# The Healthcare Environment: Evaluating Cleaning Practices and Improving Compliance

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Boston University School of Medicine

Illinois Campaign to Eliminate *Clostridium difficile*

July 2012

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Consultant – Ecolab, Steris, ASHES

Patent License - Ecolab

# A 2012 Perspective

**Developmental Emphasis**

1990 – 2009

Healthcare Environmental Cleaning Goal

Next Decade

Near-Patient Surface Bio-burden Reduction

# How is Environmental Cleaning being evaluated in this hospital ?

**Are Shiny Floors Enough ??**

# A 2012 Perspective

**Developmental Emphasis**

| 1990 – 2009 | Next Decade |
| --- | --- |
| Shinier Floors | Providing a safer patient environment |

Healthcare Environmental Cleaning Goal

Near-Patient Surface Bio-burden Reduction

# A 2012 Perspective

**Developmental Emphasis**

| | 1990 – 2009 | Next Decade |
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| Healthcare Environmental Cleaning Goal | Shinier Floors | Providing a safer patient environment |
| Near-Patient Surface Bio-burden Reduction | Disinfectant Efficacy | |

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| | 1990 – 2009 | Next Decade |
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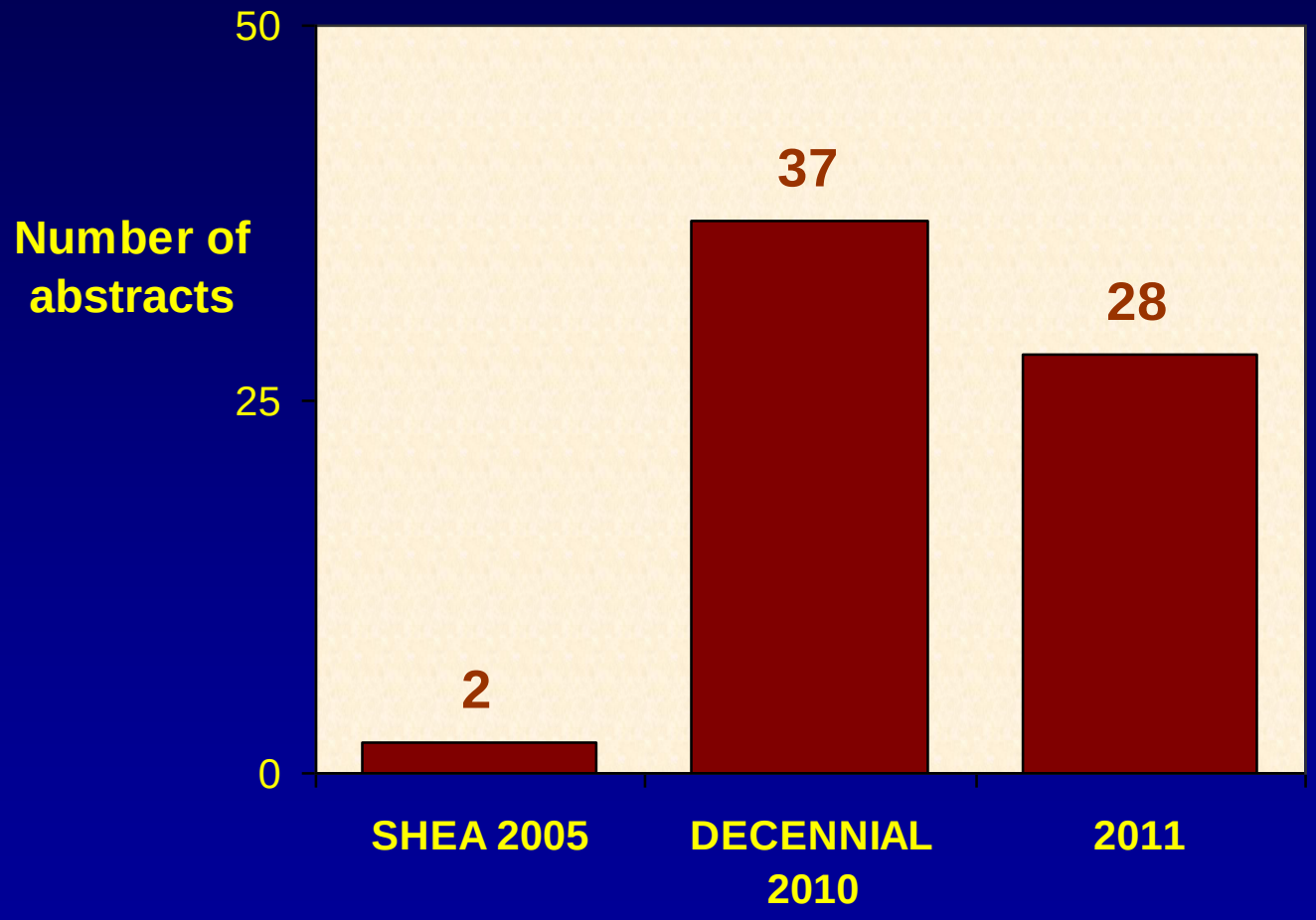
| Healthcare Environmental Cleaning Goal | Shinier Floors | Providing a safer patient environment |
| Near-Patient Surface Bio-burden Reduction | Disinfectant Efficacy | Hygienic Practice (Technologic Enhancements) |

# SHEA abstracts related to surface environmental hygiene issues



# Today's Presentation

- A new understanding healthcare surfaces microbial ecology
- Defining the risk of transmission from surfaces
- Addressing suboptimal cleaning practice
- Does improved practice matter?
- Approaches to monitoring hygienic practice in healthcare

# The new (clarified) understanding of the healthcare surface environment

# You Can't Escape from Germs!

# The microbial ecology of patient zone surfaces

**All** pathogens traditionally associated with health care transmission survive well on surfaces

# Survival of Pathogens on Dry Environmental Surfaces

| Pathogen | Survival time on dry environmental surface |
|---|---|
| *C. difficile* | >5 months |
| Staphylococci | 7 months |
| VRE | 4 months |
| Acinetobacter | 5 months |
| Norovirus | 3 weeks |
| Adenovirus | 3 months |
| Rotavirus | 3 months |
| Hepatitis C | 4 weeks |

# Outbreak v. Non-outbreak VRE

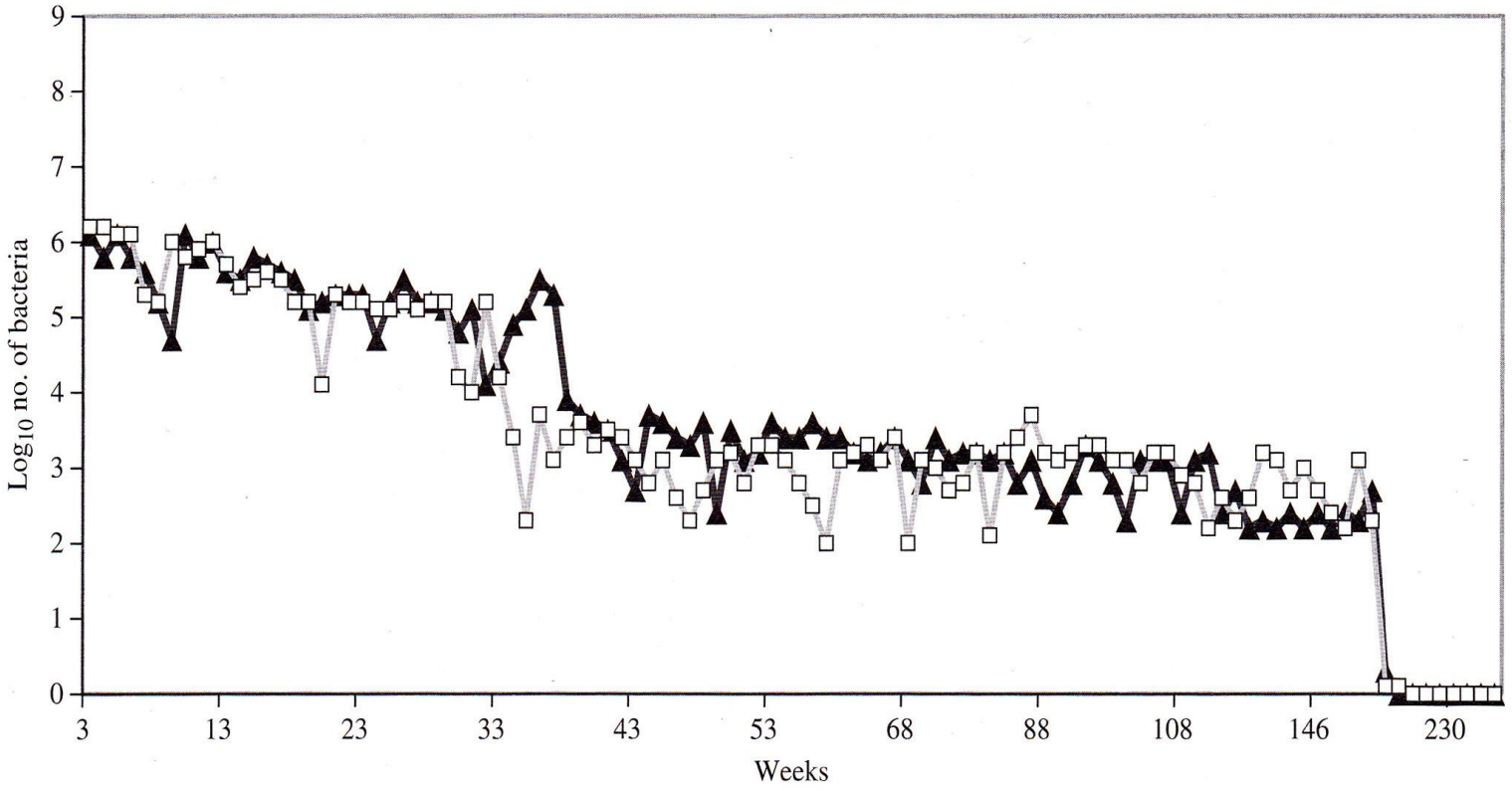



**Figure 1.** Survival of an outbreak strain (E745; open squares) and a non-outbreak strain (E802; filled triangles) of vancomycin-resistant *Enterococcus faecium* (VREFm).

JHI 2011

# The microbial ecology of patient zone surfaces

**All** Pathogens traditionally associated with health care transmission survive well on surfaces

Organism density is generally low but infective doses are low

# The microbial ecology of patient zone surfaces

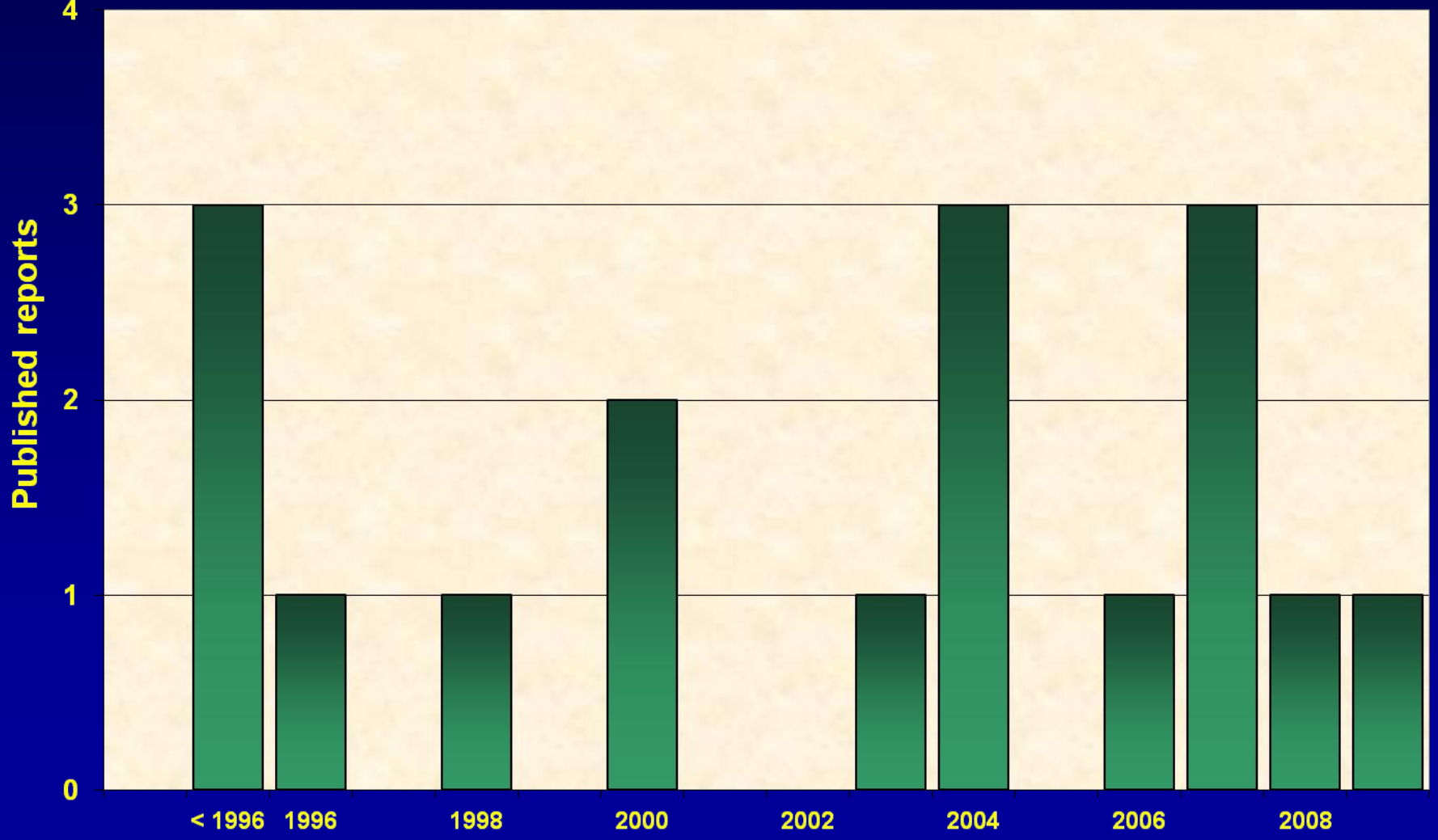
**All** Pathogens traditionally associated with health care transmission survive well on surfaces

Organism density is generally low but infective doses are low

Most near-patient surfaces are sterile or contain < 2.5 ACC / $cm^{2.}$ Therefore, simple cleanliness (culture, ATP) can not be used as a surrogate for thoroughness of cleaning

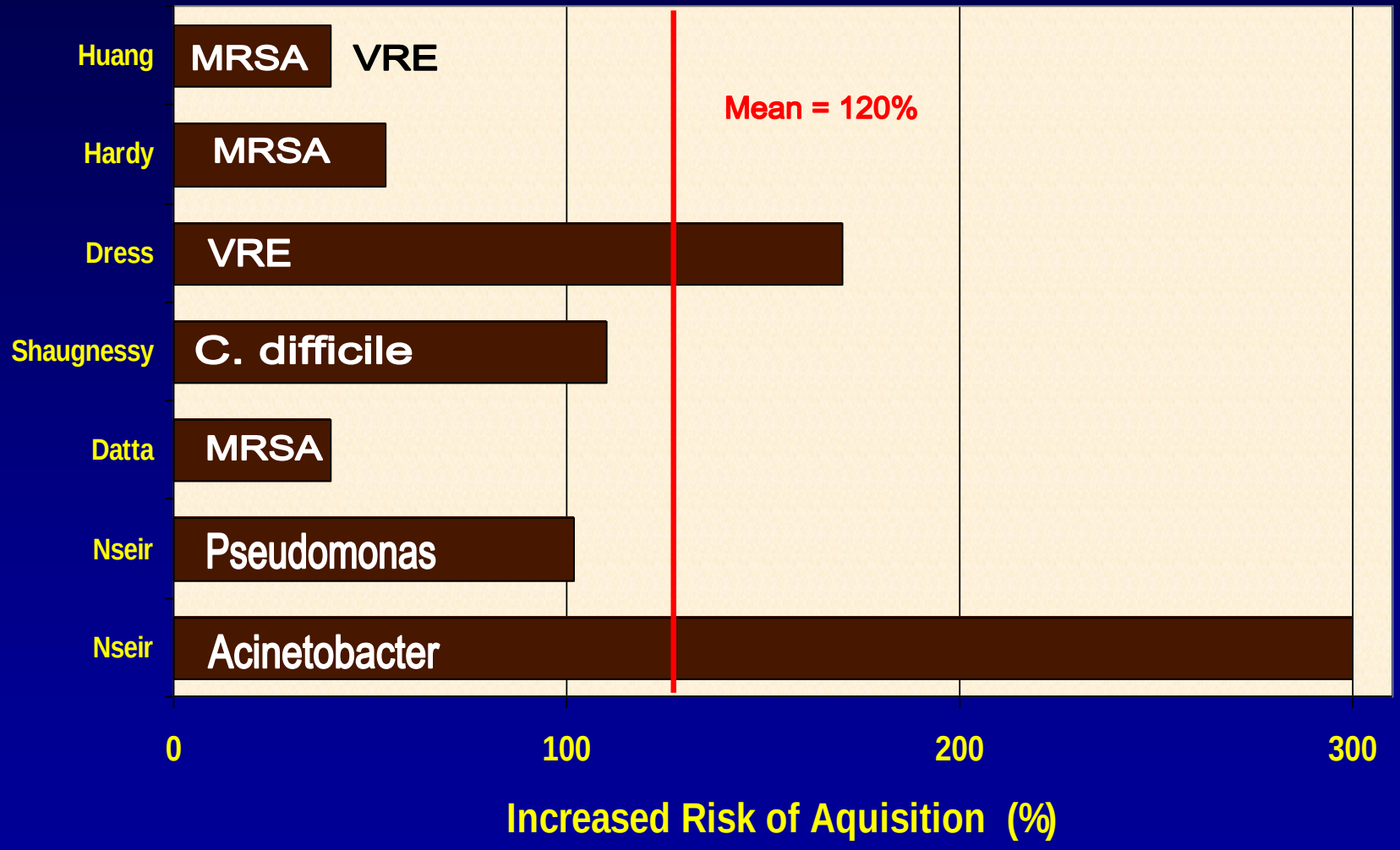
# Defining the risk of transmission

# Studies reporting a favorable impact of enhanced environmental hygiene during a CDAD outbreak



# Increased acquisition risk from prior room occupant

## 8 studies as of October 2010




Two additional studies showed very significant risk without quantification – Martinez (VRE) and Wilks (Acinetobacter)

Is there a better programmatic model ?

