

## **Scientific Basis for Current Hand Hygiene Guidelines and Future Trends**

**John M. Boyce, MD  
J.M. Boyce Consulting, LLC  
Middletown, CT**

[www.jmboyceconsulting.com](http://www.jmboyceconsulting.com)

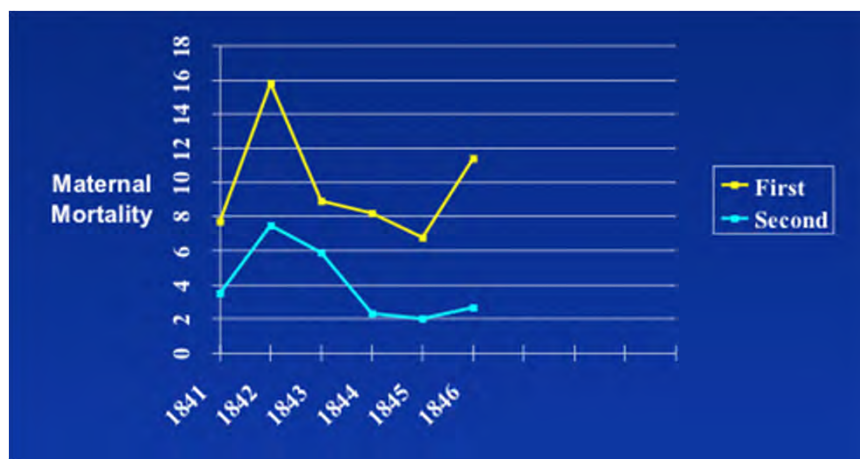
1

### **Presentation Objectives**

- **Review of evidence used to develop the CDC and WHO Guidelines for Hand Hygiene in Healthcare Settings**
- **Current challenges in improving hand hygiene compliance**
- **Future trends in hand hygiene products and strategies for improving hand hygiene practices**

2

**MATERNAL MORTALITY RATES, FIRST AND SECOND OBSTETRICS CLINICS,  
GENERAL HOSPITAL OF VIENNA, 1841-1846**



Semmelweis IP, 1861

3

### Hand Hygiene Intervention

#### May 1847

- Students and doctors were required to:
  - ◆ clean their hands with a chlorine solution when entering the Obstetrics ward
  - ◆ hands were washed with soap & water after examining each patient

4

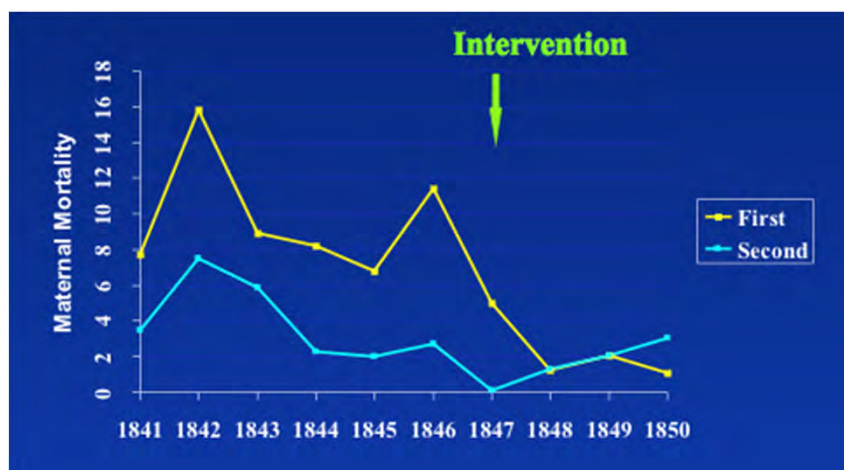
## Hand Hygiene Intervention

### October 1847

- A patient located in the bed where rounds were started each day developed signs of infection
- 11/12 patients who delivered on the ward died
- Soap & water handwashing between patients was felt to be inadequate
- Students and doctors were subsequently required to:
  - ◆ clean their hands with chlorine solution before examining each patient

5

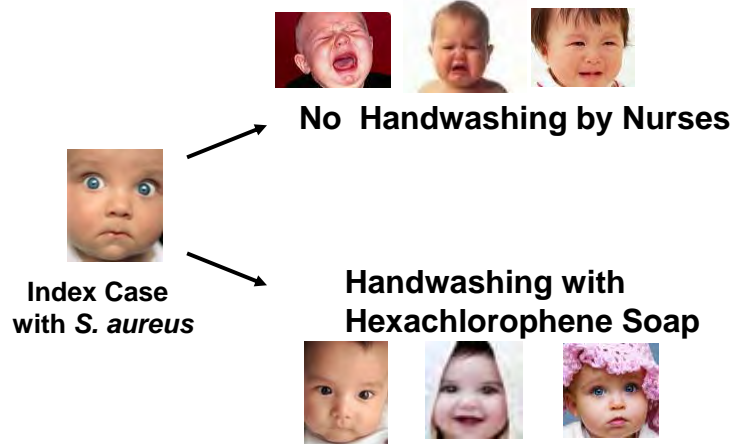
### MATERNAL MORTALITY RATES, FIRST AND SECOND OBSTETRICS CLINICS, GENERAL HOSPITAL OF VIENNA, 1841-1850



