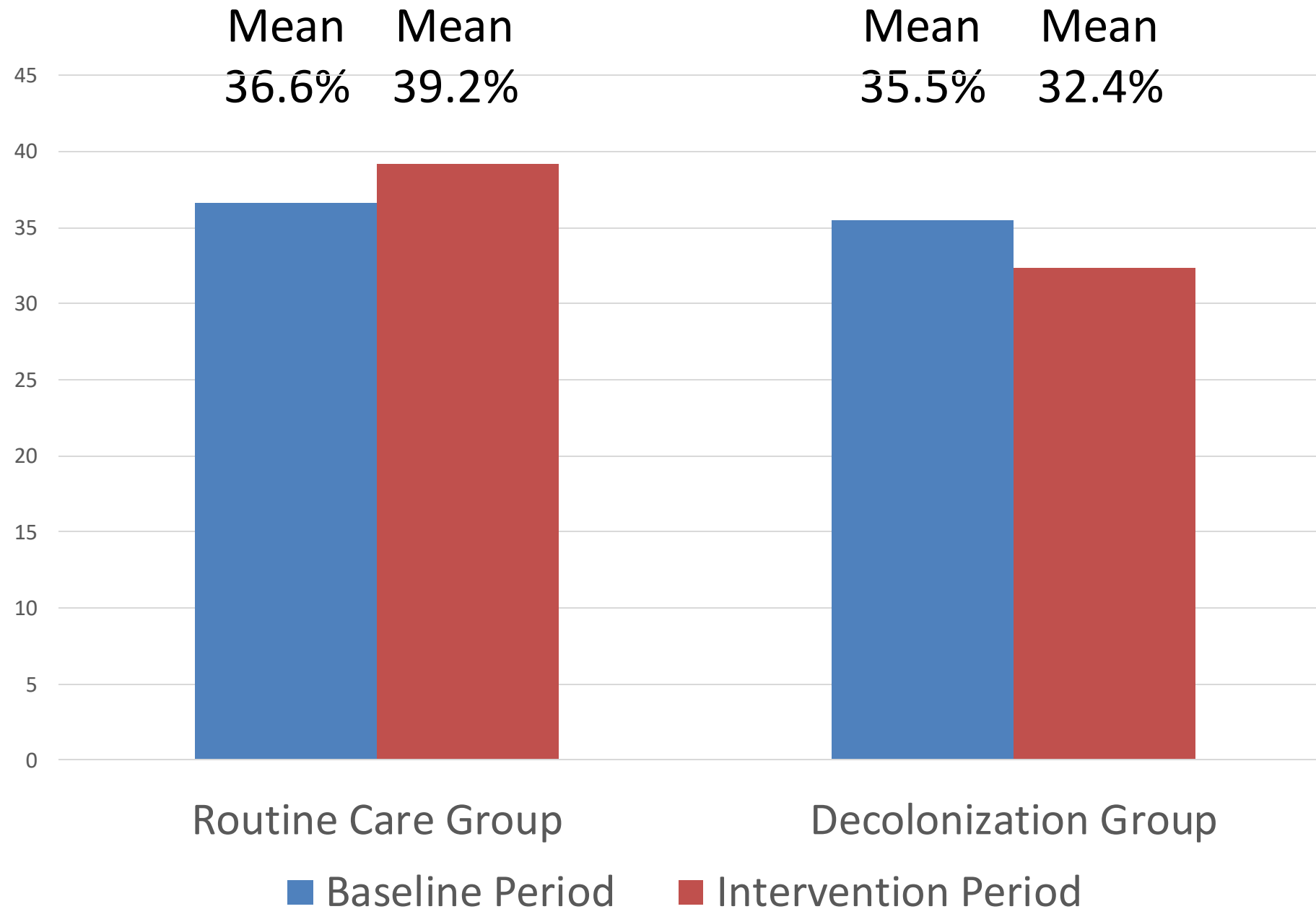
Routine Care = 1.00 (95% CI 0.96-1.04)

Decolonization = 0.83 (95% CI 0.79-0.88)