# The Health Care Environmental Hygiene Study Group Hospitals Program

To develop a surrogate marking system to objectively evaluate and improve the thoroughness of environmental cleaning/disinfection of the near-patient environment

# The Targeting Solution

A mixture of several glues, soaps and a targeting dye which:

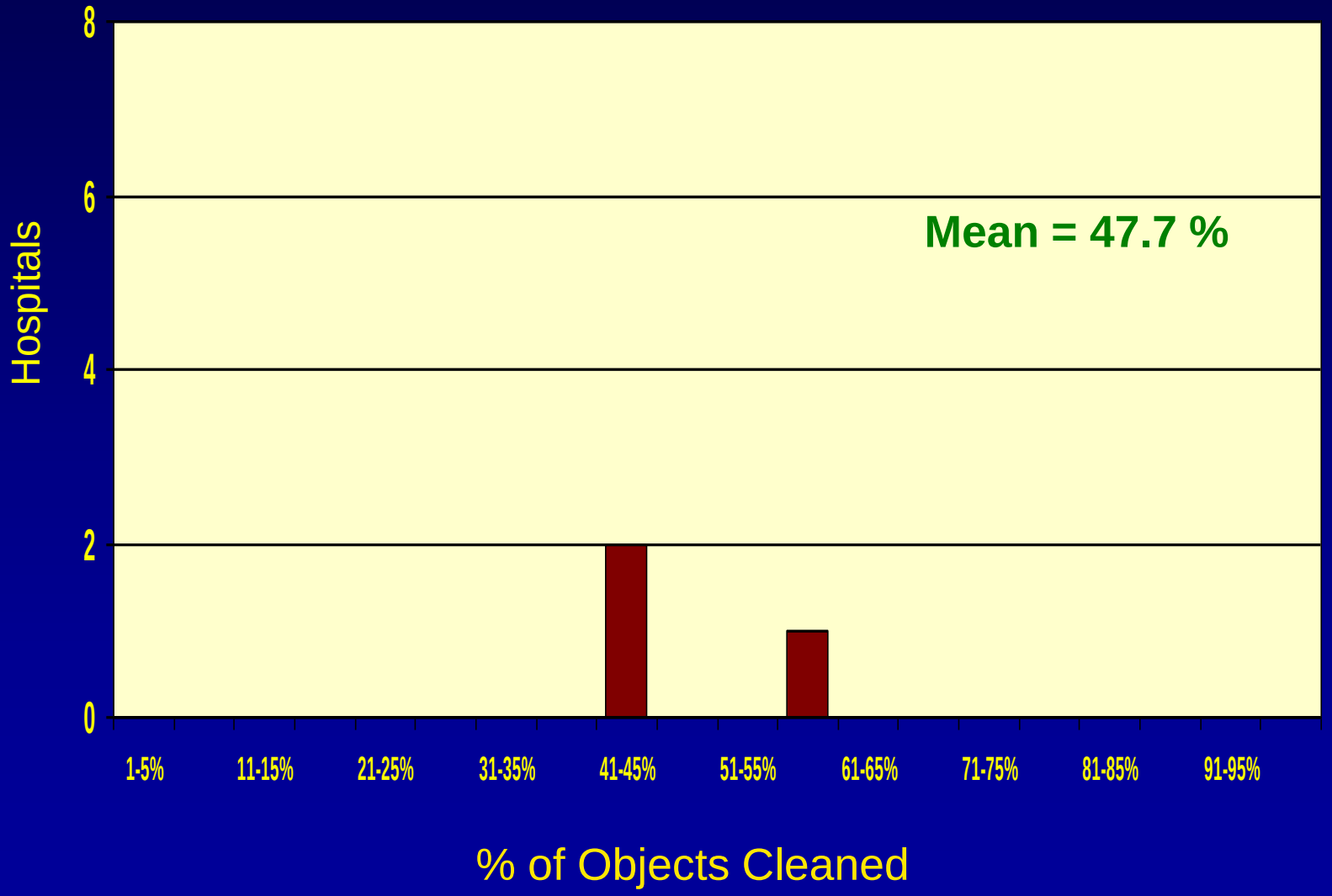
- Dries rapidly
- Environmentally stable
- Readily wetted by spray disinfectants
- Easily removed with light abrasion
- Inconspicuous

# Target After Marking

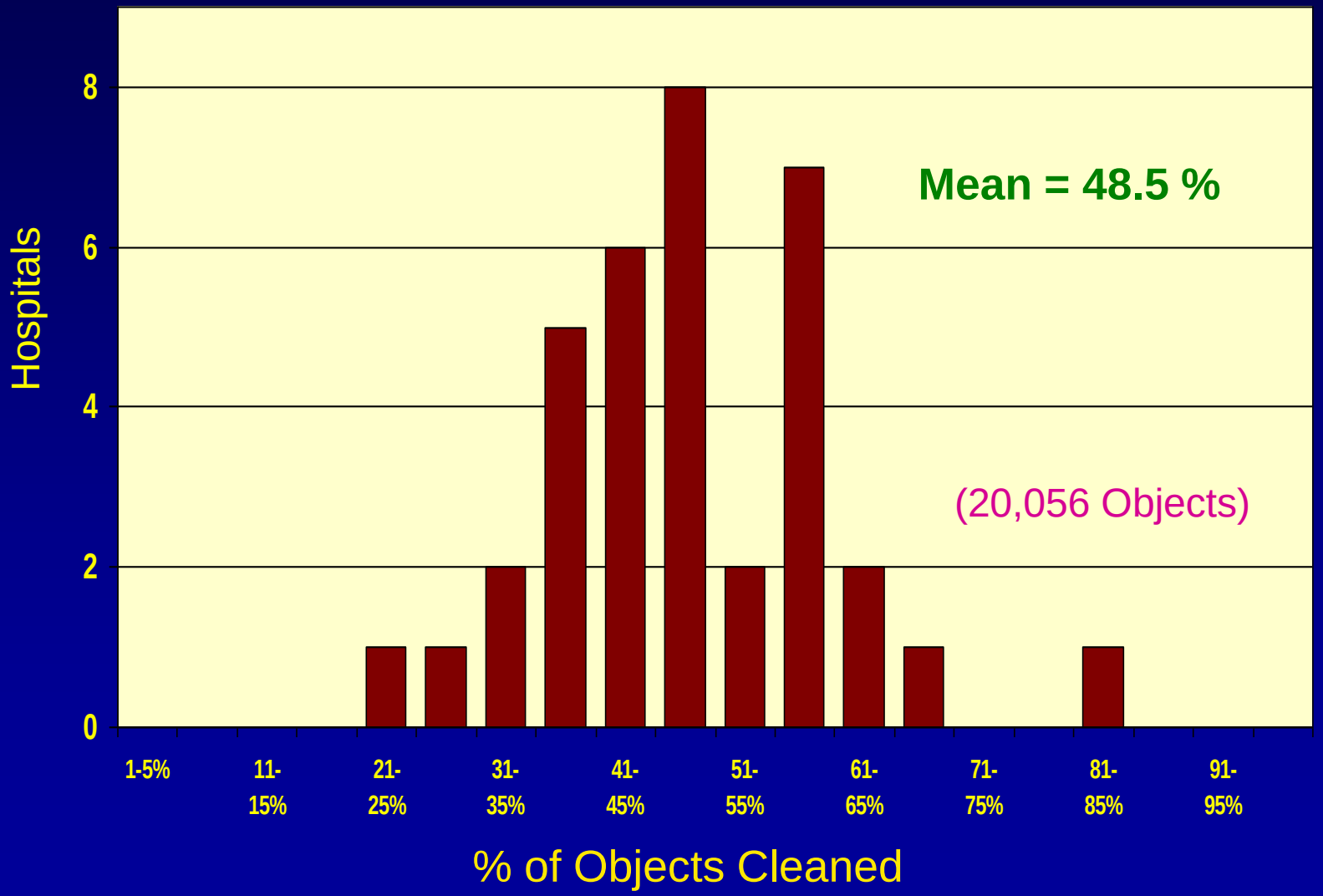
# Target Enhanced

Evaluation of the thoroughness of disinfection cleaning has shown substantial opportunities for improvement in all health care venues studied in the U.S., Canada, Ireland and Australia

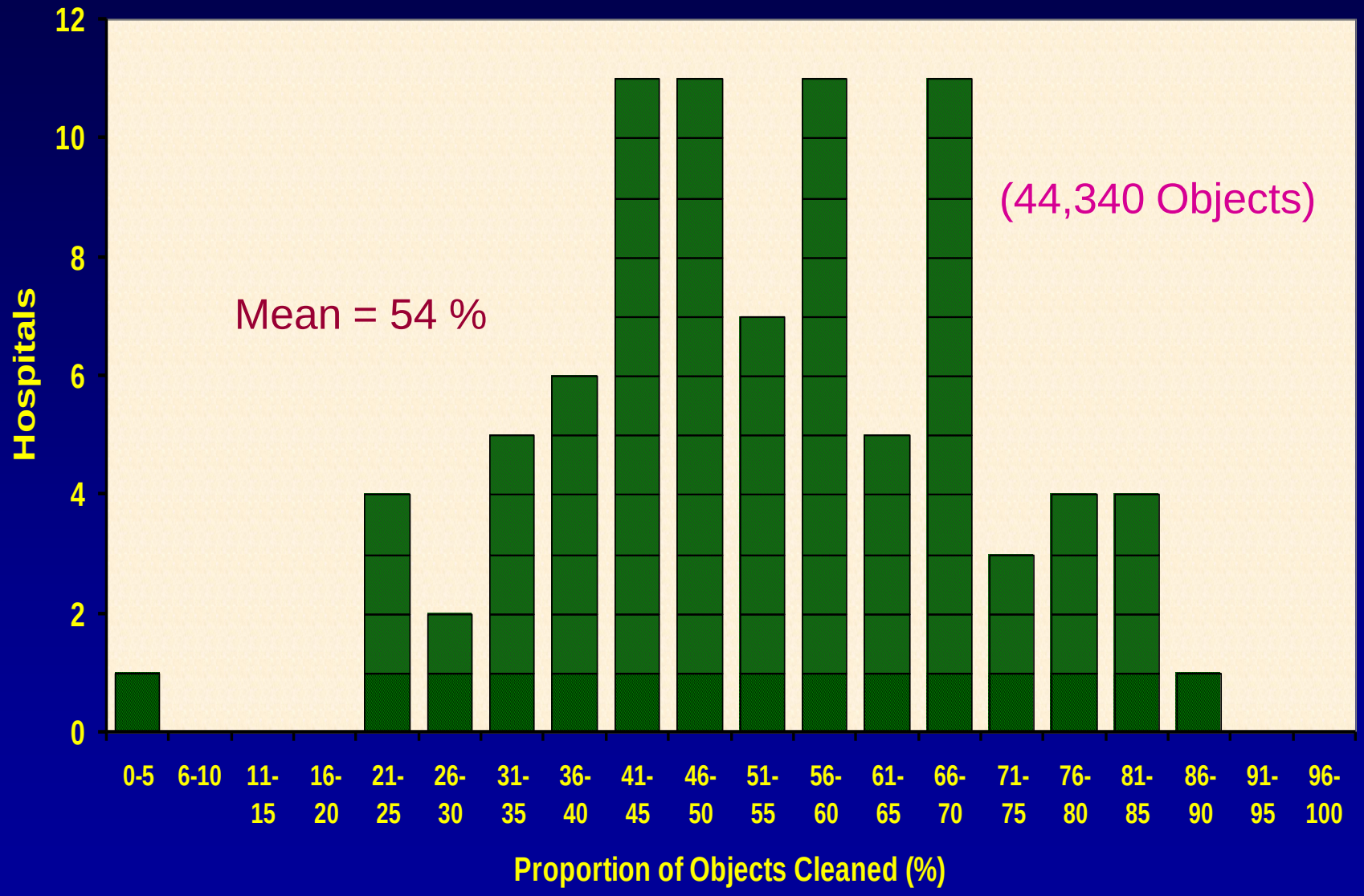
# Baseline Environmental Evaluation of 3 Acute Care Hospitals



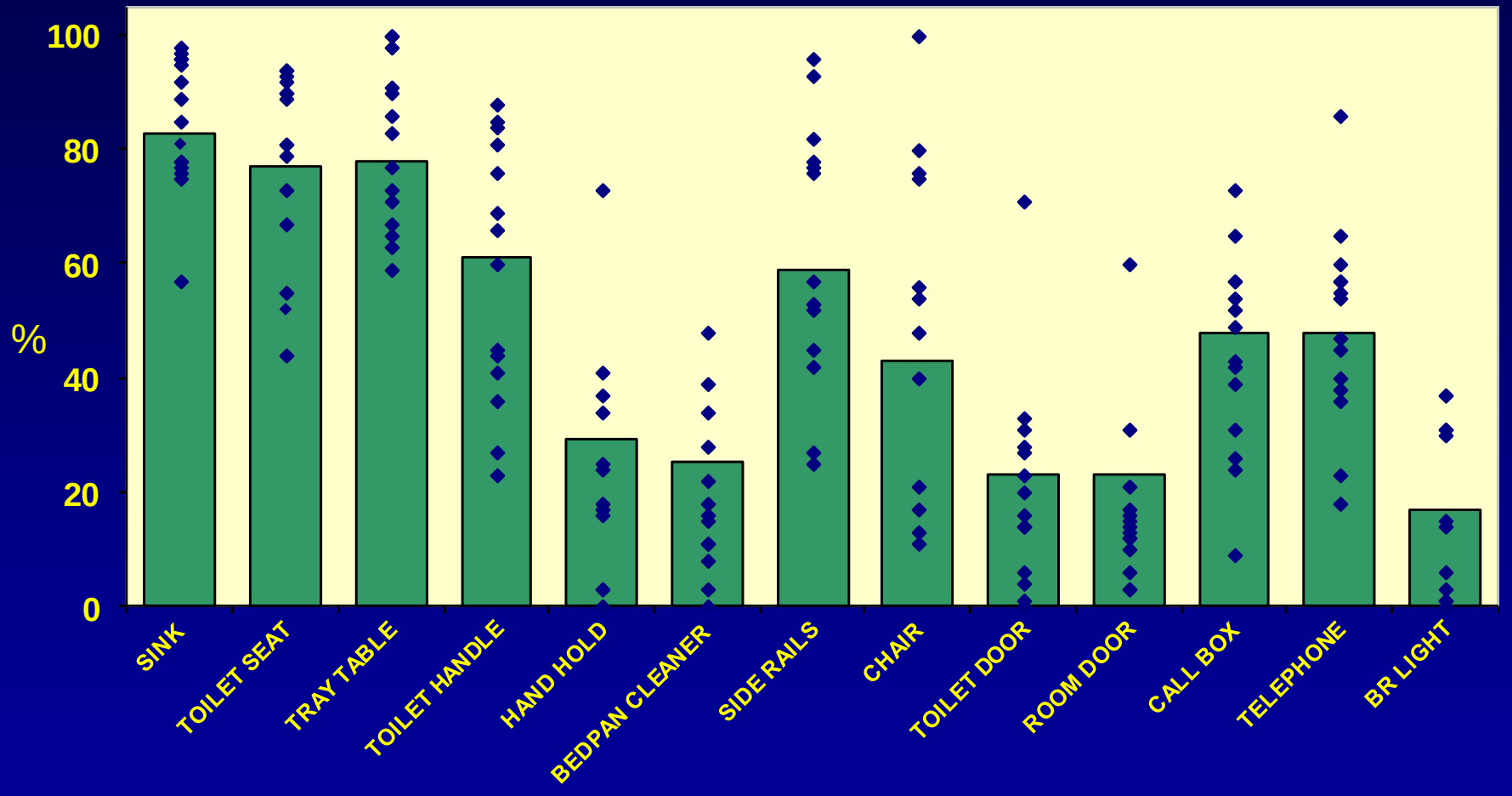
# Baseline Environmental Evaluation of 35 Acute Care Hospitals



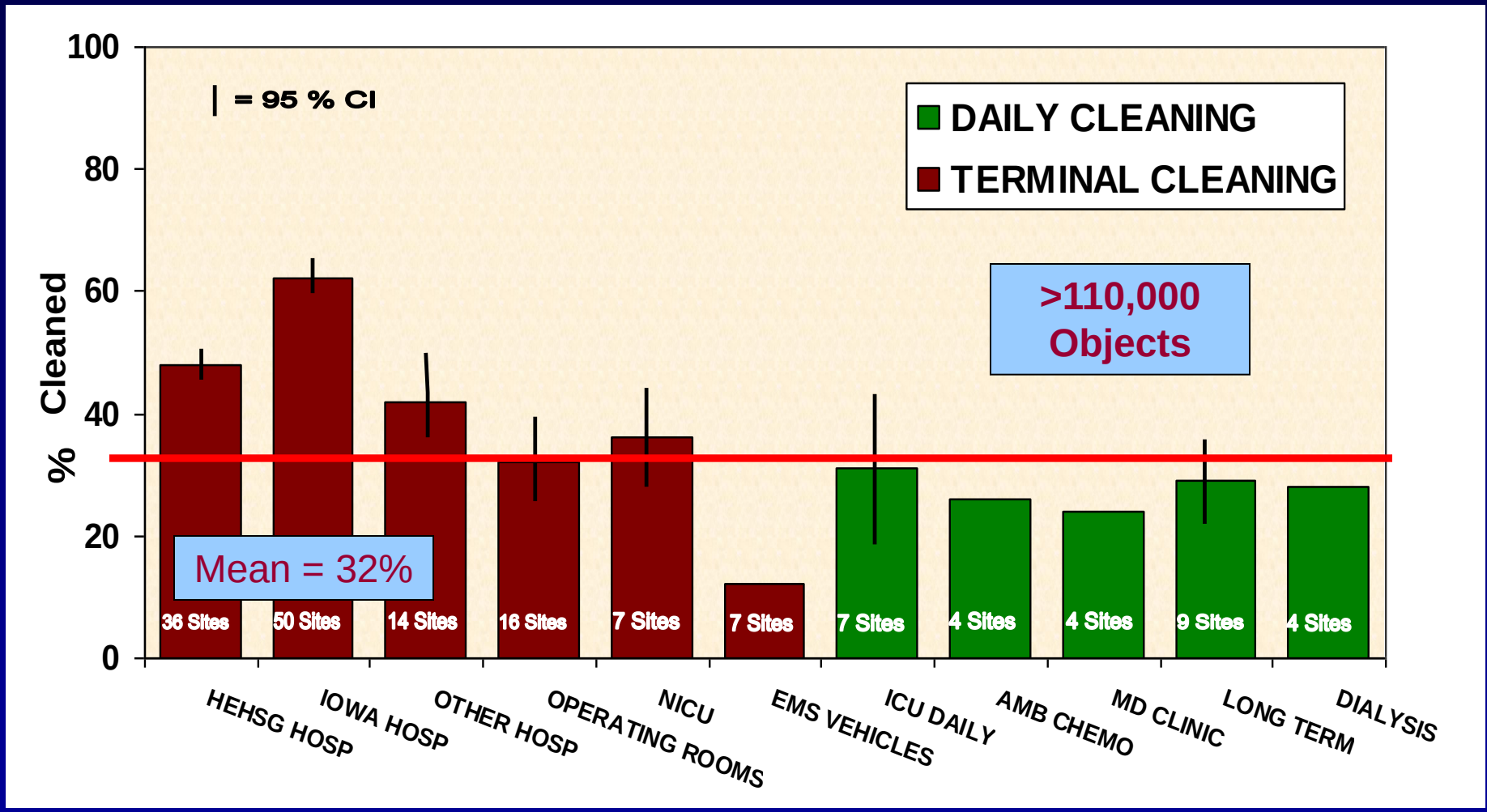
# Baseline Environmental Evaluation of 82 Acute Care Hospitals