Semmelweis IP, 1861

6

### NIH-Sponsored Prospective, Controlled Trial of Handwashing



Mortimer EA et al. Am J Dis Child 1962;104:289

7

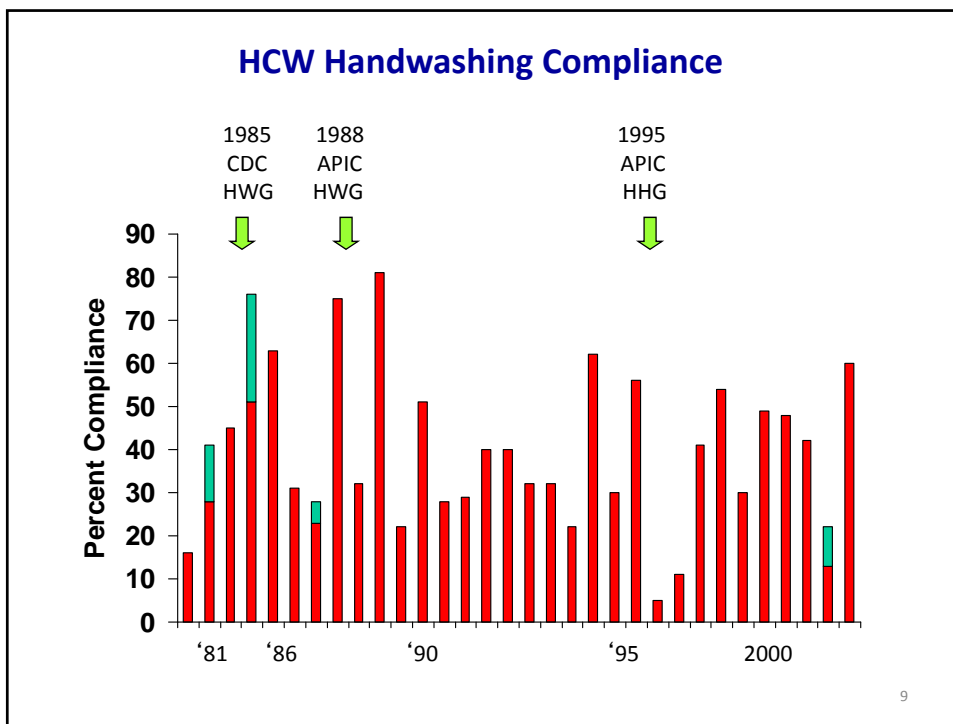
### Impact of Handwashing on Transmission of *Staphylococcus aureus*

Group	% Acquiring <i>S. aureus</i>	Avg. Hrs Exposure
No Handwashing	92% *	35 Hrs
Hexachlorophene Handwashing	53% *	133 Hrs

\* O.R. = 9.9      95% CI = 2.6 - 45      p = 0.0001

Mortimer EA et al. Am J Dis Child 1962;104:289

8



- ### Factors Associated with Poor Handwashing Compliance
- |   |   |
|---|---|
| <p><b><u>Observed Risk Factors</u></b></p> <ul style="list-style-type: none"> <li>• Physician (rather than nurse)</li> <li>• Nursing assistant (not nurse)</li> <li>• Male sex</li> <li>• Working during the week</li> <li>• Wearing gowns/gloves</li> <li>• Activities with high risk of cross-transmission</li> <li>• High number of opportunities for hand hygiene per hour of care</li> </ul> | <p><b><u>Self-Reported Risk Factors</u></b></p> <ul style="list-style-type: none"> <li>• Handwashing causes irritation and dryness of skin</li> <li>• Sinks inconveniently located</li> <li>• Lack of soap and paper towels</li> <li>• Often too busy/insufficient time</li> <li>• Patient needs take priority</li> <li>• Belief that wearing gloves obviates the need for hand hygiene</li> <li>• Forgetfulness</li> <li>• Disagreement with guidelines</li> </ul> |
|---|---|
- Adapted from Pittet D Infect Control Hosp Epidemiol 2000;21:381



## Attitudes of Healthcare Workers in the United States about Alcohol Hand Rubs

- A few countries in Europe and Scandinavia were using alcohol-based hand rubs (ABHRs) for hand hygiene in the 1980s and 1990s
- However, in the U.S., there was a widespread belief among healthcare workers that : “alcohol will dry out my hands”



## Are Recommended Handwashing Policies Practical?

- Time required for soap & water handwashing:
  - 62 seconds to get to sink, wash, dry and return
- ICU with 12 nurses
- 40% compliance: 2 to 6.4 hrs/8-hr shift
- 100% compliance: 16 hrs/shift
  
- Time required for alcoholic hand disinfection:
  - 15-second contact time · bedside dispenser
- 40% compliance: 1 to 1.6 hrs/8-hr shift
- 100% compliance: 4 hrs/shift