Difference in Differences: 16.6%

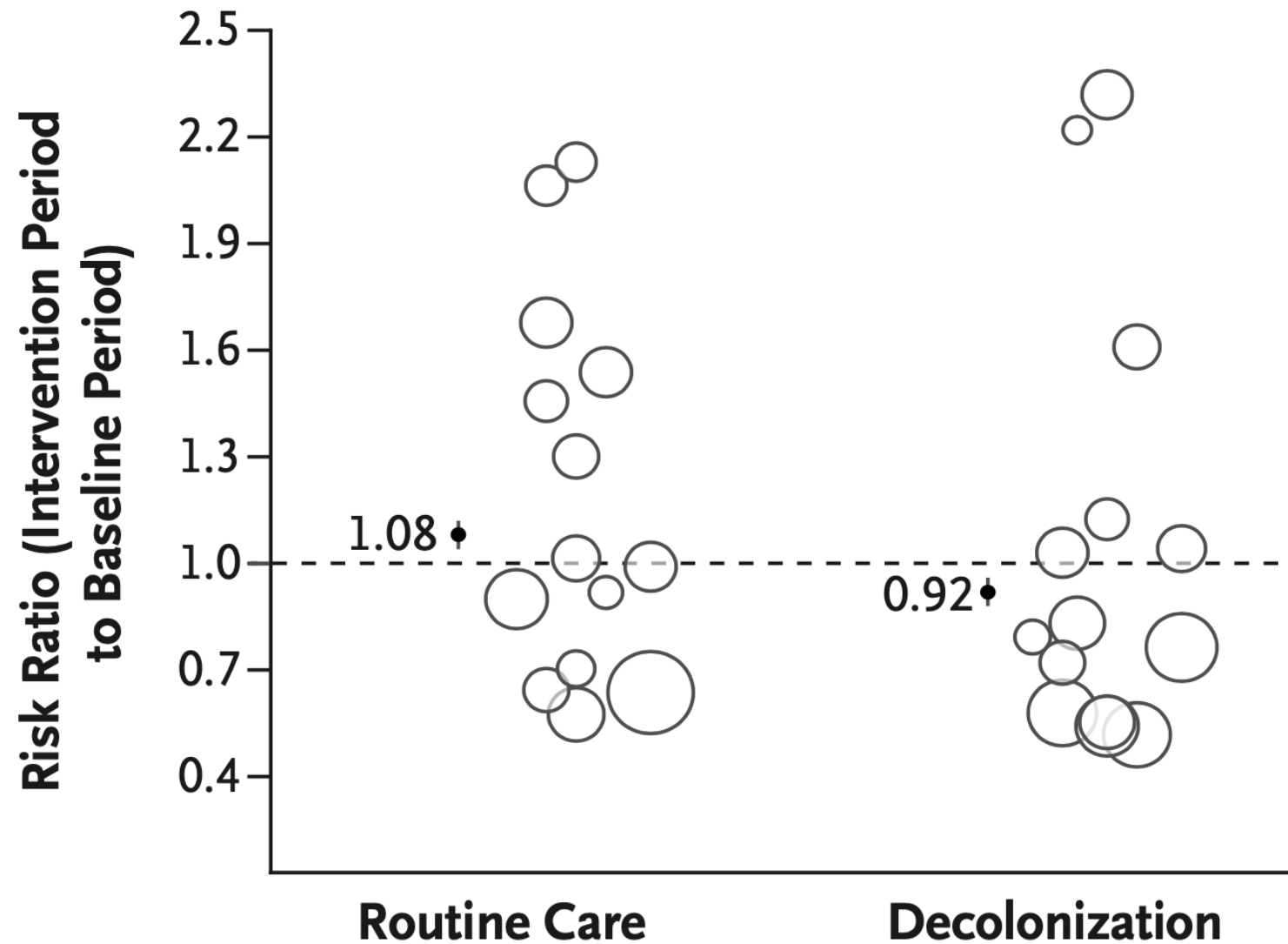
(95% CI: 11.0% to 21.8%, $P < 0.001$)

Secondary Outcome: % of Discharges to a Hospital, by Group



Transfer to a Hospital for Any Reason

B Transfer to a Hospital for Any Reason



Intervention vs Baseline (RR)

Routine Care = 1.08 (95% CI 1.04-1.12)