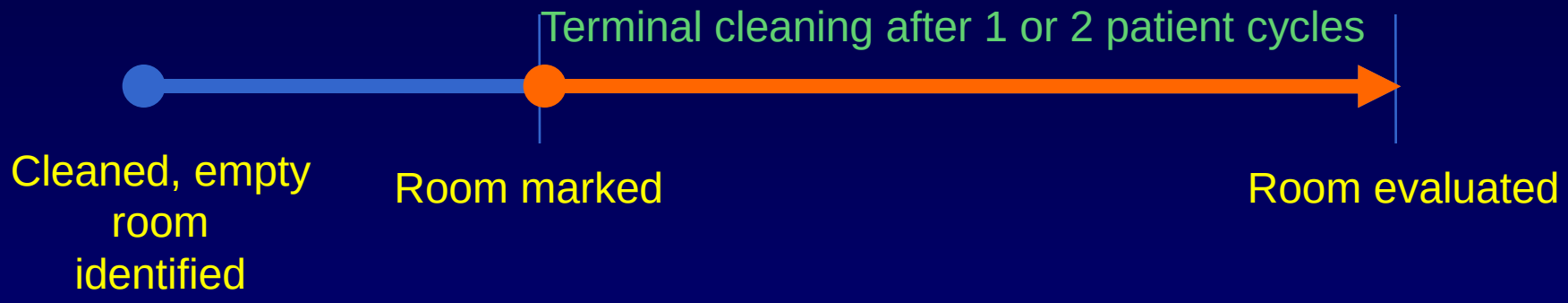
# PROPORTION OF OBJECTS CLEANED AS PART OF TERMINAL ROOM CLEANING IN 20 ACUTE CARE HOSPITALS



# Thoroughness of Environmental Cleaning

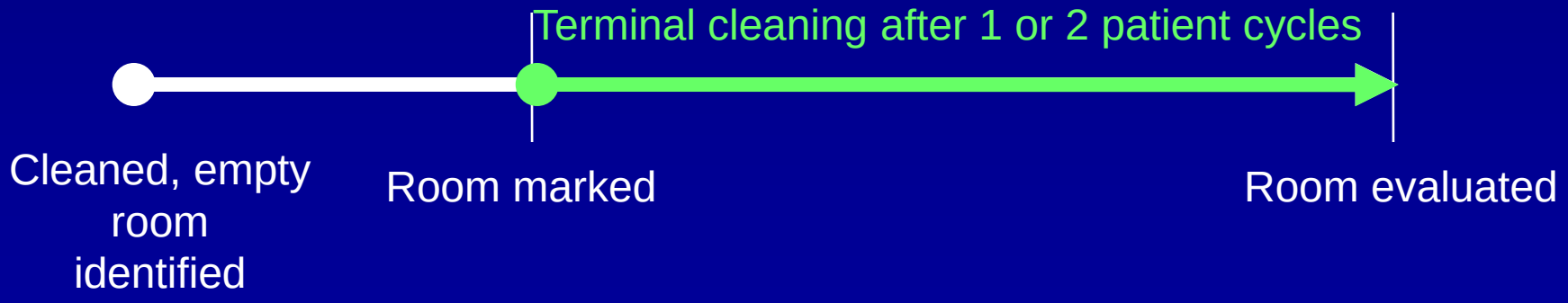


## Phase I: Covert Baseline Environmental Cleaning Evaluation




## Phase II: A. Programmatic Analysis
## B. Educational Interventions – ES staff

## Phase III: Re-evaluation of Cleaning and feedback to ES



INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY NOVEMBER 2008, VOL. 29, NO. 11

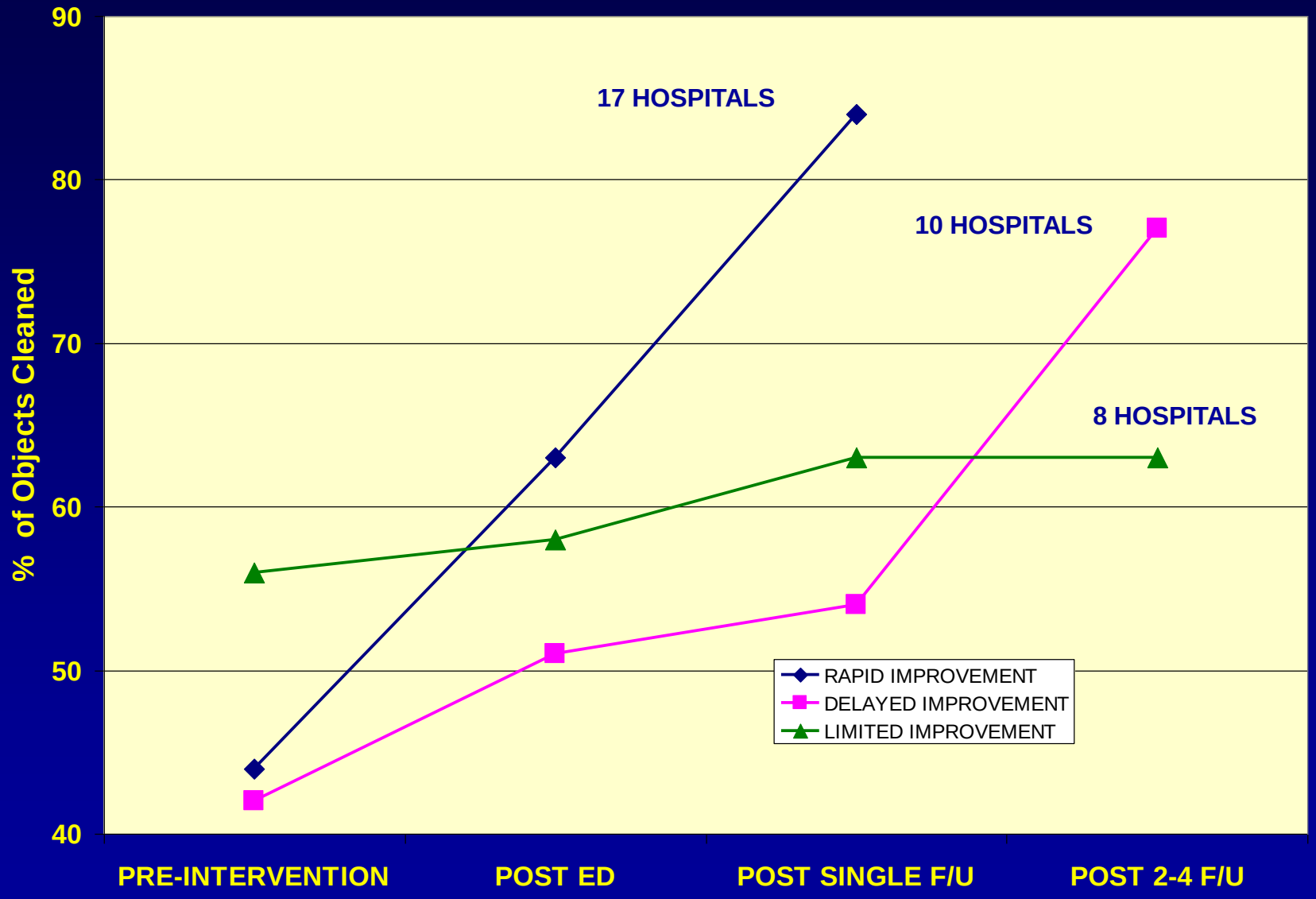
ORIGINAL ARTICLE

# Improving Cleaning of the Environment Surrounding Patients in 36 Acute Care Hospitals

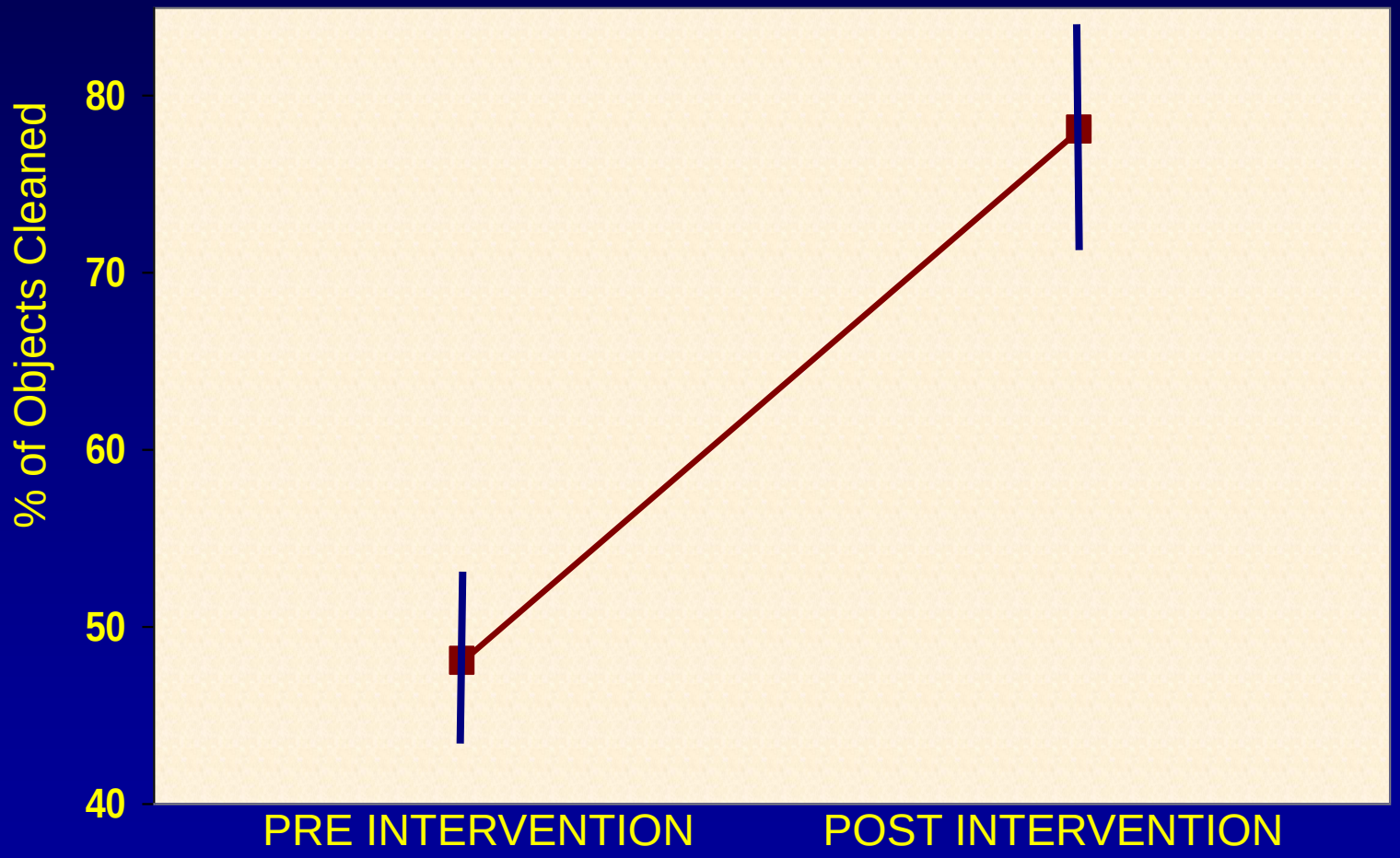
Philip C. Carling, MD; Michael M. Parry, MD; Mark E. Rupp, MD; John L. Po, MD, PhD; Brian Dick, MS, CIC; Sandra Von Beheren, RN, BSN, MS, CIC; for the Healthcare Environmental Hygiene Study Group

## RESULTS

# Terminal Room **Cleaning** Project – Three Programmatic Responses



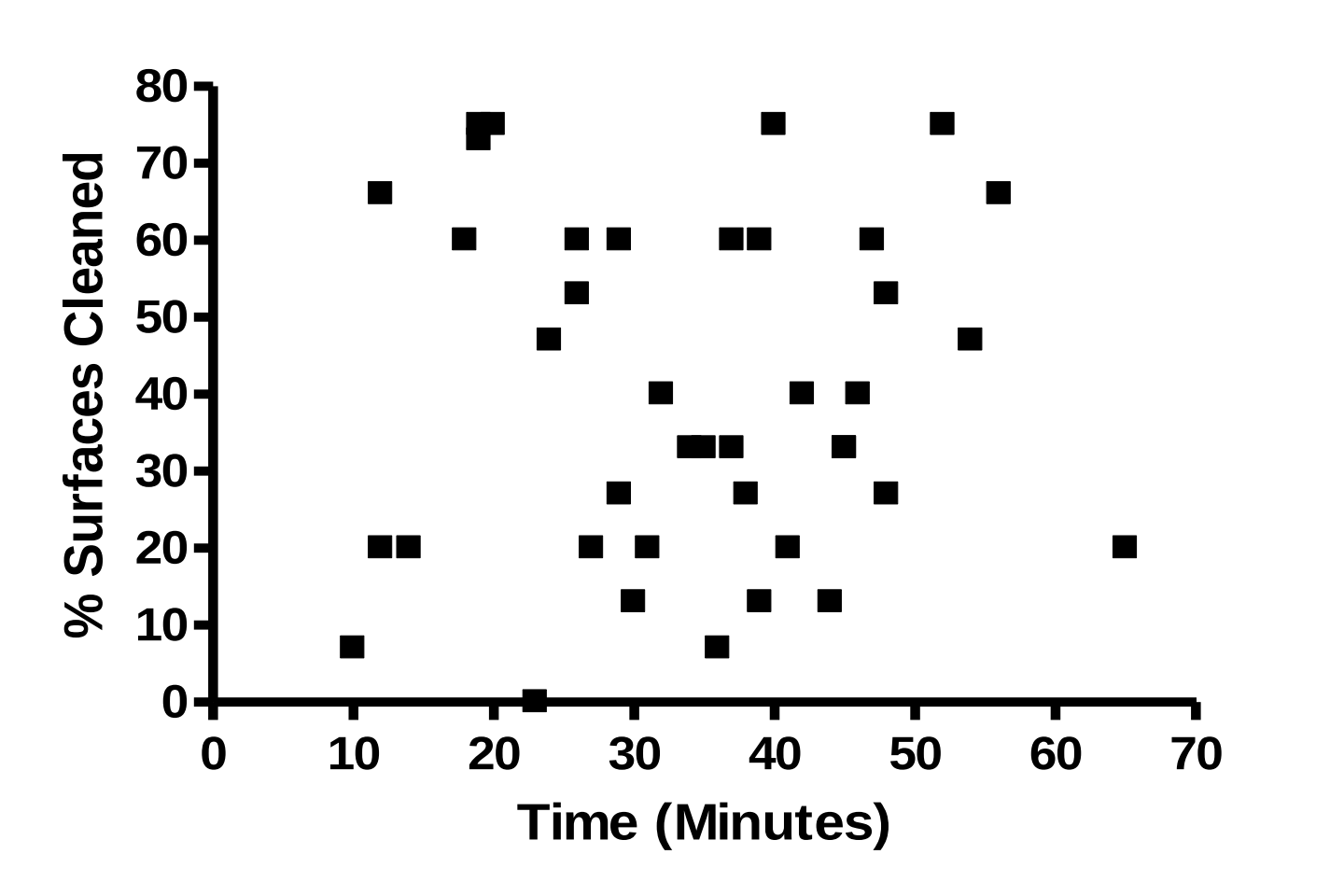
# Hospitals Environmental Hygiene Study Group
# 36 Hospital Results




Resource Neutral

P = <.0001

# Is it a surprise that this degree of improvement was resource neutral ??




Terminal Cleaning

Rupp ME, Adler A, Schellen M, Abstract 203 Fifth Decennial

So much for acute hospitals what about long term care?

# THE SNF ENVIRONMENTAL HYGIENE STUDY
# PICTORAL PRIMER

*In this section:*

1. *Introduction*
2. *Pictoral examples of objects marked*
3. *Optimal marking and evaluation after cleaning*

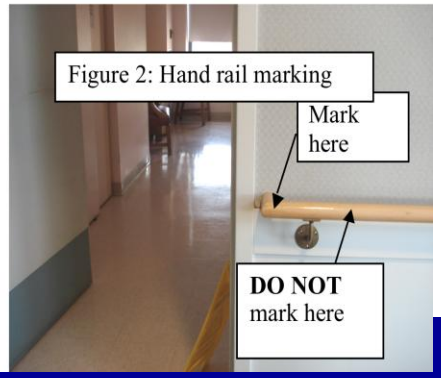
FIGURE 1: A patient room in a SNF

Unlike hospital ward rooms and similar rooms found in acute care facilities, patient rooms in SNFs are much more individualized, providing greater challenges in determining what areas can be marked in a consistent manner. Figure 1 represents a patient's room in a SNF which contains many personal items as well as objects which have been associated with the transmission of bacterial and viral pathogens.