Voss A & Widmer AF Infect Control Hosp Epidemiol 1997;18:205-8

15

## Irritant Contact Dermatitis Due to Frequent Handwashing

- Frequent use of soap & water can lead to skin irritation and damage due to irritant contact dermatitis
  - Painful skin irritation causes healthcare personnel to avoid handwashing
  - May lead to increased colonization of hands by pathogens



16



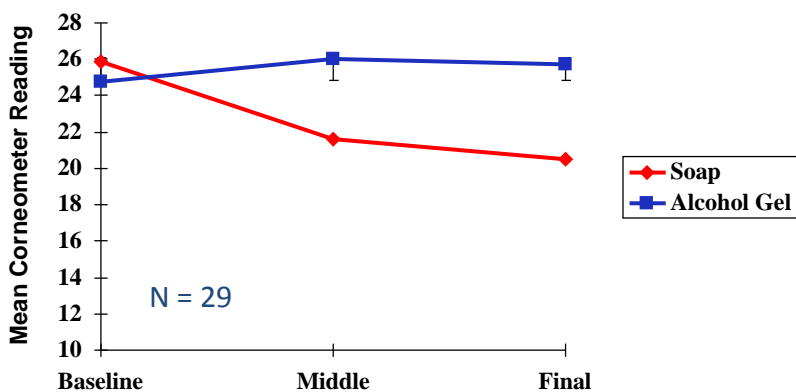
### Skin Irritation and Dryness: Soap & Water Handwashing vs Alcohol Hand Gel

- In 1998, a 6-week prospective randomized trial with crossover design
  - Funded by GOJO Industries
- 29 nurses on 3 wards participated
- The study compared:
  - a non-medicated, “mild” soap
  - an alcohol hand gel
- Skin irritation/dryness of nurses hands were assessed:
  - self-assessment by participants
  - visual assessment by study nurse
  - measuring electrical capacitance of skin on hands ➔



Boyce JM et al. Infect Control Hosp Epidemiol 2000;21:442

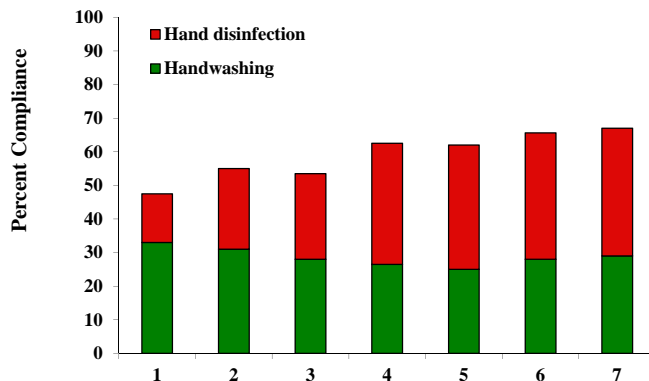
### Electrical Capacitance of Dorsal Hand Skin Surface



\* Low Corneometer reading = dry skin

Boyce JM et al. Infect Control Hosp Epidemiol 2000;21:442

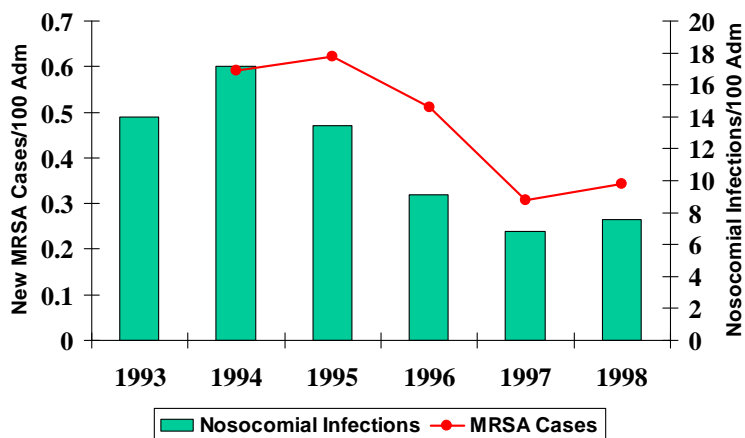
### HAND-HYGIENE COMPLIANCE DURING 7 HOSPITAL-WIDE SURVEYS, UNIVERSITY OF GENEVA HOSPITALS, 1994-97



Pittet D et al. Lancet 2000;356:1307

19

### Prevalence of Nosocomial Infections and Incidence of MRSA, University of Geneva Hospitals, 1993-98



Pittet D et al. Lancet 2000;356:1307

20

## Brief Summary of Evidence Supporting the Use of Alcohol-Based Hand Rubs

- Handwashing compliance among HCWs has remained unacceptably low for decades
- Advantages of using alcohol-based handrubs
  - can be made more accessible; faster
  - cause less skin irritation and dryness
  - more effective than washing with plain soap/water; more effective than washing with antimicrobial soap
  - can promote improved hand hygiene compliance

21

## Why Clean Hands Before Touching Patients?

- Cleaning your hands before patient contact **protects the patient**
- Healthcare workers can contaminate their hands before touching patients by
  - Touching their own skin or mucous membranes
  - Touching contaminated items on the ward
    - Computer keyboards
    - Door knobs
    - Bedside rails or sheets