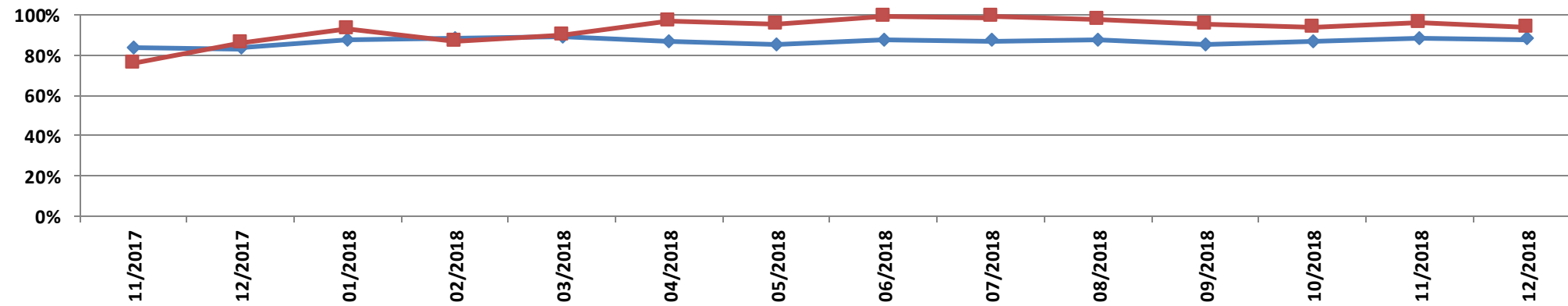
Decolonization = 0.92 (95% CI 0.88-0.96)

Difference in Differences: 14.6%

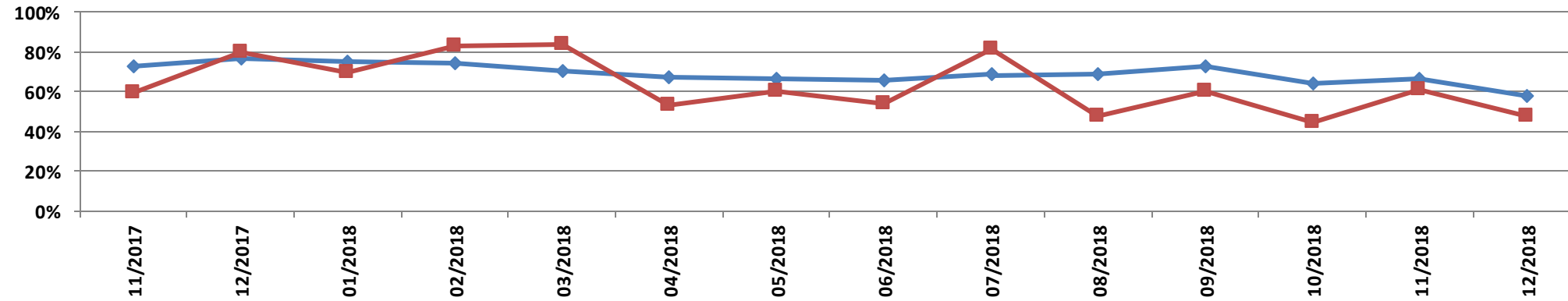
(95% CI: 9.7% to 19.2%, $P < 0.01$)

Intervention: CHG & Iodophor Compliance

CHG



Iodophor



■ Admission Bathing ◆ Post Admission Bathing

Conclusions

- Universal nursing home resident decolonization with CHG for routine bathing and showering
 - 17% Reduction in % of hospitalizations due to infection
 - 15% Reduction in % of discharges to a hospital
- NNTs = 9.7, 8.9 (as treated 6.8 and 5.8)

Conclusions (2)

- Mechanistically, ↓ in clinical infections likely related to ↓ in MDRO colonization
- CHG ↓ skin bacterial bioburden >> soap & water
- Iodophor ↓ MRSA nasal colonization

So.....

- What about adding CHG to mupirocin in HD patients?
 - Mupirocin mono-Rx antiquated
 - Data from other populations suggest ↓ infection rate
- Challenges to HD patients do CHG bathing?
- Does decolonization reduce non-*S. aureus* infections?
- Other...