## PICTORAL EXAMPLES OF COMMON AREA OBJECT MARKING

**Handrails**

For handrails (Figure 2), the optimal place for marking is at the end of the rail. Mark the face of the rail rather than on top to minimize the chance of hand contact with the target. Marking near the terminus of a rail will decrease the chance of the target being accidently removed,



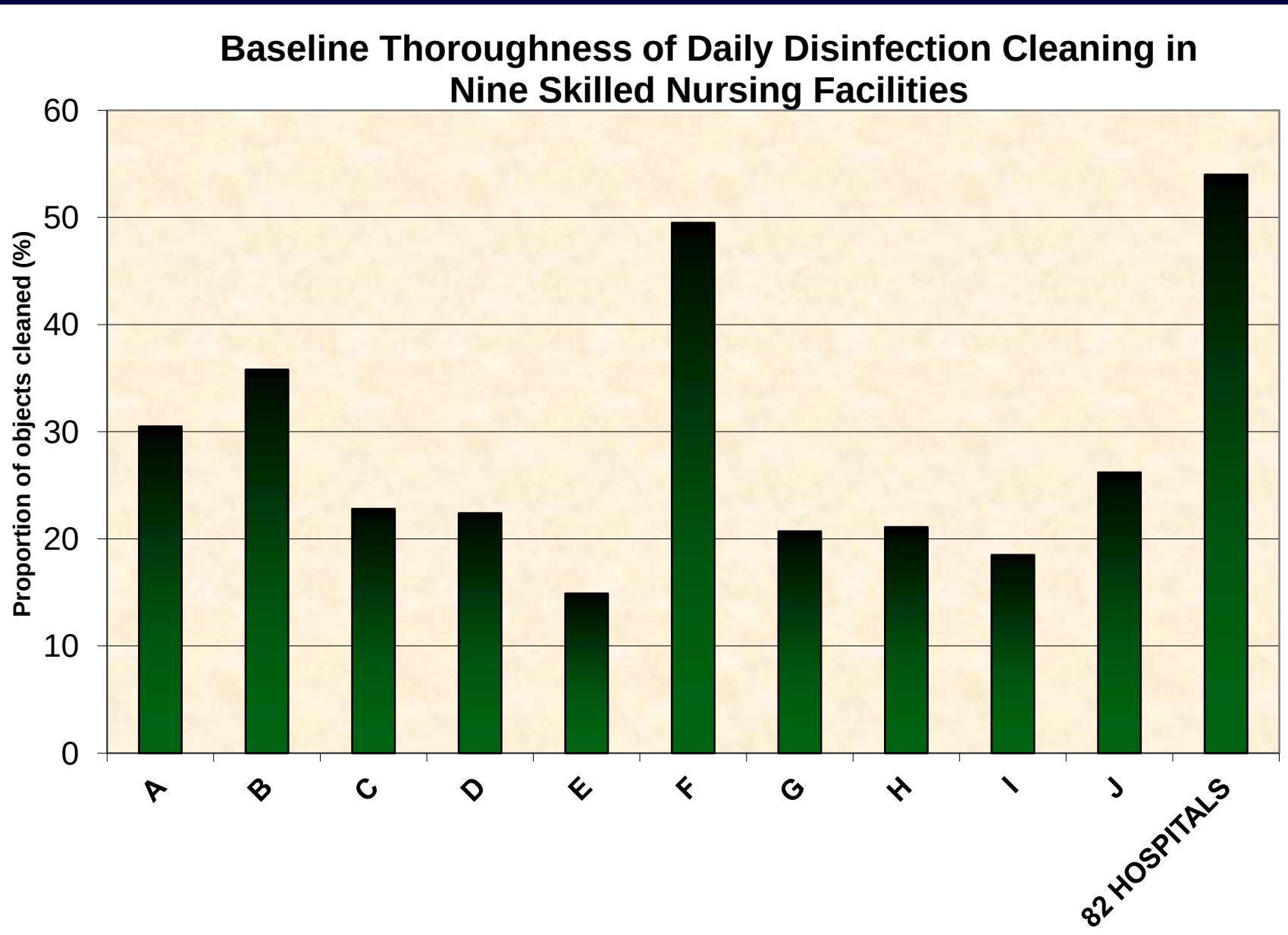

**Patient Lifts and Scales**

The lift control panel and handle should be marked and the scale control panel and the metal part of the hand hold should be marked" (Figure 6 A and B). Since these devices may be moved around the facility, it is recommended that an additional mark be placed in an area that will not be cleaned to allow the device can be "tracked down" to determine whether or not the object is actually the one marked for evaluation or an identical unmarked object.

Figures 6, A and B: Note arrows

A: MECHANICAL PATIENT LIFT

B: PATIENT SCALE


Baseline Thoroughness of Daily Disinfection Cleaning in Nine Skilled Nursing Facilities
Proportion of objects cleaned (%)
60
50
40
30
20
10
0
A
B
C
D
E
F
G
H
I
J
82 HOSPITALS

CLINICAL INVESTIGATIONS

# Methicillin-Resistant *Staphylococcus aureus* Burden in Nursing Homes Associated with Environmental Contamination of Common Areas

*Courtney R. Murphy, MS,[*] Samantha J. Eells, MPH,[†] Victor Quan, BA,[‡] Diane Kim, BS,[‡] Ellena Peterson, PhD,[§] Loren G. Miller, MD, MPH,[†] and Susan S. Huang, MD, MPH[‡]*

J. of the American Geriatrics Society – July 2012

Table 2. Multivariate Analysis of Methicillin-Resistant *Staphylococcus aureus* (MRSA)-Positive Objects and Nonremoval of Cleaning Marks

| Variable | Odds Ratio (95% Confidence Interval) | *P*-Value |
|---|---|---|
| MRSA-positive culture | | |
| High MRSA delta prevalence group[a] | 2.8 (1.4–5.9) | .005 |
| Less time spent cleaning per room (per 10 minute reduction) | 2.9 (1.5–5.4) | <.001 |
| Lower frequency of common room cleaning | 1.5 (1.1–2.0) | .01 |
| Nonremoval of cleaning mark | | |
| Object type | | |
| Tables | Reference | |
| Hallway objects | 4.2 (2.4–7.4) | <.001 |
| Chairs | 3.5 (1.6–7.3) | .001 |
| Rehabilitation equipment | 2.4 (1.4–4.3) | .002 |
| Counters | 0.9 (0.4–1.9) | .77 |
| MRSA admission prevalence[b] | 1.2 (1.0–1.4) | .04 |

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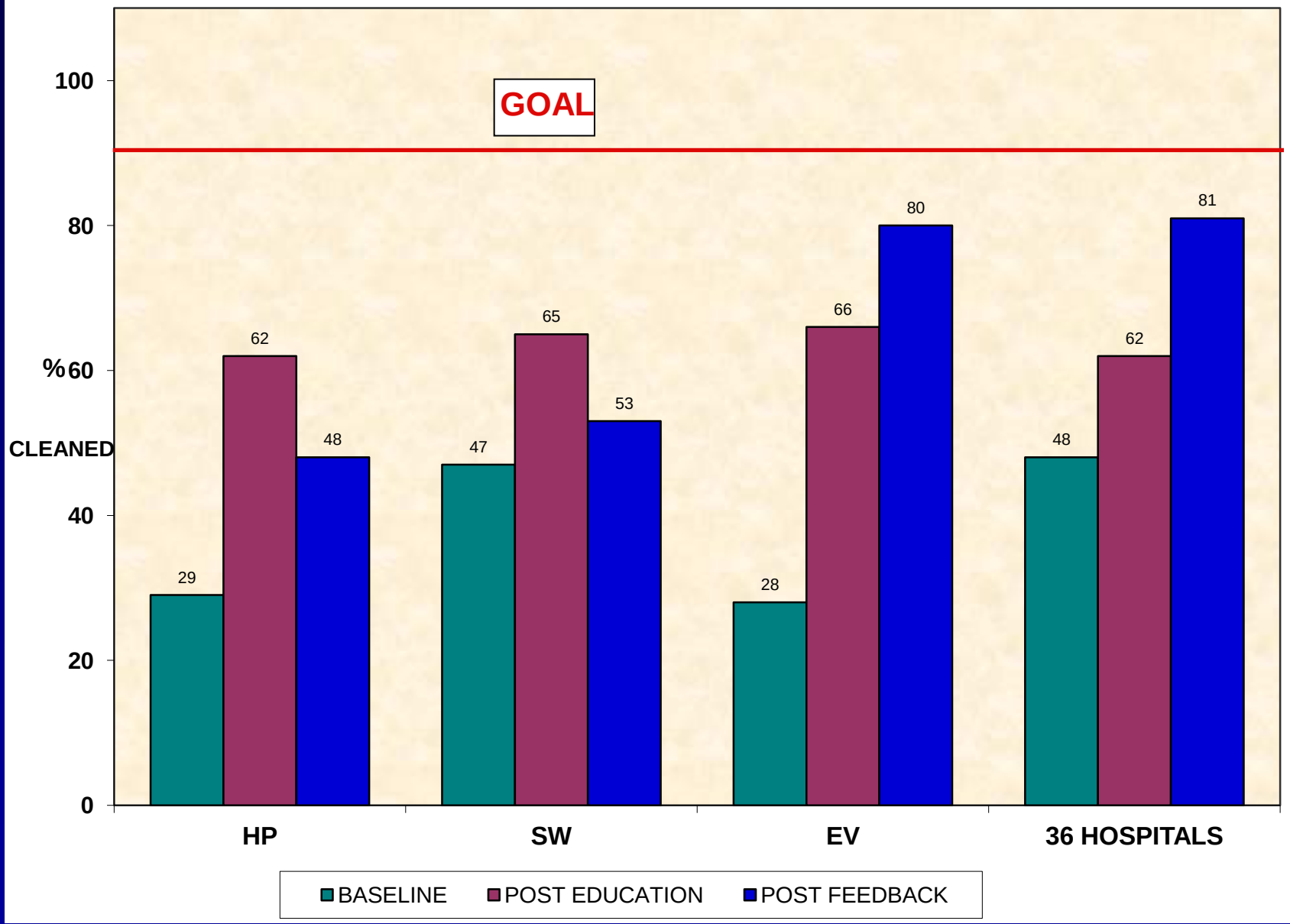
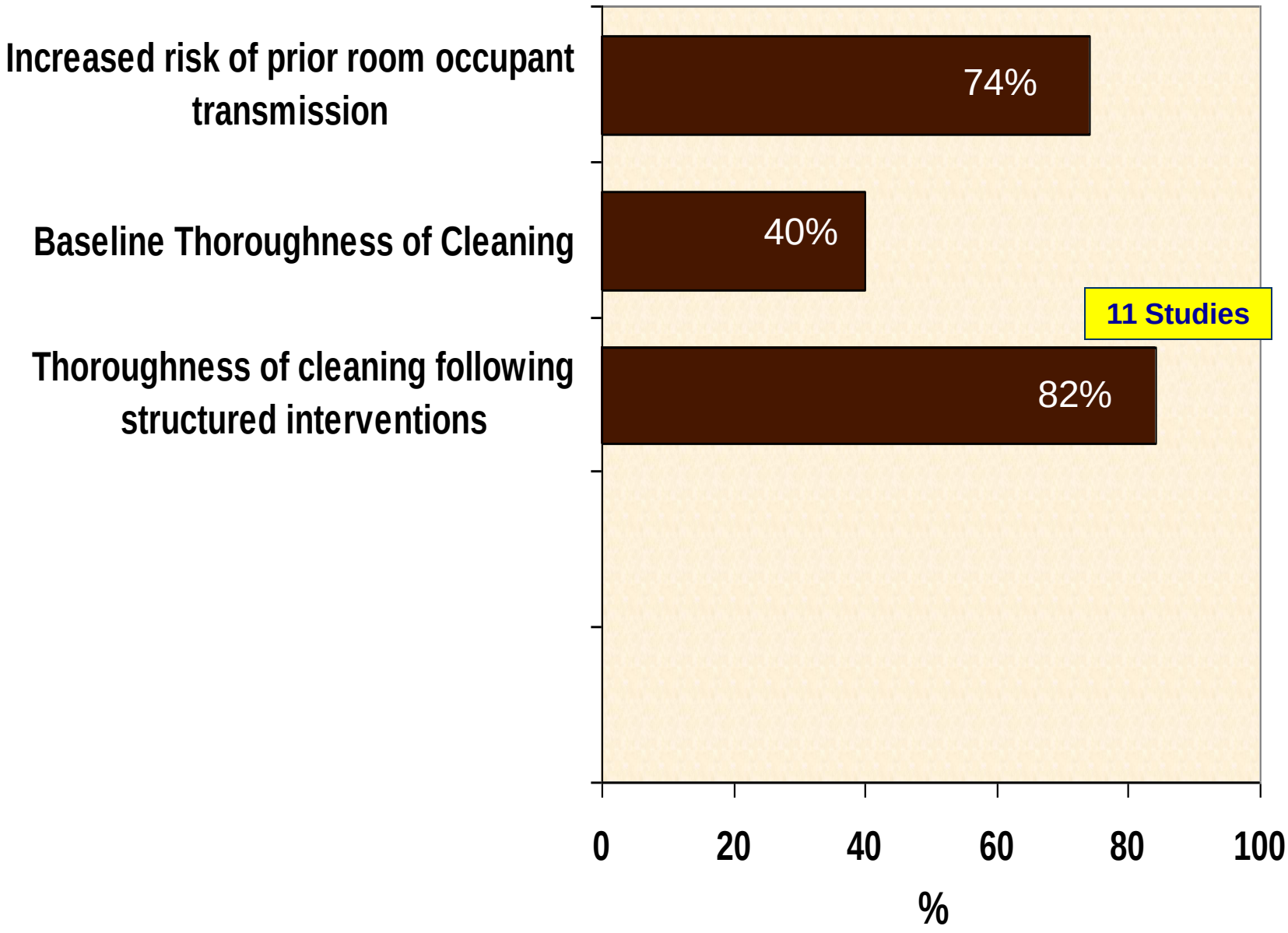
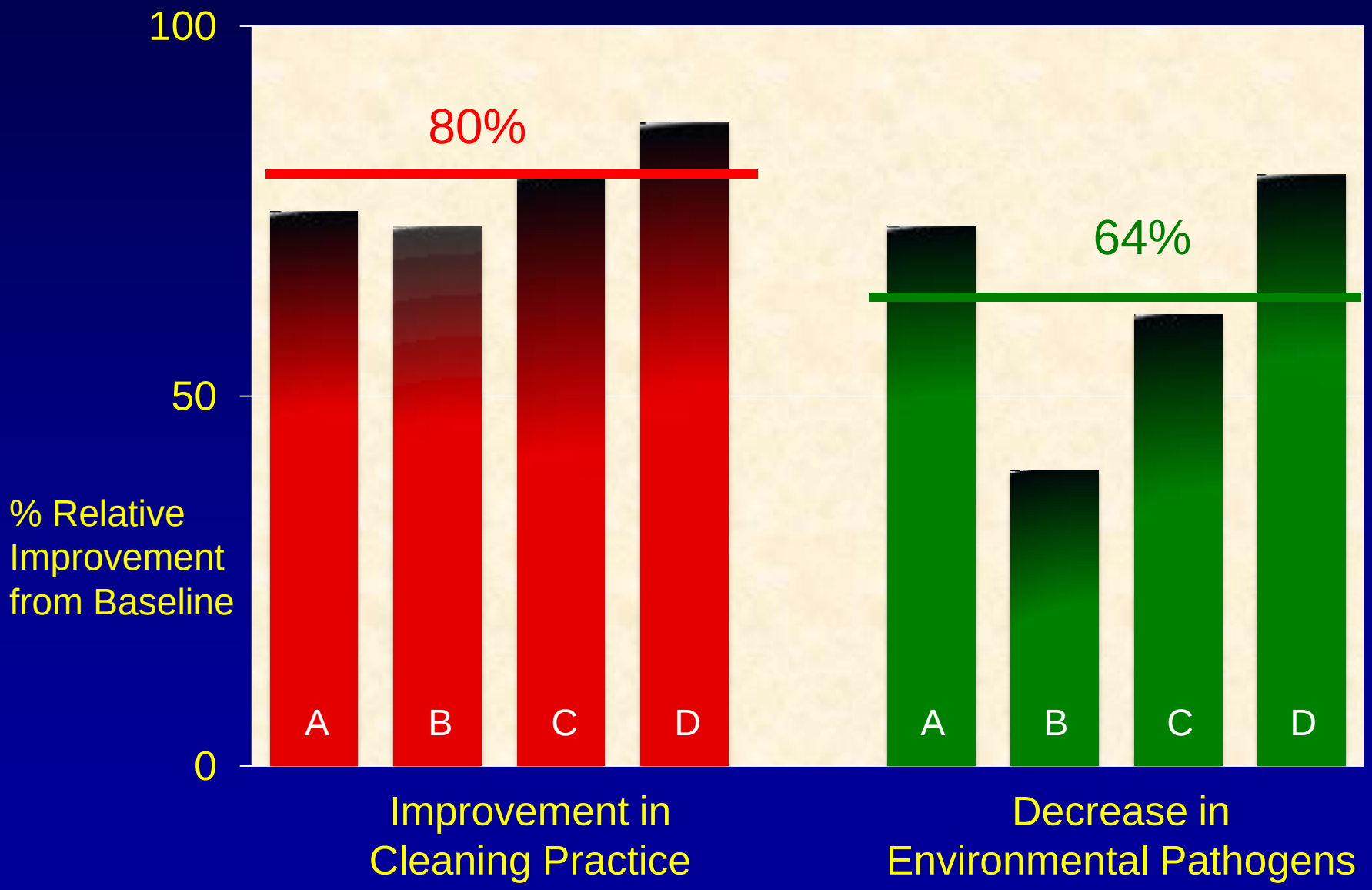
# Patient Safety Environmental Cleaning



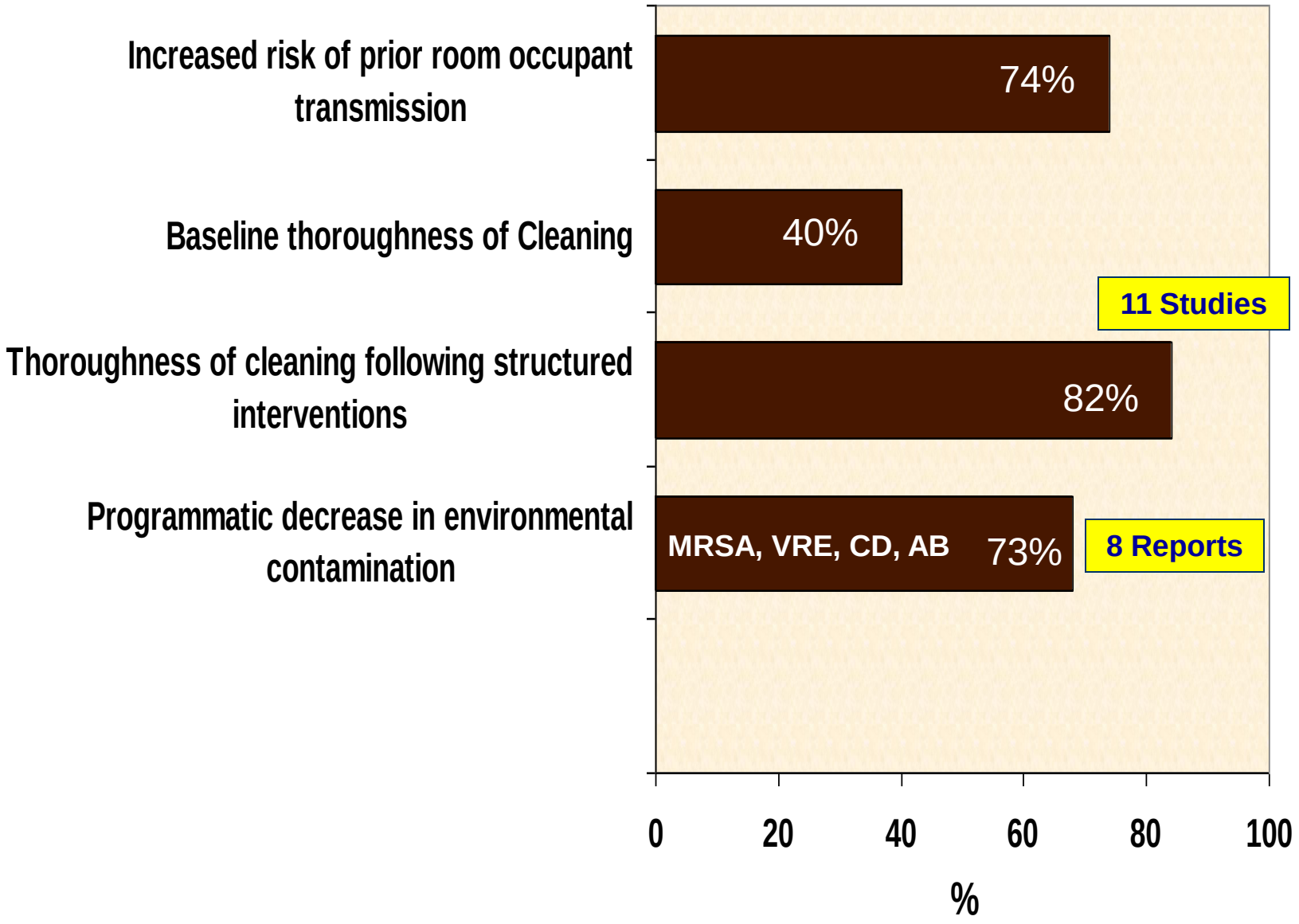

Increased risk of prior room occupant transmission
74%
Baseline Thoroughness of Cleaning
40%
11 Studies
Thoroughness of cleaning following structured interventions
82%
0
20
40
60
80
100
%

Does Improved thoroughness of disinfection decrease surface contamination?