Courtesy of Prof. Didier Pittet

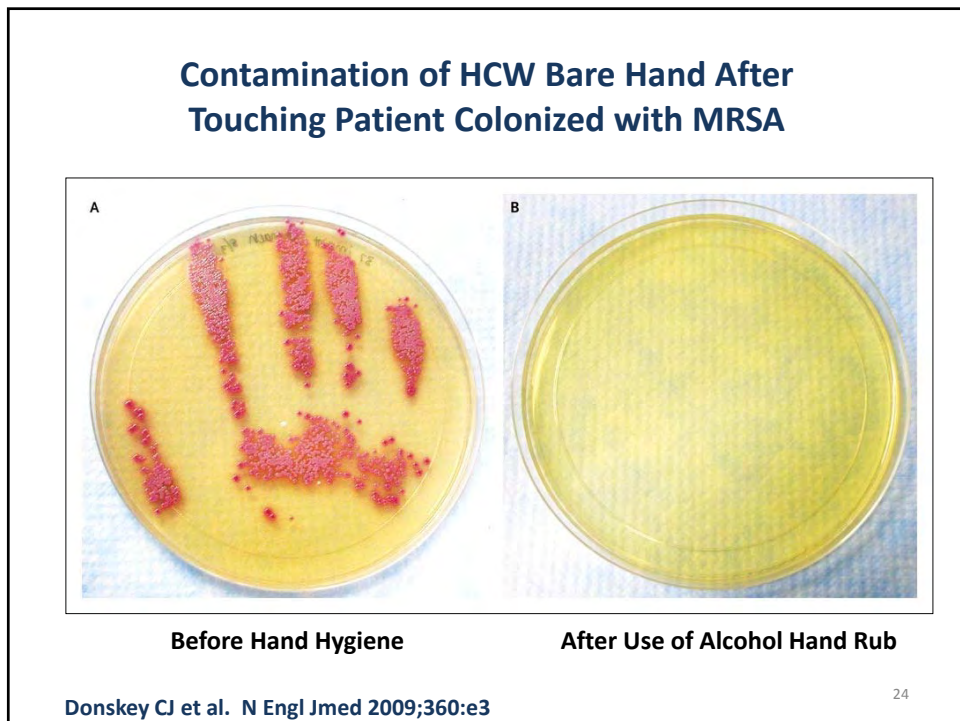
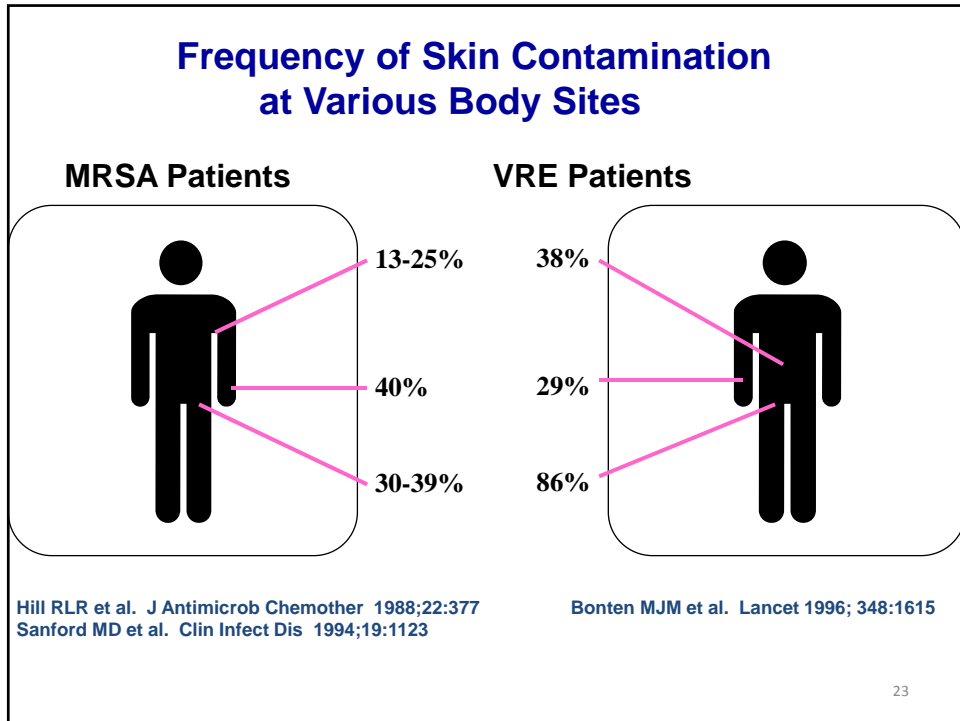