# Improving Disinfection Cleaning to Decrease Environmental Surface Contamination



Improved thoroughness of hygienic cleaning is a worthy goal given the billions of dollars involved…but will it impact transmission of healthcare acquired pathogens (HAPs)?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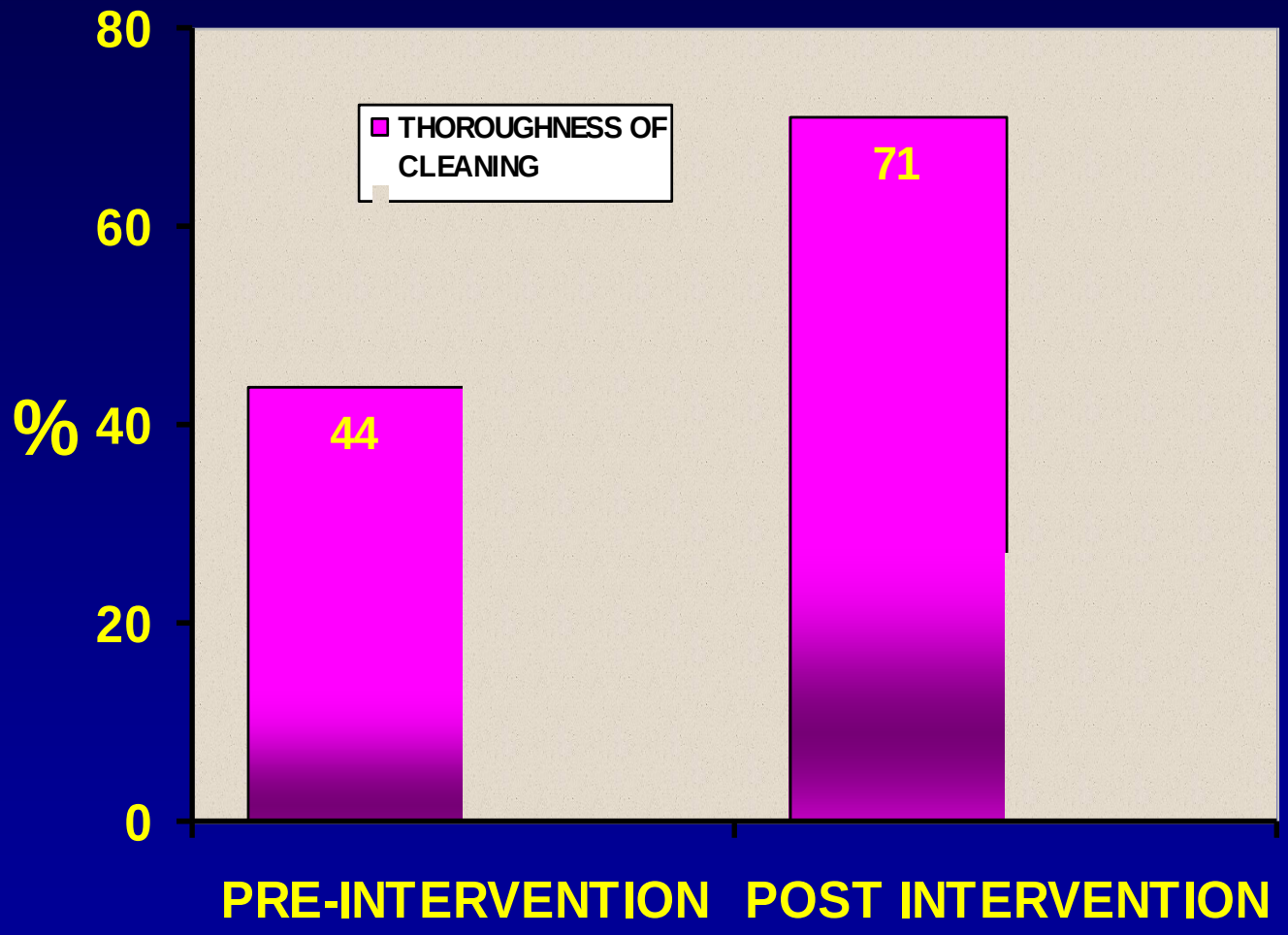
Programmatic decrease in environmental contamination
MRSA, VRE, CD, AB
73%
8 Reports
0
20
40
60
80
100
%

# Brigham & Woman's ICU Study



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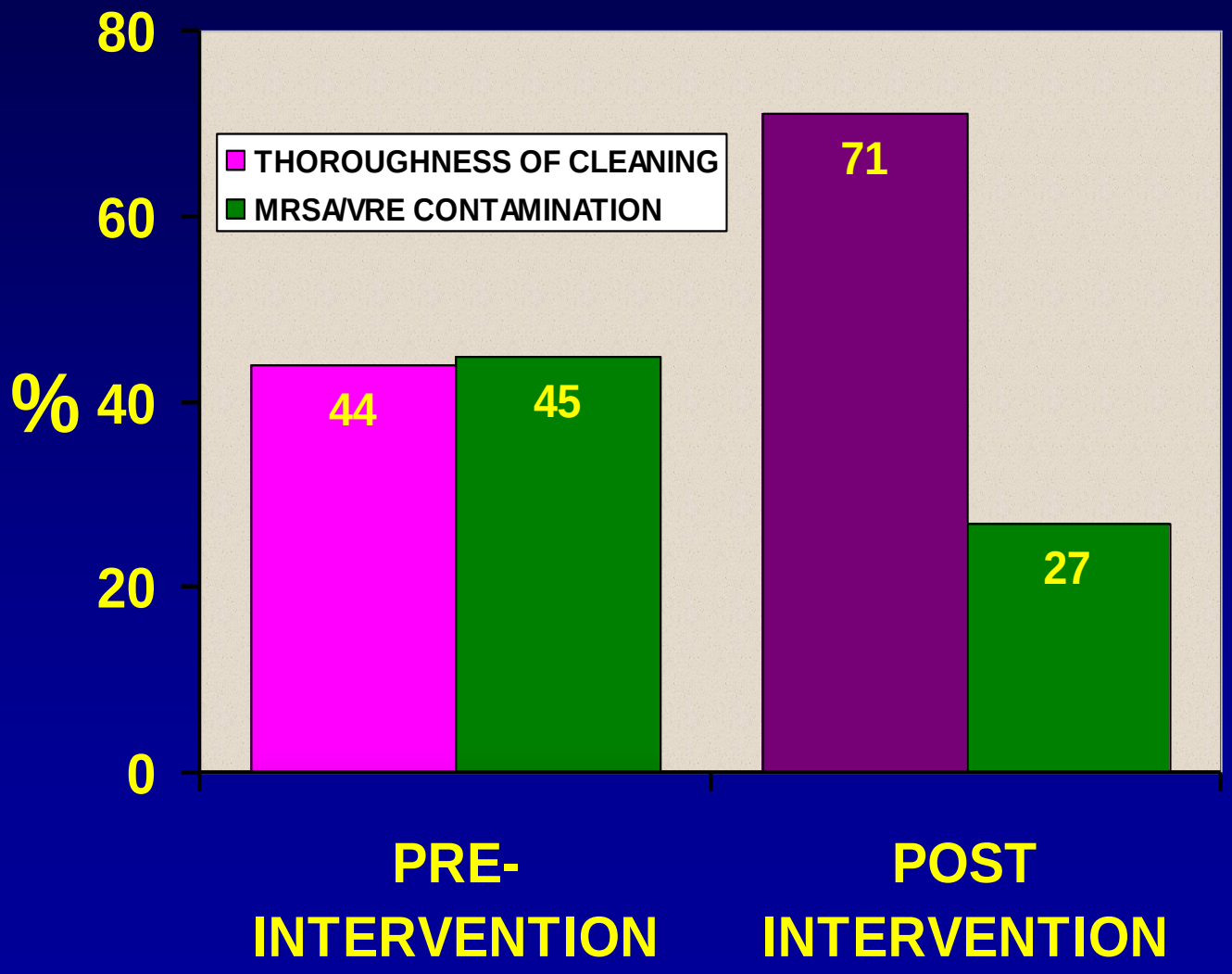

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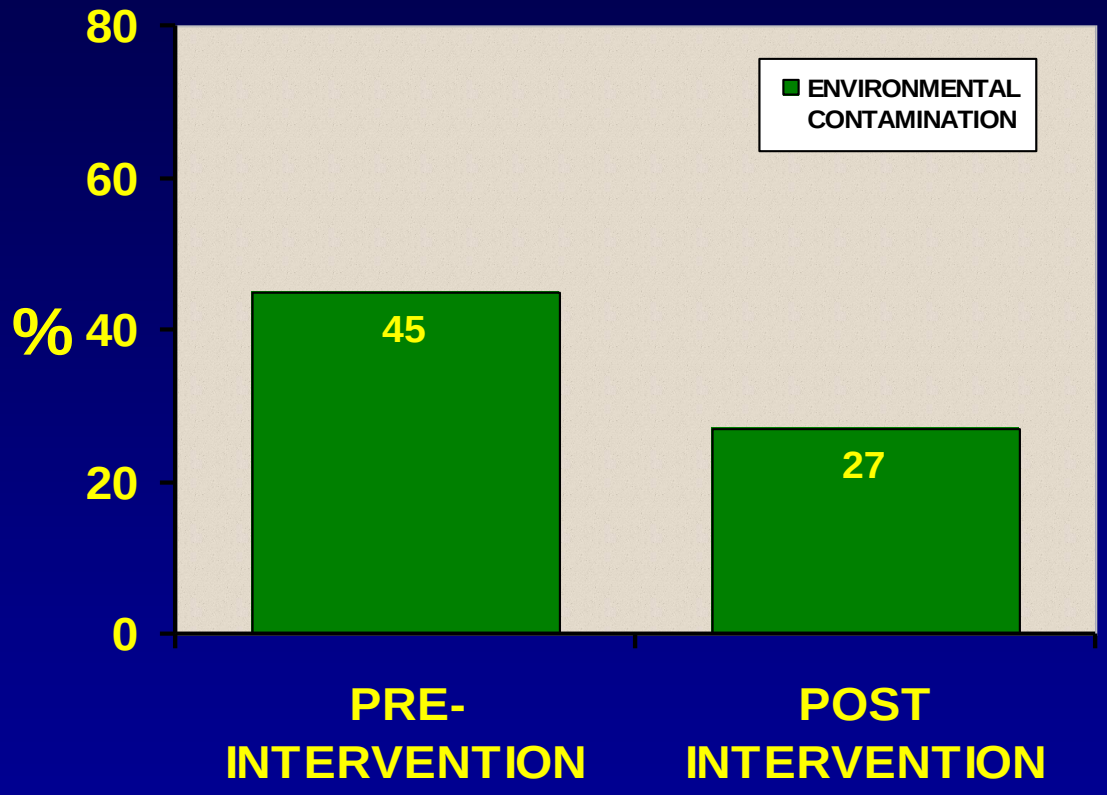
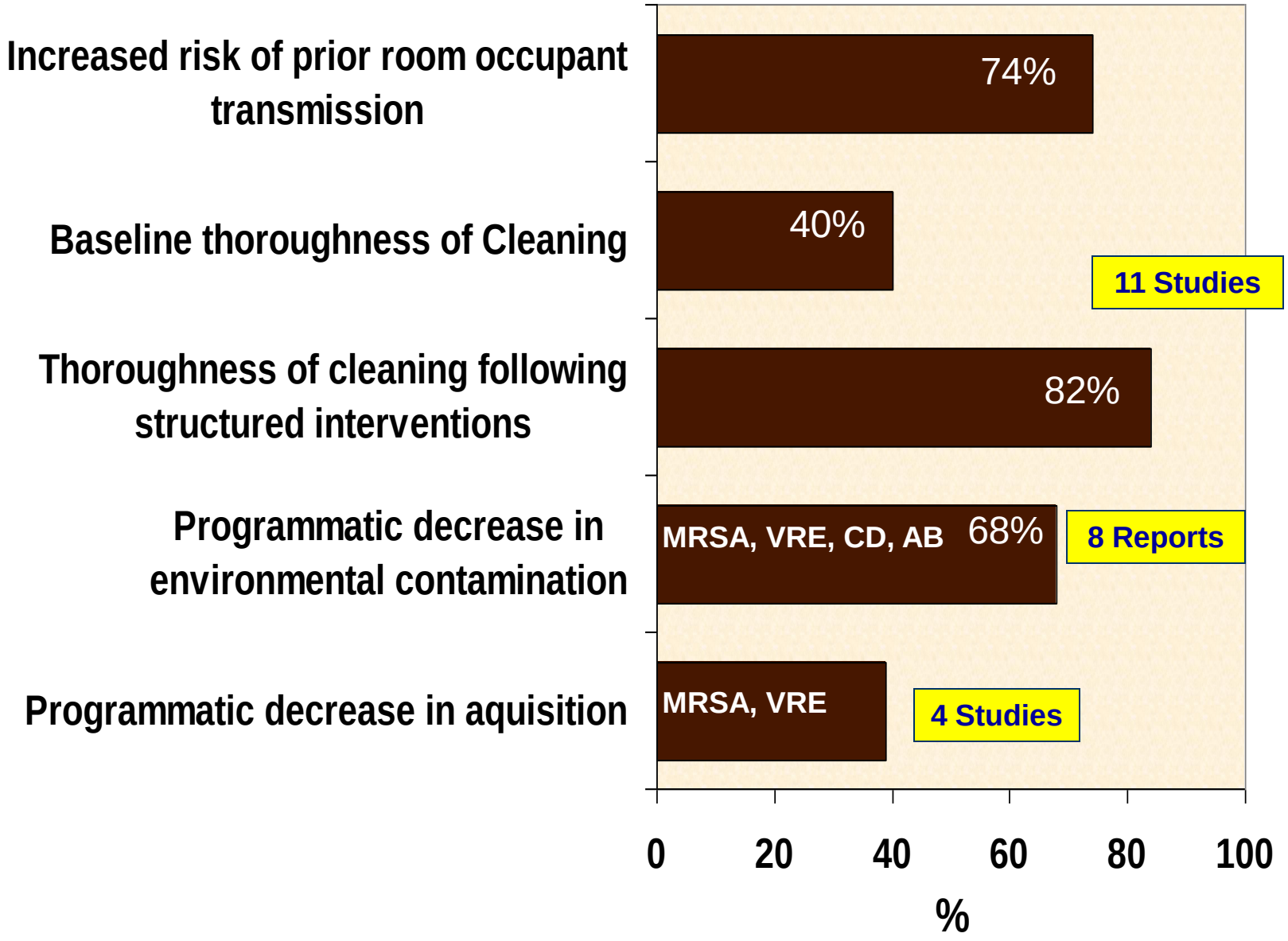



Result of the intervention

MRSA Acquisition Decreased 50% p<0,001)

VRE Acquisition Decreased 28% (p<0.02)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MRSA, VRE, CD, AB
68%
8 Reports
Programmatic decrease in aquisition
MRSA, VRE
4 Studies
0
20
40
60
80
100
%

# CDC Recommendations

Acute Care Hospitals should implement a:

Level I Program:

Basic interventions to optimize disinfection cleaning policies, procedures and ES staff education and practice. When completed move to Level II Program

Level II Program:

All elements of Level I + Objective monitoring

**Options for Evaluating Environmental Cleaning**

October 2010

National Center for Emerging and Zoonotic Infectious Diseases

Division of Healthcare Quality Promotion

CDC

# CDC Recommendations

Web Link:

http://www.cdc.gov/HAI/toolkits/Evaluating-Environmental-Cleaning.html

**Options for Evaluating Environmental Cleaning**

October 2010

National Center for Emerging and Zoonotic Infectious Diseases

Division of Healthcare Quality Promotion

# So much for the why

Let’s get to the how

# First establish a structure for the program

Infection Prevention

AND

Environmental Services

- Early joint planning to define expectations, clarify policies and foster mutual respect
- One sided programs fail on many levels

# Systems of Objectively Monitoring Hygienic Practice

What are the merits and limitations of the tools that can be used to objectively monitor the thoroughness of patient zone cleaning?