MRSA on Bed Sheets

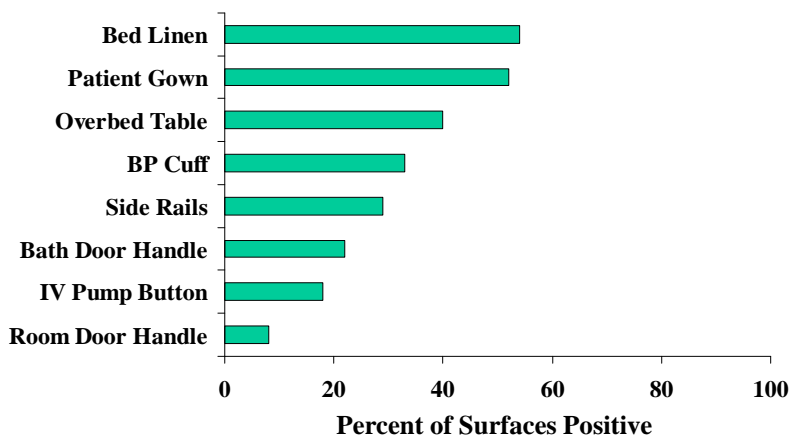


VRE on Bedside Rail

22



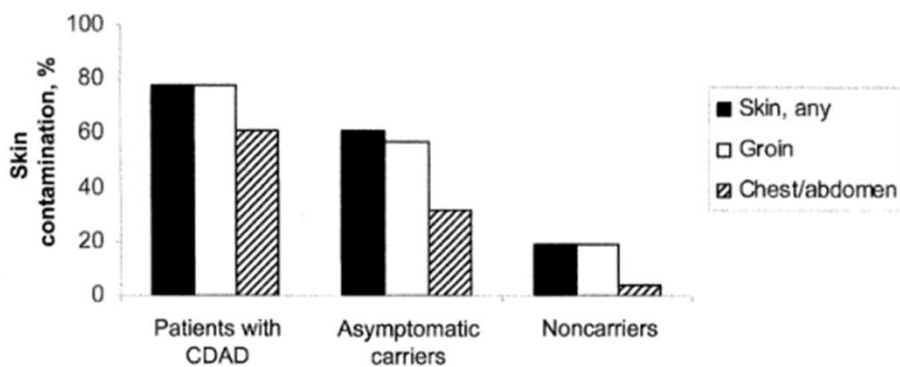
### Environmental Sites Positive for MRSA in Rooms of 38 Patients Colonized or Infected with MRSA



Boyce JM et al. Infect Control Hosp Epidemiol 1997;18:622

25

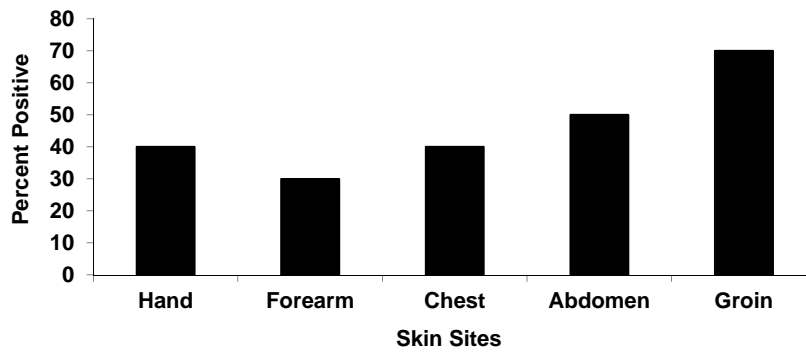
### Percent of Skin Cultures Positive for *C. difficile* in LTCF Residents with *C. difficile* diarrhea, Asymptomatic Carriage and Non-Carriers



Riggs MM et al. Clin Infect Dis 2007;45:992

26

### Frequency of Acquisition of *Clostridium difficile* on Sterile Gloves After Contact with Skin Sites



Bobulsky G et al. Clin Infect Dis 2008;46:447-50

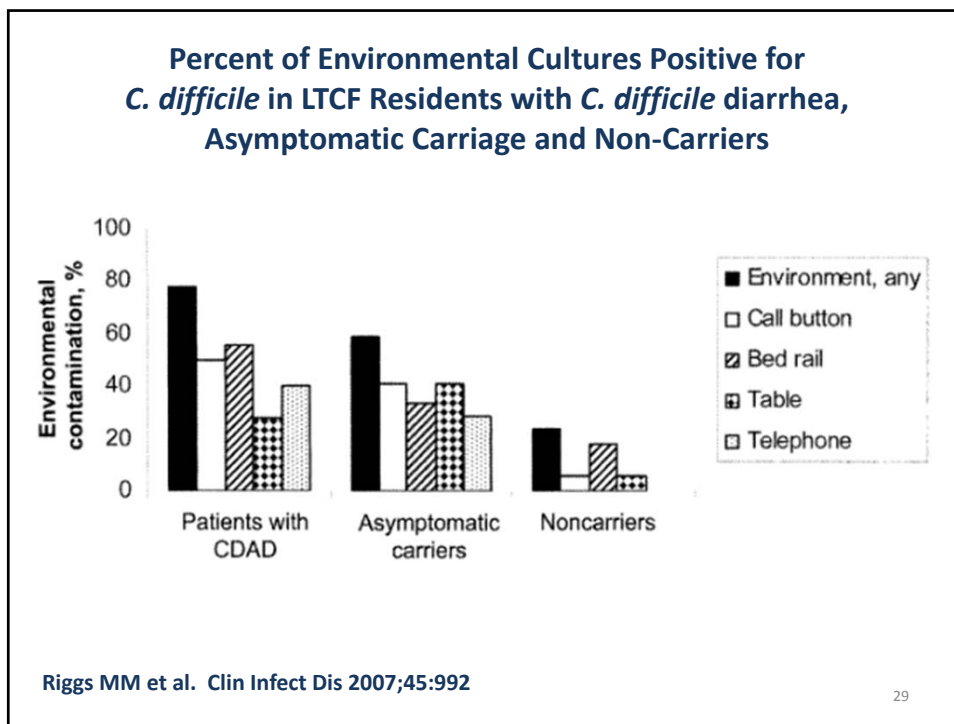
27

### Contamination of Glove Following Contact with Patient with *Clostridium difficile*

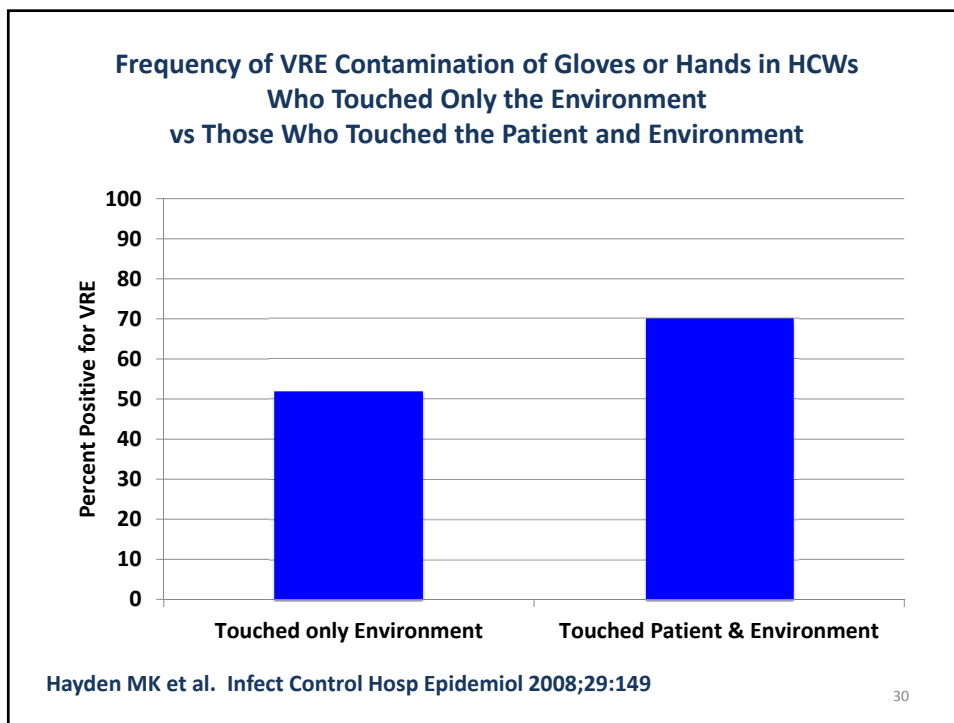


Bobulsky G et al. Clin Infect Dis 2008;46:447

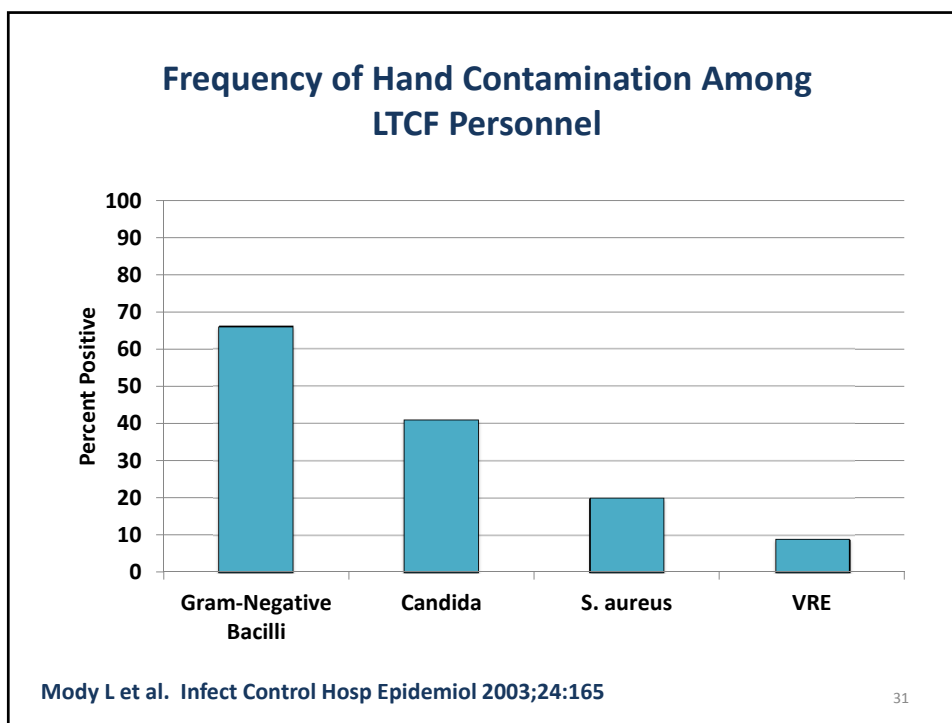
28



29



30



### Evidence Supporting the Need for Hand Hygiene After Removing Gloves

- **HCWs often contaminate their gloves while touching patients or surfaces near patients**
- **Multiple studies have documented that HCWs' hands may become contaminated even though they wore gloves**
- **Hand contamination may occur despite glove use because:**
  - Gloves may have tiny holes not apparent to HCWs
  - Hands may become contaminated during removal of gloves