# Defining the Difference Between Cleaning and Cleanliness

| | **Cleanliness** | **Cleaning** |
|---|---|---|
| Definition | A measure of bacteria on a surface | Measured by evaluating process |
| Defined Criteria | No “Cleanliness Standard” | Compliance with existing cleaning policy |
| Improvement shown to decrease bacterial transmission (Published) | None | Two |
| Impacted by | Bioburden, thoroughness of recent cleaning, effectivness of disinfectant, recent contamination or lack of | Thoroughness of evaluated cleaning practice |
| CDC endorsed to improve patient safety | No | Yes |

# Evaluating Patient Zone Environmental Cleaning

| Method | Ease of Use | Identifies Pathogens | Accuracy | Useful for Teaching | Use in Programmatic Monitoring |
|---|---|---|---|---|---|
| Direct observation | | | | | |
| Culture swab | | | | | |
| Agar culture system | | | | | |
| Fluorescent system | | | | | |
| ATP Bioluminescence | | | | | |

# Evaluating Patient Zone Environmental Cleaning

| Method | Ease of Use | Identifies Pathogens | Accuracy | Useful for Teaching | Use in Programmatic Monitoring |
|---|---|---|---|---|---|
| **Direct observation** | Low | No | Variable | Yes | Difficult |

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|---|---|---|---|---|---|
| **Direct observation** | Low | No | Variable | Yes | Difficult |
| **Culture swab** | High | Yes | High | No | No |

# Evaluating Patient Zone Environmental Cleaning

| Method | Ease of Use | Identifies Pathogens | Accuracy | Useful for Teaching | Use in Programmatic Monitoring |
|---|---|---|---|---|---|
| **Direct observation** | Low | No | Variable | Yes | Difficult |
| **Culture swab** | High | Yes | High | No | No |
| **Agar culture system** | Moderate | Possible | Moderate | No | Possible* |

* Measures cleanliness at that moment but NOT the process of cleaning

# Evaluating Patient Zone Environmental Cleaning

| Method | Ease of Use | Identifies Pathogens | Accuracy | Useful for Teaching | Use in Programmatic Monitoring |
|---|---|---|---|---|---|
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| Culture swab | High | Yes | High | No | No |
| Agar culture system | Moderate | Possible | Moderate | No | Possible* |
| Fluorescent system | High | No | High | Yes | Yes |

# Evaluating Patient Zone Environmental Cleaning

| Method | Ease of Use | Identifies Pathogens | Accuracy | Useful for Teaching | Use in Programmatic Monitoring |
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| Direct observation | Low | No | Variable | Yes | Difficult |
| Culture swab | High | Yes | High | No | No |
| Agar culture system | Moderate | Possible | Moderate | No | Possible* |
| Fluorescent system | High | No | High | Yes | Yes |
| ATP Bioluminescence | High | No | Variable | Yes | Possible* |

* Measures cleanliness at that moment but NOT the process of cleaning

# Surface evaluation using ATP bioluminescence

Swab surface → luciferace tagging of ATP → Hand held luminometer

# The ATP tool in context

## Industrial Use

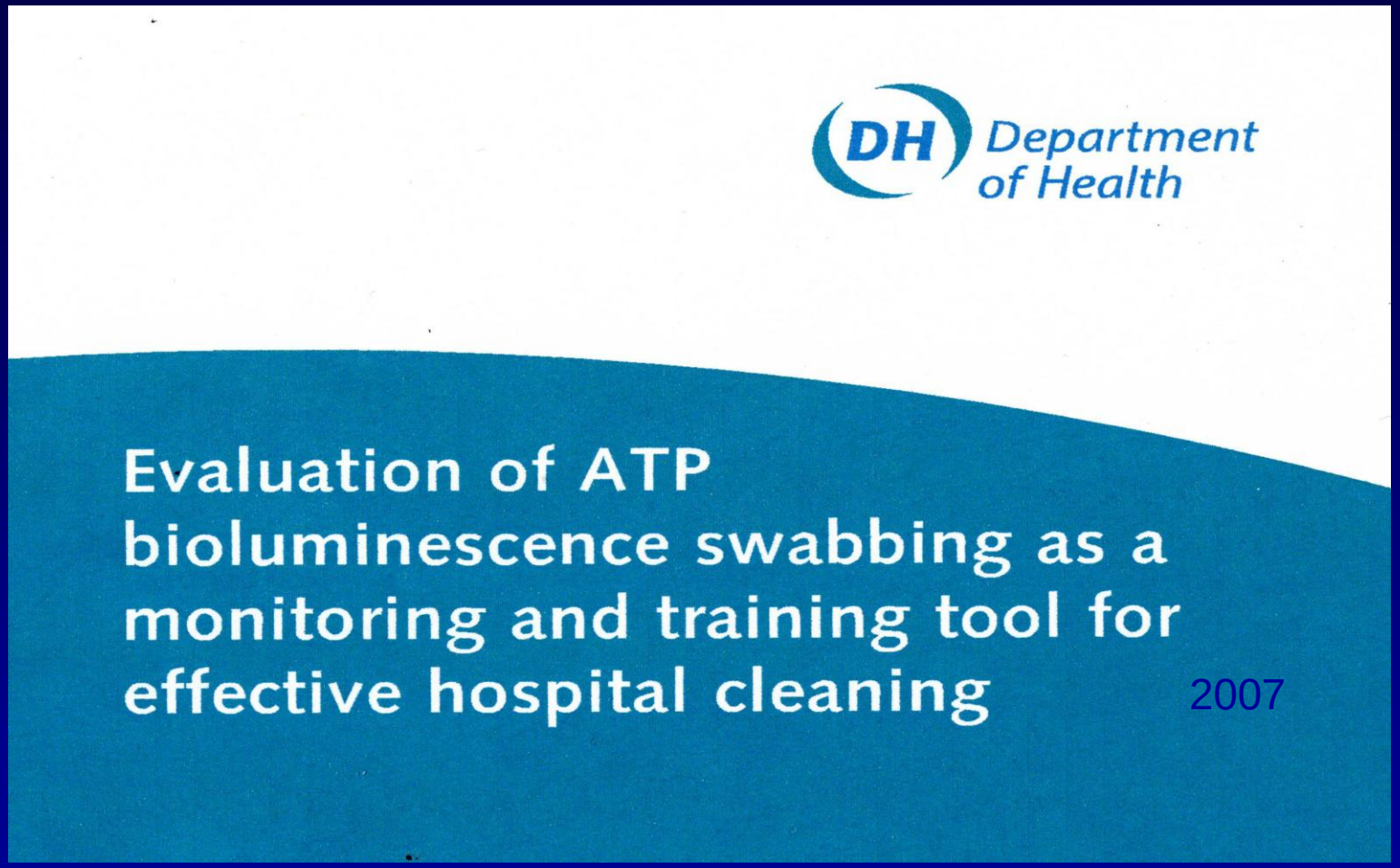
- Developed in the 1970s for commercial food preparation
- Used when very clean surfaces are important
- High-grade disinfectants + Rinsing
- Testing immediately after cleaning and just before use is the standard

## Healthcare Use

- Griffiths – JHI studies – Effectively used cultures and ATP to debunk the “visibly clean ” standard
- He and later Dancer showed that most surfaces had both high bacterial and ATP counts (89% of surfaces “Failed”) (many appeared dirty!)
- The Hygienic standard is proposed

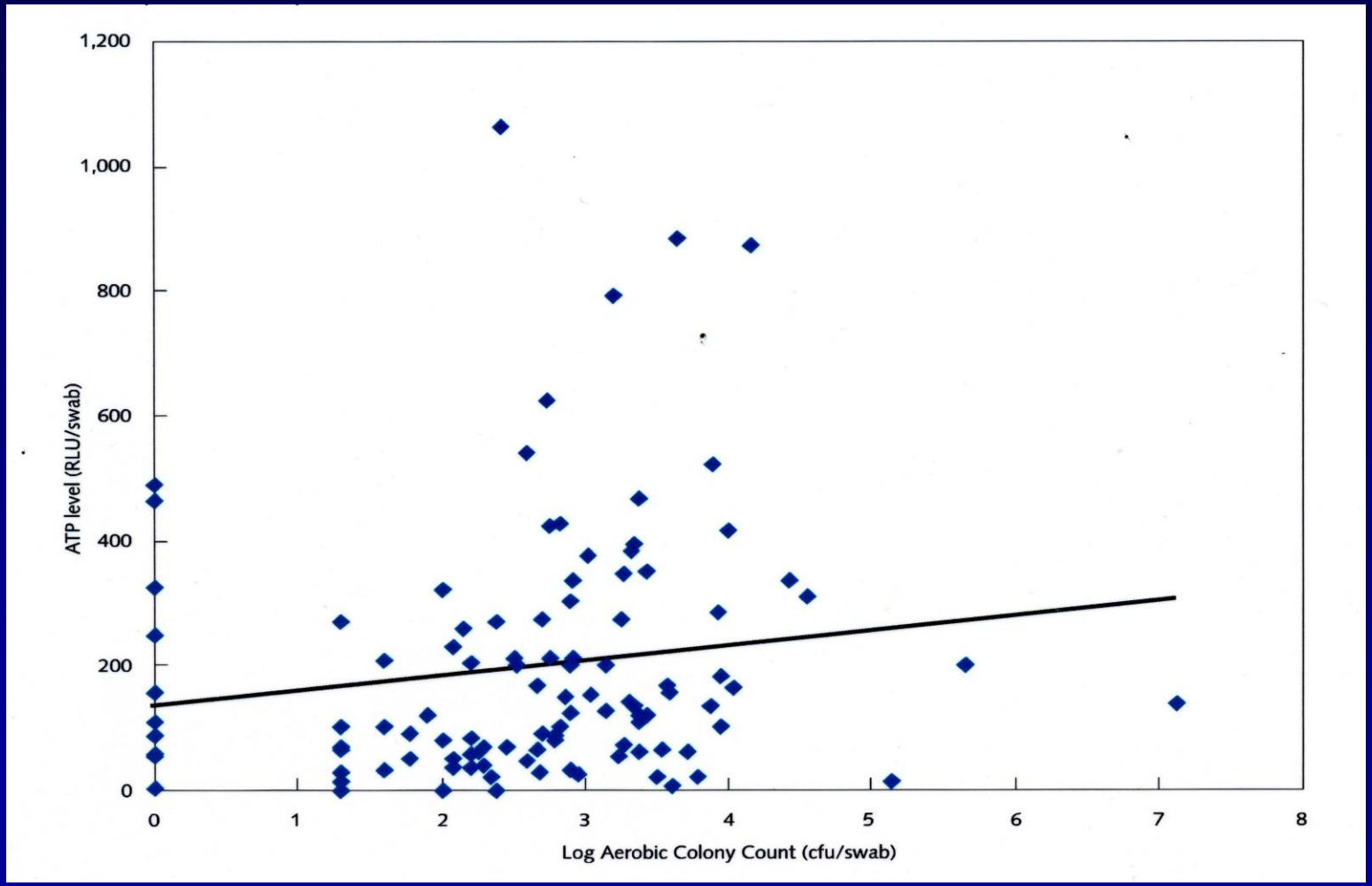
# Limitations of ATP evaluation of cleanliness in healthcare settings

Two independent studies of ATP sensitivity and specificity have clarified the limits of the ATP “Cleanliness Standard” as it was proposed several years ago




National Health Service. Link 195.92.246.148/knowledge_network/documents/**Bioluminescence**_20070620104921.pdf

# Correlation between ATP bioluminescence (RLU/Swab) and aerobic colony count (cfu/swab)



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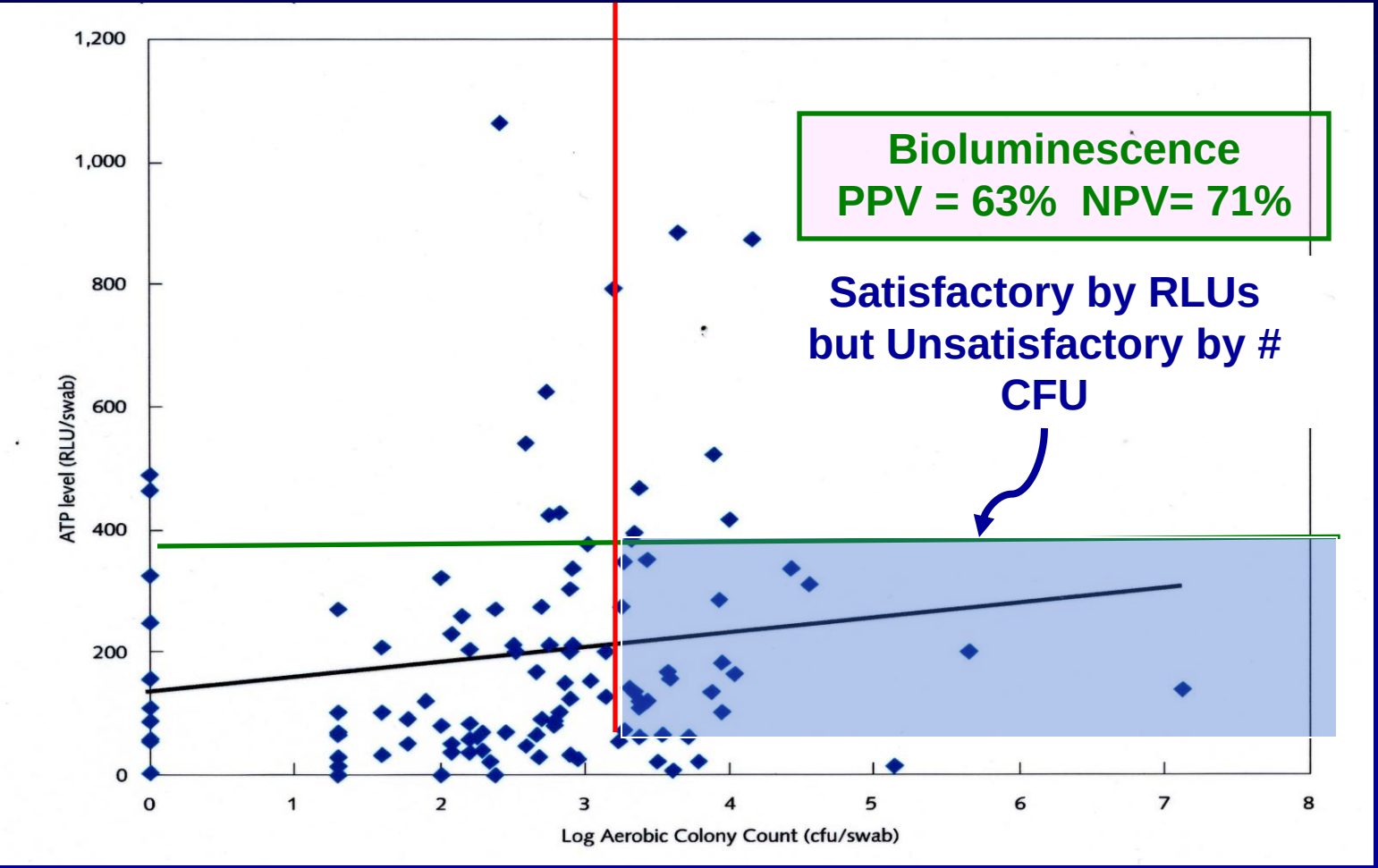


# Correlation between RLU & Microbial Contamination. Mulvey D, et al. J Hosp Infect 2011

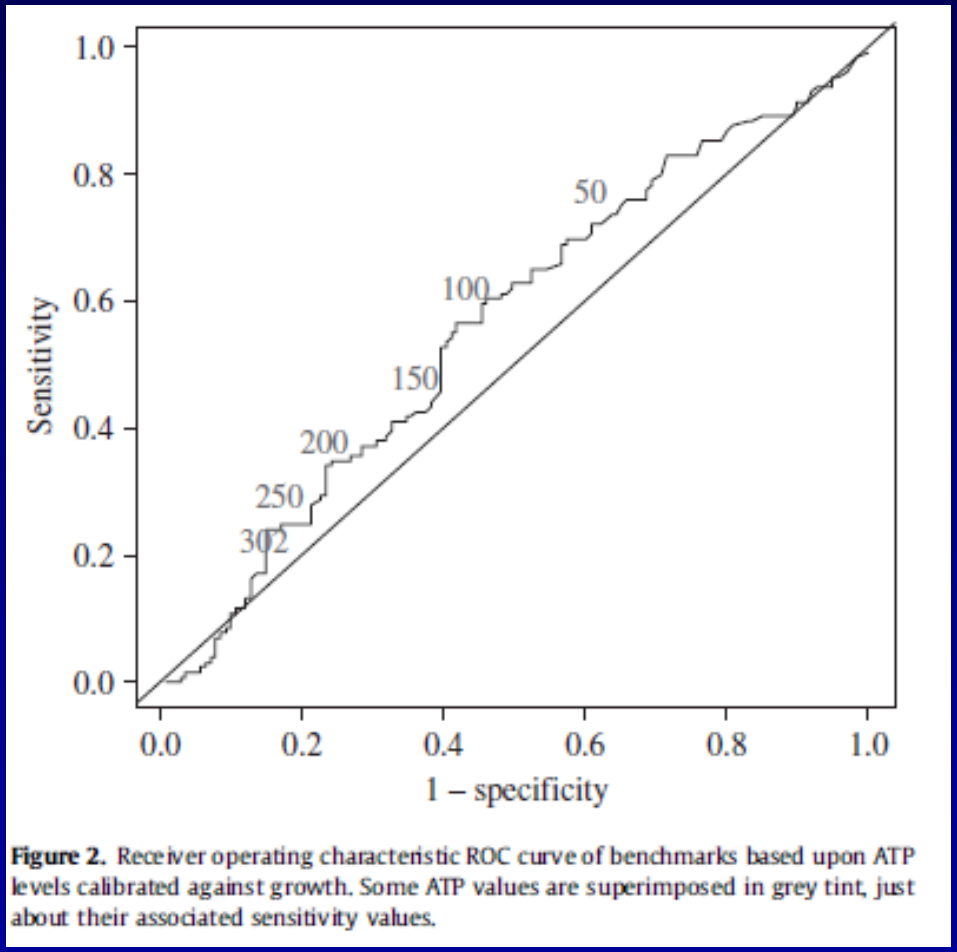



**Figure 2.** Receiver operating characteristic ROC curve of benchmarks based upon ATP levels calibrated against growth. Some ATP values are superimposed in grey tint, just about their associated sensitivity values.