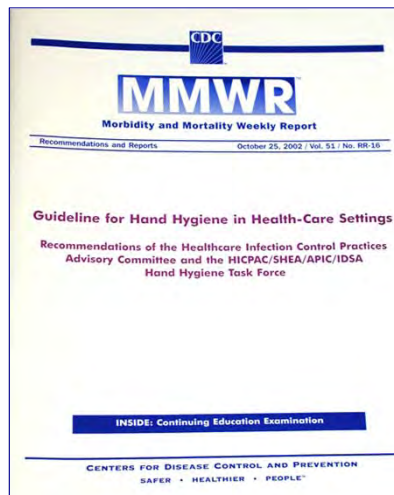
Olsen RJ et al. JAMA 1993;270:350  
 Tenorio AR et al. Clin Infect Dis 2001;32:826  
 Grundmann H et al. J Infect Dis 2002;185:481  
 Hayden MK et al. Infect Control Hosp Epidemiol 2008;29:149  
 Morgan DJ et al. Infect Control Hosp Epidemiol 2010;31:716

32



## HICPAC/SHEA/APIC/IDSA Guideline for Hand Hygiene in Health-Care Settings

- **Major recommendations:**
  - Alcohol-based hand rub (ABHR) was recommended as the preferred form of hand hygiene if hands are not visibly soiled
  - Indications for when to wash with soap and water were included
  - Educate healthcare workers (HCWs) regarding the advantages of ABHRs
  - Monitor hand hygiene compliance of HCWs and provide them with feedback on their performance



Boyce JM & Pittet D et al. MMWR 2002;51 (RR-16):1-45

33

## 2009 World Health Organization (WHO) Guidelines on Hand Hygiene in Health Care



Developed by a team of >100 international experts, led by Prof. Didier Pittet

[www.who.int/gpsc/5may/en/](http://www.who.int/gpsc/5may/en/)

34

### **Selected Recommendations from WHO Guideline**

- **Wash hands with soap and water when visibly dirty or visibly soiled with blood or other body fluids, or after using the toilet**
- **If exposure to potential spore-forming pathogens is strongly suspected or proven, including outbreaks of *C. difficile*, hand washing with soap & water is the preferred means**
- **Use alcohol-based handrub as the preferred means for routine hand antisepsis in all other clinical situations listed below, if hands are not visibly soiled. If alcohol-based handrub is not available, wash hands with soap & water**

WHO Guideline for Hand Hygiene in Health Care, 2009

35

### **Selected Recommendations from WHO Guideline**

- **Perform hand hygiene:**
  - Before and after touching the patient
  - Before handling an invasive device for patient care, regardless of whether or not gloves are used
  - After contact with body fluids or excretions, mucous membranes, non-intact skin, or wound dressings
  - If moving from a contaminated body site to another body site during care of the same patient
  - After contact with inanimate surfaces and objects (including medical equipment) in the immediate vicinity of the patient
  - After removing sterile or non-sterile gloves

WHO Guideline for Hand Hygiene in Health Care, 2009

36

### Selected Recommendations from WHO Guideline

- Before handling medication or preparing food, perform hand hygiene using an alcohol-based handrub or wash hands with either plain or antimicrobial soap & water
- Soap and alcohol-based handrub should not be used concomitantly
- Apply a palmful of alcohol-based handrub and cover all surfaces of the hands. Rub hands until dry. This should take 20-30 seconds
- When washing hands with soap & water, wet hands with water and apply the amount of product necessary to cover all surfaces. Rinse hands with water and dry thoroughly with a single-use towel. This should take 40-60 seconds

WHO Guideline for Hand Hygiene in Health Care, 2009

37

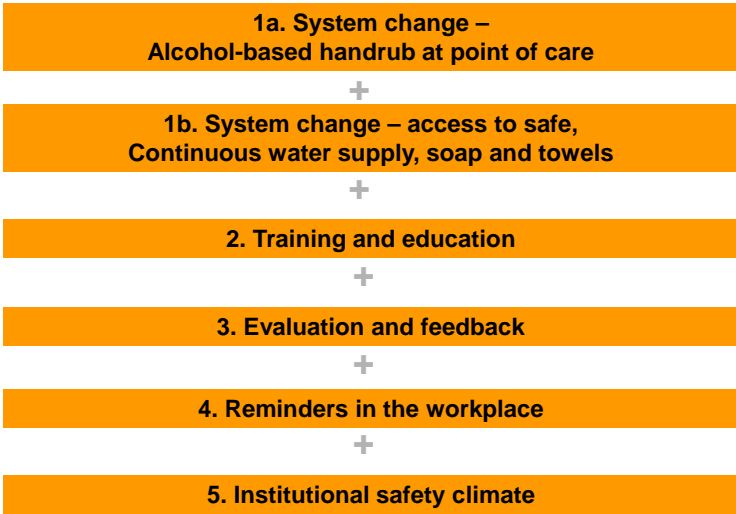
### Selected Recommendations from WHO Guideline