# Lack of Correlation between RLU & Microbial Contamination.

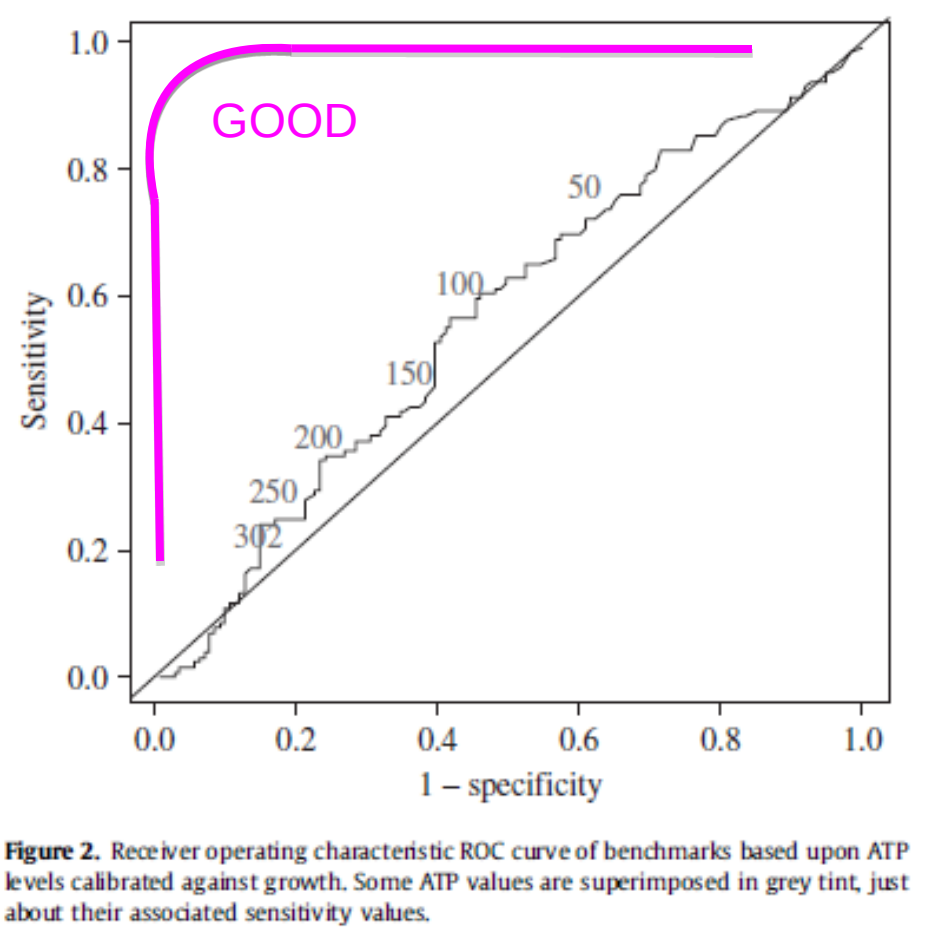



**Figure 2.** Receiver operating characteristic ROC curve of benchmarks based upon ATP levels calibrated against growth. Some ATP values are superimposed in grey tint, just about their associated sensitivity values.

"Routine cleaning with detergent can reduce concentration of microbes & organic matter by RLU. The effect is not large, with many sites exhibiting similar values after cleaning as they did before. …Further work is required to refine practical sampling strategy and choice of benchmarks."

# Mulvey D, et al. J Hosp Infect 2011

## Conclusion

The range and diversity of the ATP results must be carefully considered. Despite monitoring in triplicate, occasional inflated values, for no apparent (visible) reason, skewed the overall results.[4] It is already known that organic soil contains both microbial and human DNA, as well as food debris and liquids.[4,5] ATP can also be confounded by disinfectants (bleach), microfibre products and manufactured plastics used in cleaning and laundering industries.[21] If ATP assessment is introduced into hospitals, it should be on the understanding that there will be inevitable failures that do not necessarily indicate true infection risk for patients. Sensitivity and specificity of 57% mean that the margin for error is too high to justify stringent monitoring of the hospital environment at present. Further work is required to fully assess routine ATP monitoring in hospitals.

The other problem with using an evaluation of cleanliness by agar dip slide or ATP

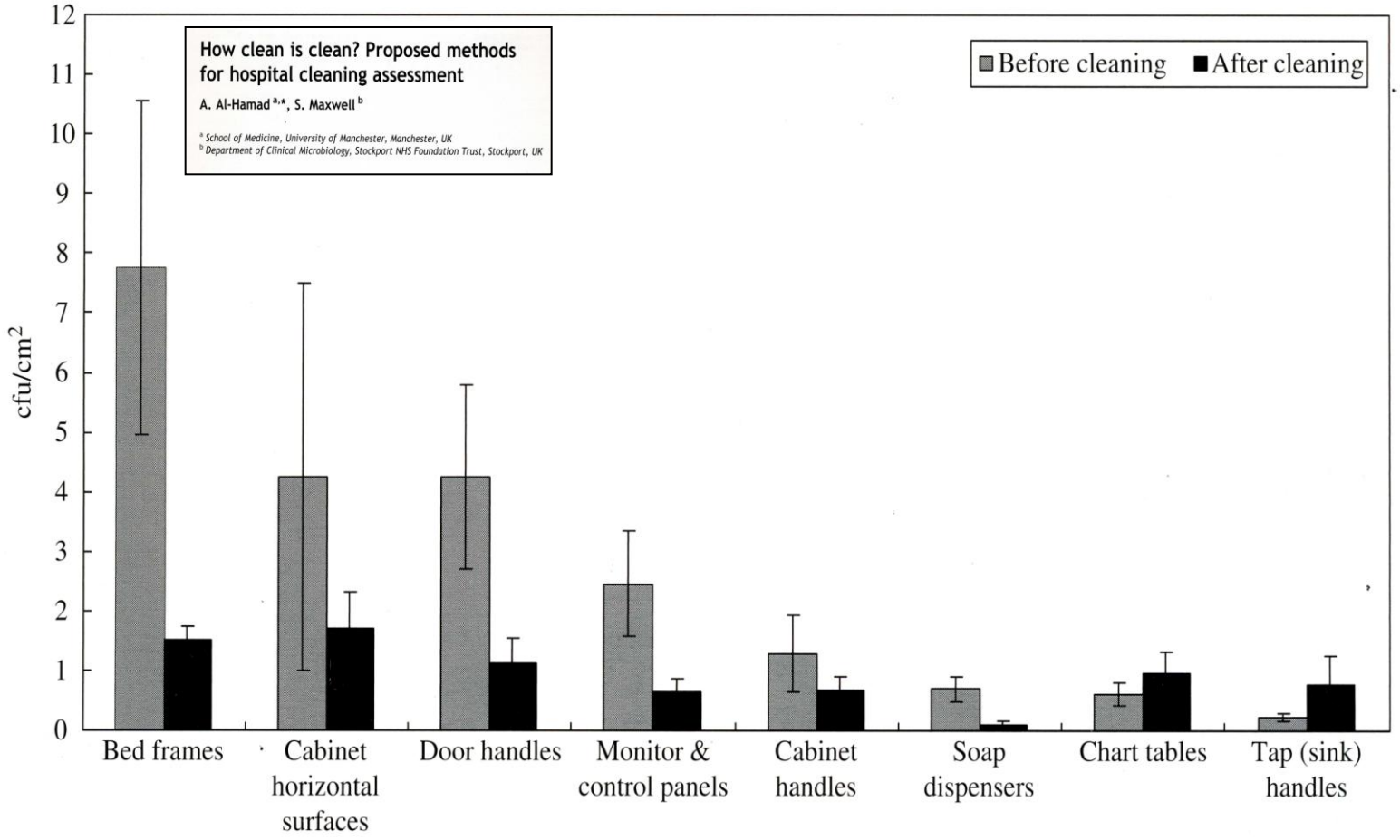



**Figure 1** Overall cfu/cm$^2$ $\pm$ SE from frequent-touch surfaces from clinical areas with cleaning policy.

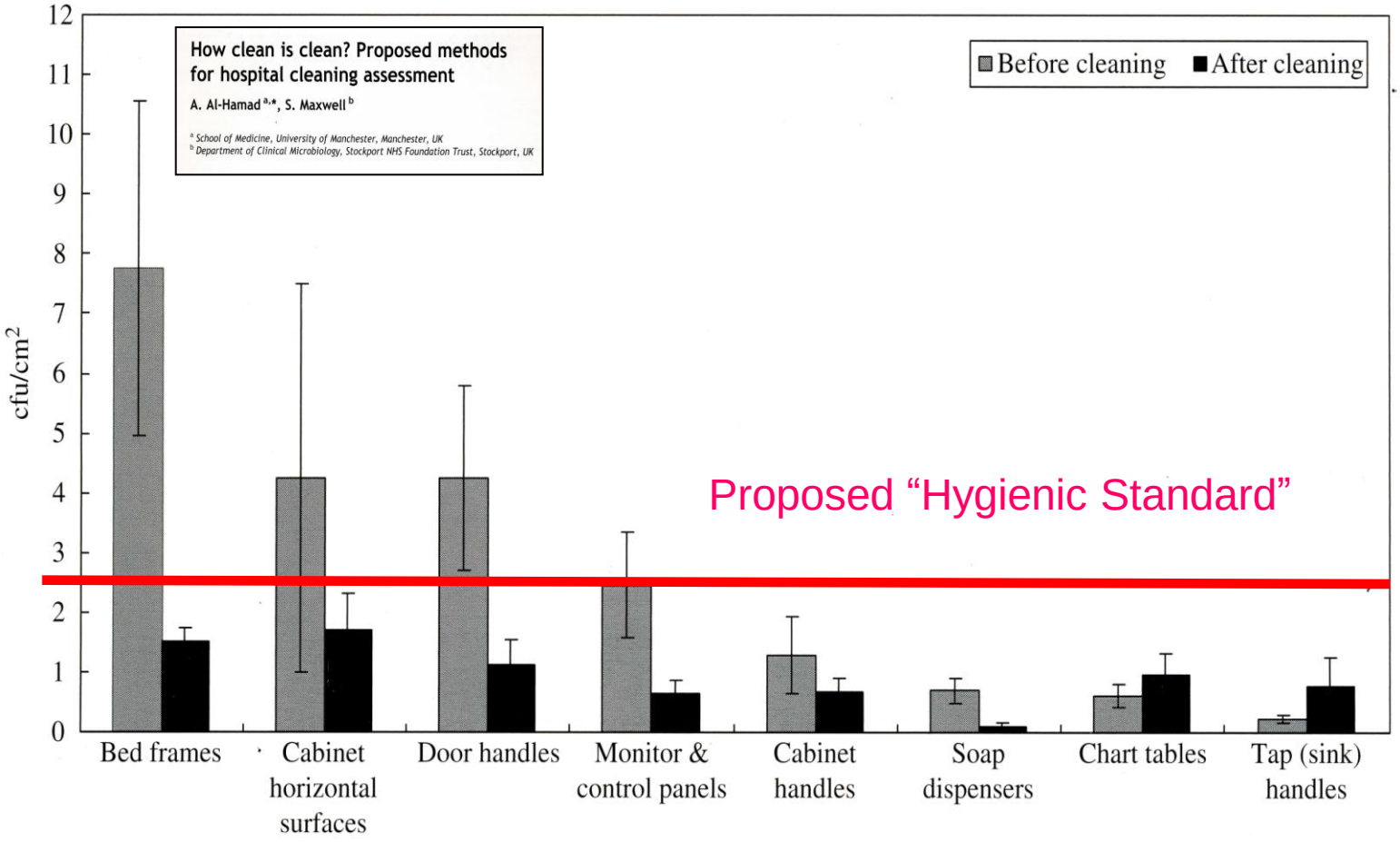
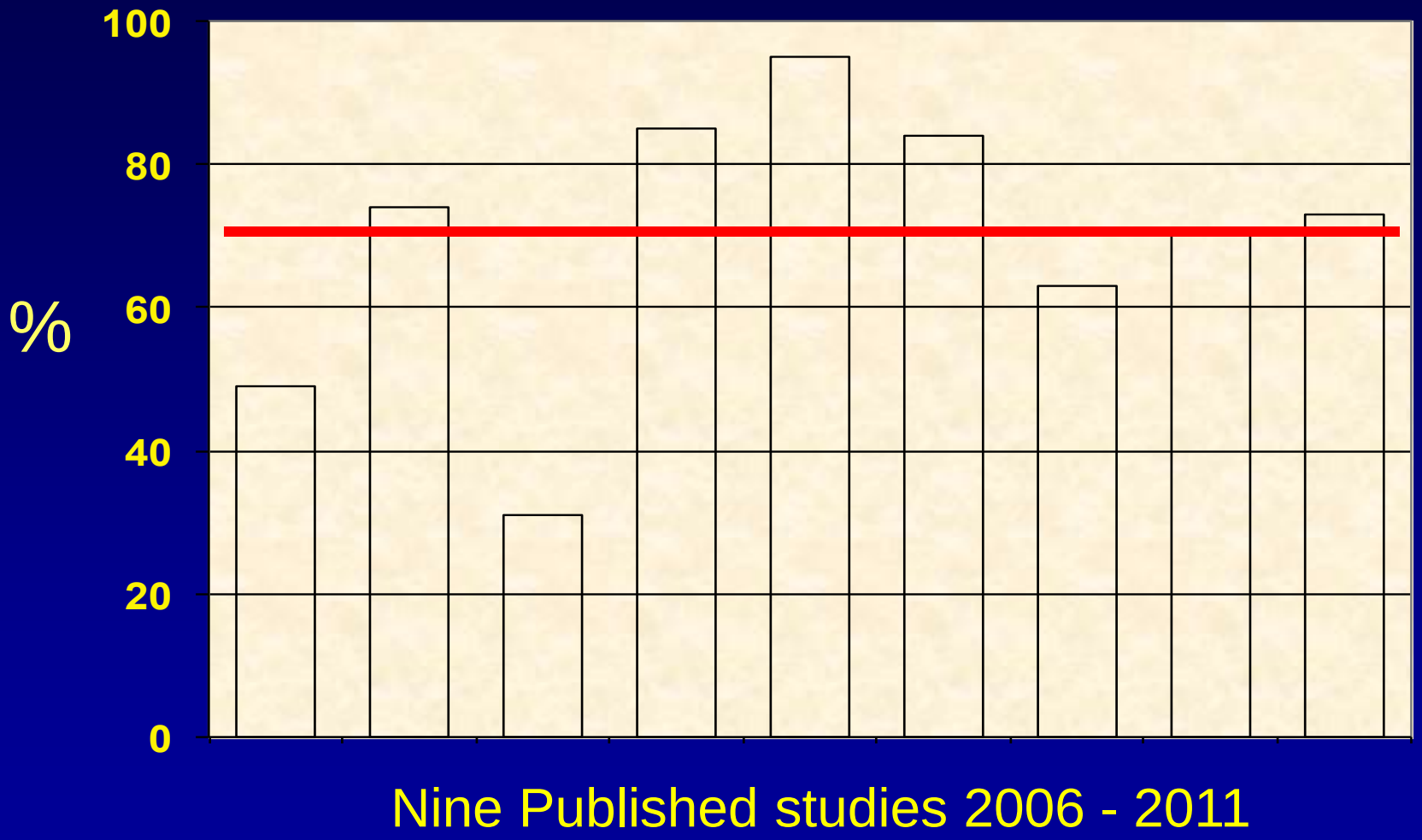



**Figure 1** Overall cfu/cm$^2$ ± SE from frequent-touch surfaces from clinical areas with cleaning policy.

# Basic cleanliness* of healthcare surfaces

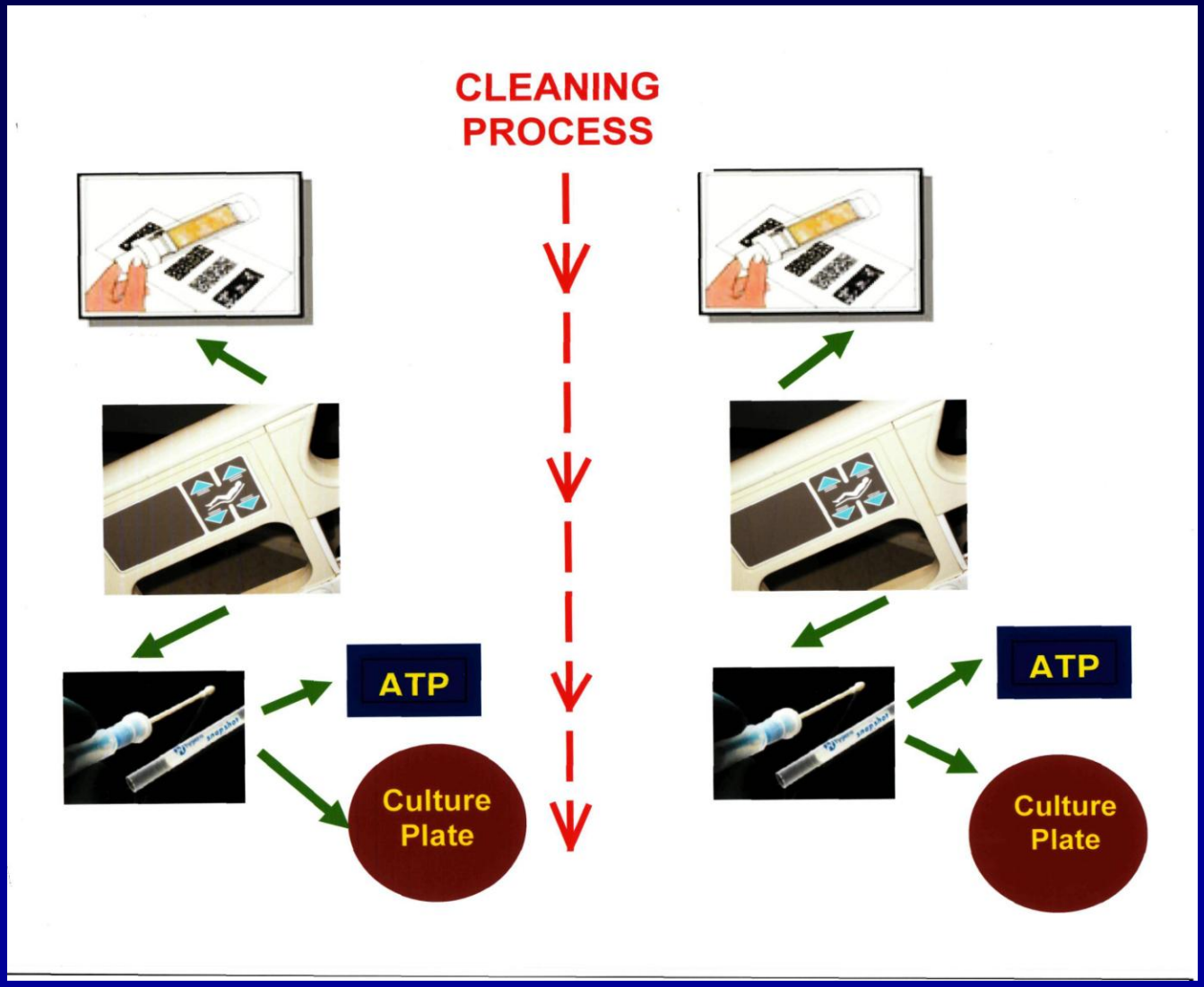



* No aerobic growth or < 2.5 CFU/cm$^2$

Despite their limitations, can dip slide cultures or ATP be theoretically used to evaluate cleaning practice?

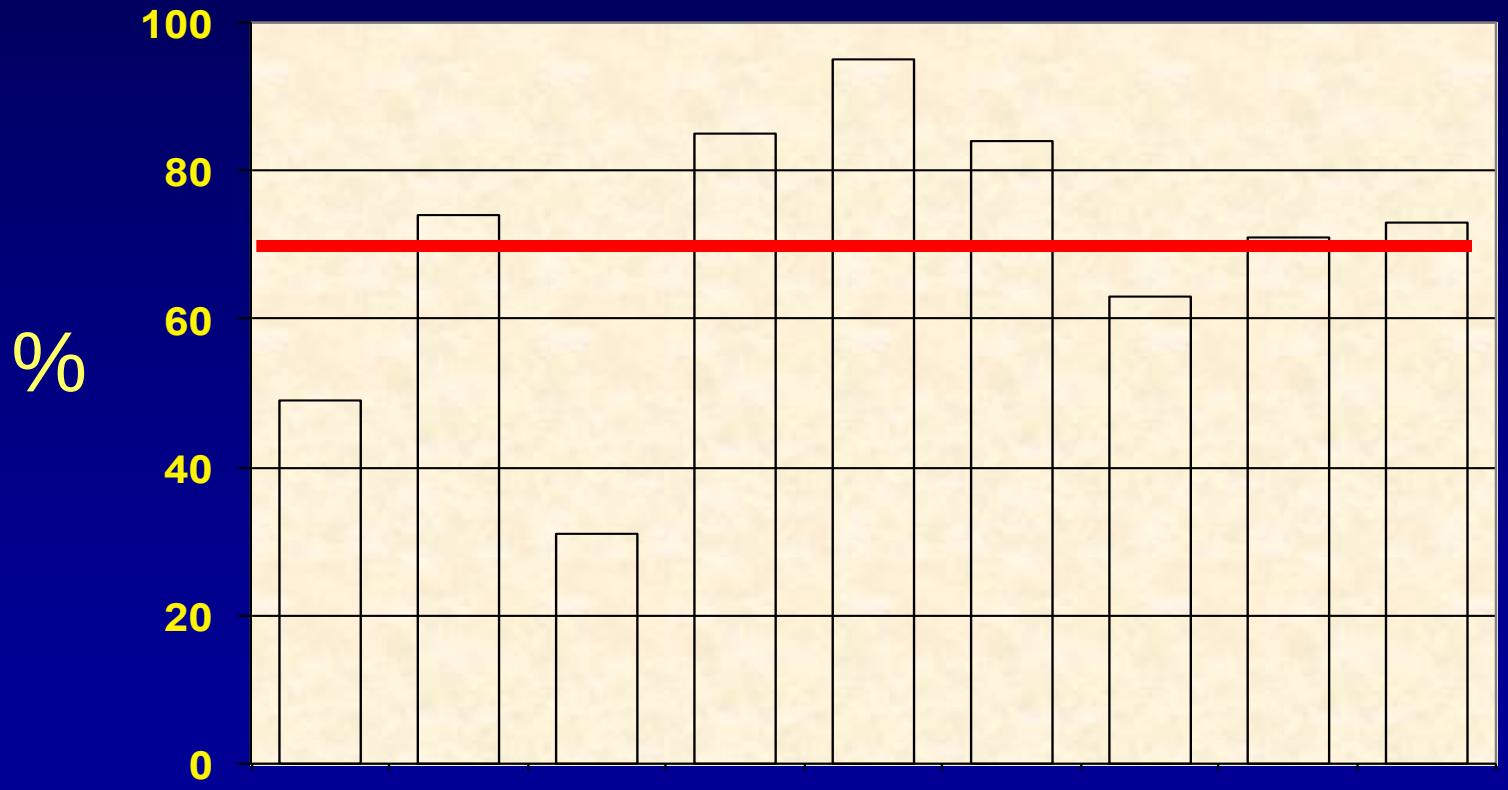
The CDC Guidance says yes……But

# Using tools that measure cleanliness to systematically evaluate cleaning process



But then you will need to deal with the other implication of the…..

Most surfaces have too low a bioburden to evaluate… you need to mark two to three times the number of surfaces you planned to get an appropriately sized sample to detect a 20% change in process



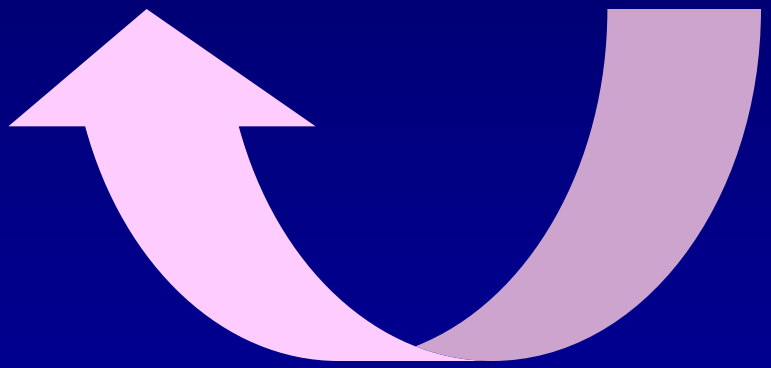

Nine Published studies 2006 - 2011

* No aerobic growth or < 2.5 CFU/cm$^2$

So what about the disinfectant?

# Don’t forget the Rutala Equation

Product + Practice



# Issues with disinfectants, detergents, cloths, etc.

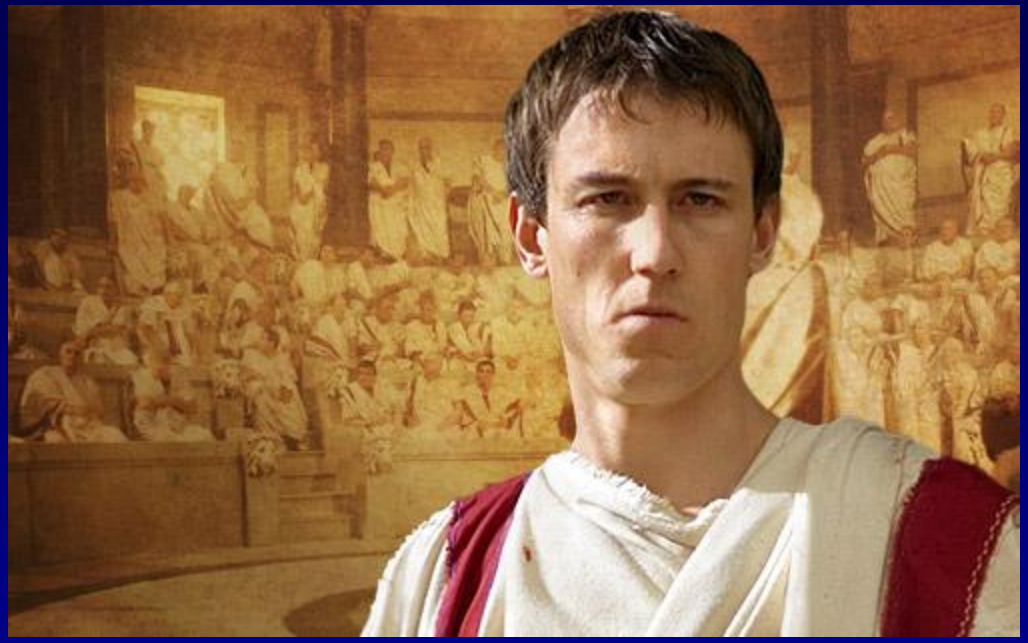
- What is the true role of bleach in disinfection cleaning?
- How effective will new green disinfectants be?
- When is it okay to use detergents?
- Where are we going with dwell time?
- Where does microfibre fit in?
- If effective killing with bleach takes many minutes, what is the clinical efficacy of bleach wipes?
- What is the correct amount of quat?
- Are disinfectants being mixed accurately?

So what about
Hand Hygiene??

# Hand Hygiene Issues

What did Mark Anthony have to say about HH?

# Hand Hygiene Issues



Friends, Romans and Minnesota IPs,

I come not to bury Hand Hygiene but to praise it (in context)

# Hand Hygiene Issues

Success stories were based on mixed interventions….Not enhanced HH alone

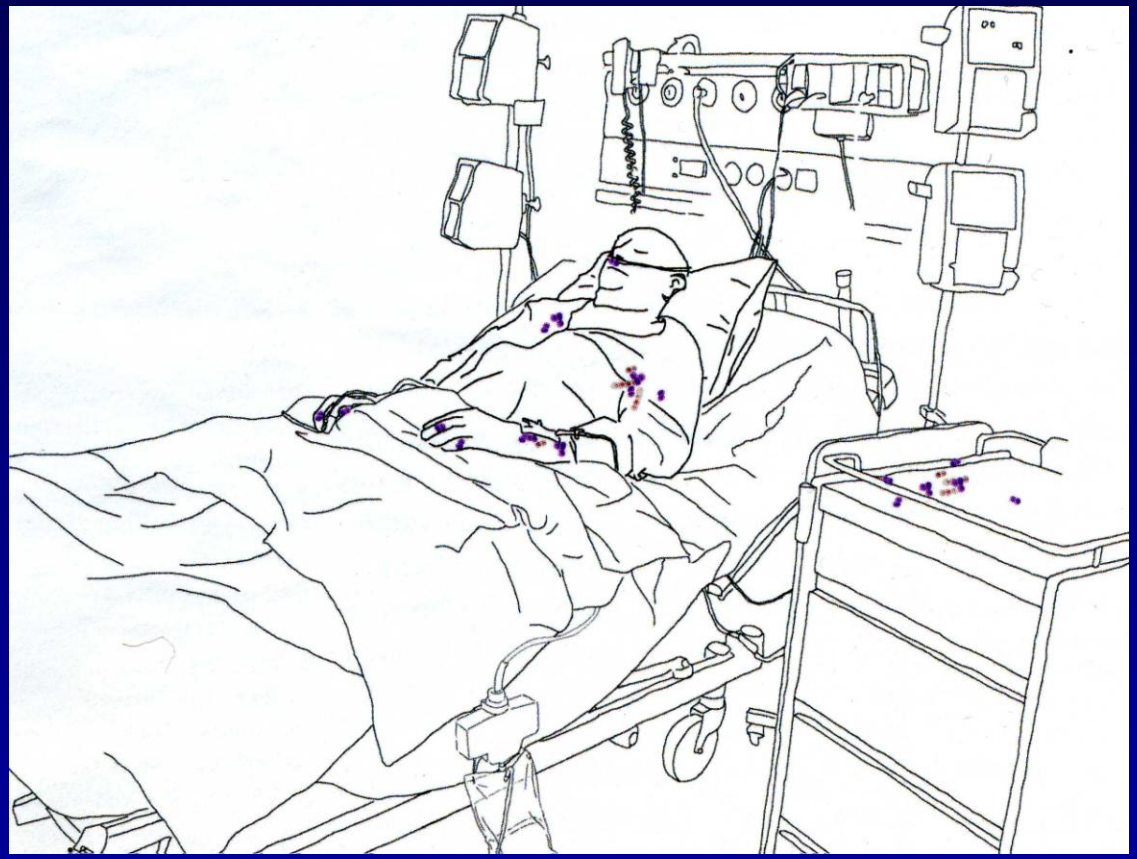
Logistical limitations are becoming clarified

There may be a “compliance ceiling”

Microbial efficacy – Product Differences

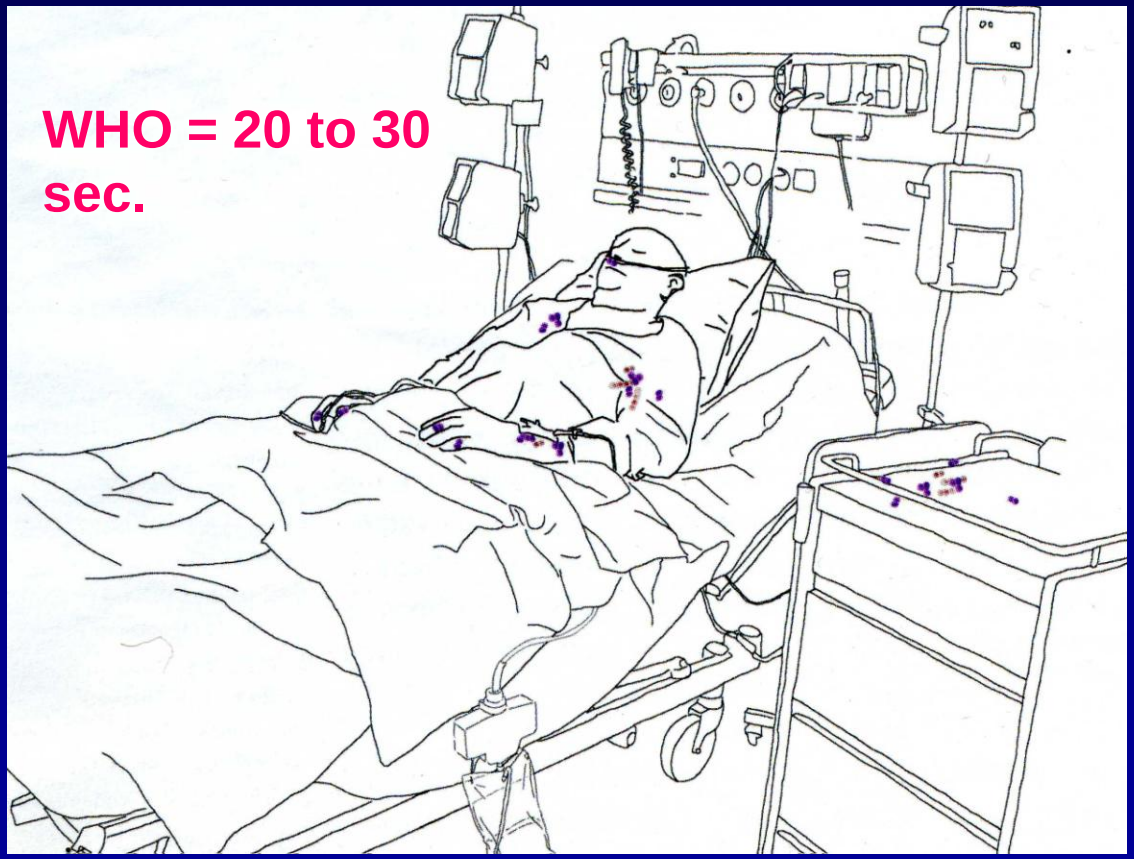
Microbial resurgence is rapid following HH

# HH in Complex Intense Environments is Very Difficult



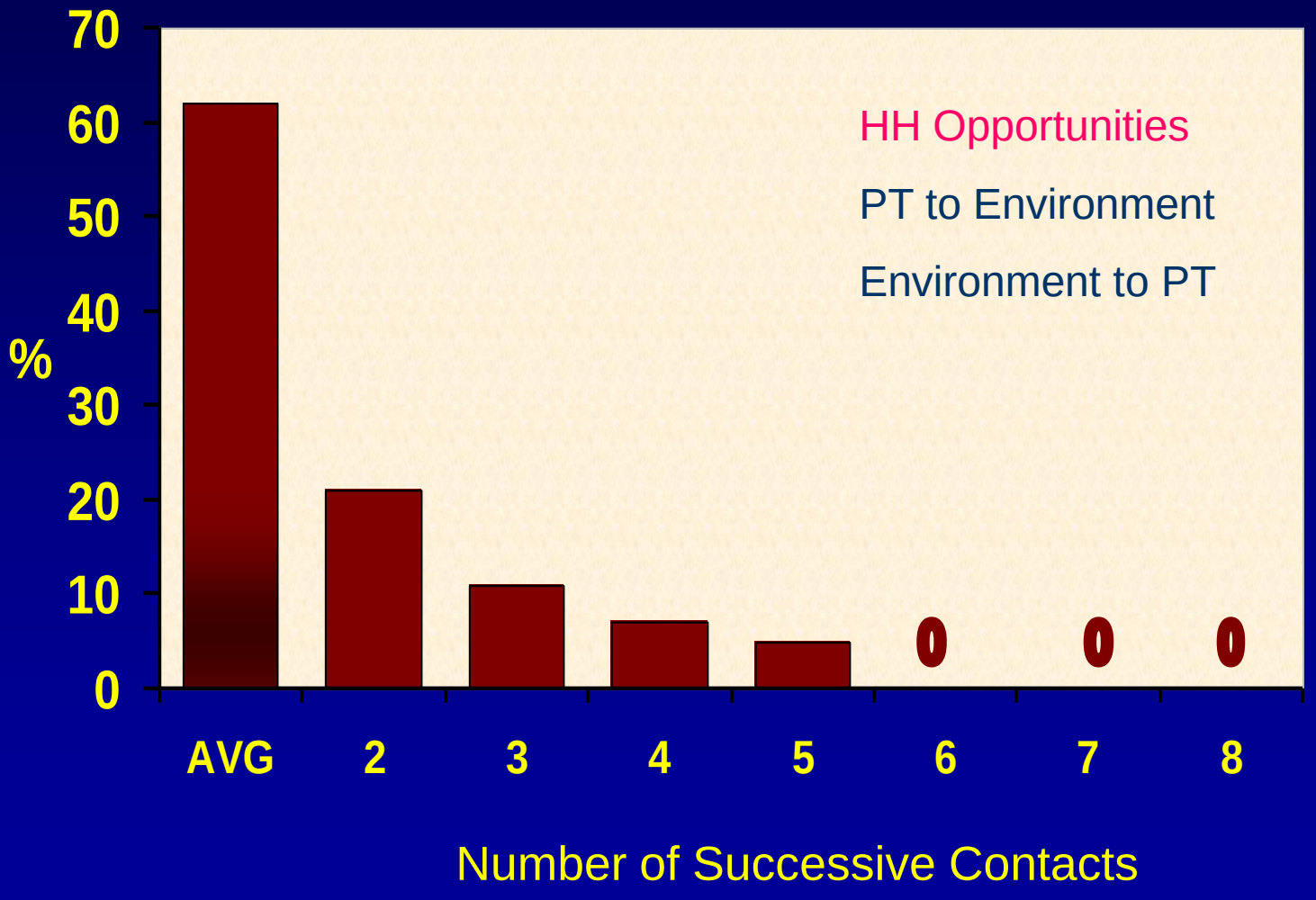
30 to 40 HH “Moments” per Hour during direct patient care

# HH in Complex Intense Environments is Very Difficult




30 to 40 HH “Moments” per Hour during direct patient care

# How Rapidly does HH compliance deteriorate during a single patient encounter?




Evillard etal J Hosp Infect – July 2009

THE
ENVIRONMENTAL
HYGIENE
IMPERATIVE

# Conclusions

- It is very likely that surfaces in the Patient Zone are of relevance in the transmission of Healthcare Associated Pathogens.

- While optimizing hand hygiene and isolation practice is clearly important there is no reason why the effectiveness and thoroughness of environmental hygienic cleaning should not also be optimized, particularly since such an intervention can be essentially resource neutral.

**Thanks for inviting me !!**

Questions – Comments?

pcarling@cchcs.org