- Educate HCWs about the type of patient-care activities that can result in hand contamination and about the advantages and disadvantages of various methods to clean their hands
- Monitor HCWs' adherence to recommended hand hygiene practices and provide them with performance feedback
- Encourage partnerships between patients, their families, and HCWs to promote hand hygiene in health care settings

WHO Guideline for Hand Hygiene in Health Care, 2009

38

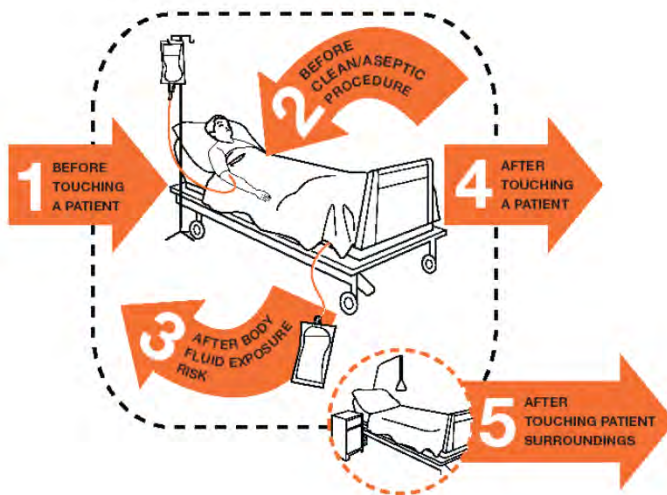
### The Five Components of the WHO multimodal hand hygiene improvement strategy



[www.who.int/gpsc/5may/tools/training\\_education/en/](http://www.who.int/gpsc/5may/tools/training_education/en/)

39

### Your 5 Moments for Hand Hygiene



Sax H et al. J Hosp Infect 2007;67:9

**Hand Hygiene in Outpatient and Home-based Care and Long-term Care Facilities**

A Guide to the Application of the WHO Multimodal Hand Hygiene Improvement Strategy and the "My Five Moments for Hand Hygiene" Approach

World Health Organization

[http://www.who.int/gpsc/5may/EN\\_GPSC1\\_PSP\\_HH\\_Outpatient\\_care/en/](http://www.who.int/gpsc/5may/EN_GPSC1_PSP_HH_Outpatient_care/en/)

41

**WHO Guideline for Hand Hygiene in Long-Term Care**

**Your Moments for Hand Hygiene**  
Health care in a residential home

1 BEFORE TOUCHING A PATIENT

2 BEFORE CLEAN/ASEPTIC PROCEDURE

3 AFTER BODY FLUID EXPOSURE RISK

4 AFTER TOUCHING A PATIENT

[http://www.who.int/gpsc/5may/EN\\_GPSC1\\_PSP\\_HH\\_Outpatient\\_care/en/](http://www.who.int/gpsc/5may/EN_GPSC1_PSP_HH_Outpatient_care/en/)

42

## **SHEA 2014 Compendium: Strategies to Prevent Healthcare-Associated Infections through Hand Hygiene**

**In 2014, SHEA published a document intended to:**

- **Highlight practical recommendations in a concise format**
- **Update recommendations with the most current evidence**
- **Elucidate topics that warrant clarification or more research**
- **Assist healthcare facilities in implementing hand hygiene adherence improvement programs**
  - including efforts to optimize hand hygiene product use
  - monitor and report back hand hygiene adherence data
  - promote behavior change

Ellingson K et al. *Infect Control Hosp Epidemiol* 2014;35:937

43

## **Hand Hygiene in LTCFs**

- **Deficiencies in hand hygiene practices are among the top 25 deficiencies for which LTCFs are cited by CMS**
- **From 2000 – 2009, an average of 9% of nursing homes per year received a deficiency citation (F-Tag 444) for inadequate hand hygiene practices from CMS**
  - In Wisconsin, 10% to 36% of nursing homes per year received a deficiency citation for hand hygiene during this time period
- **These data suggest that there has been (? and still is) an opportunity to improve hand hygiene practices in LTCFs**

Castle N et al. *J Appl Gerontol* 2014;33:24

44

### Challenges to Improving Hand Hygiene in LTCFs

- **Survey of 1143 individuals in 17 nursing facilities in 6 states identified knowledge, attitudes and barriers to hand hygiene**
- **29.7% stated that they would not change their hand hygiene practices regardless of guideline recommendations**
  - ~20% felt that guidelines were impractical
- **~21% of employees either did not receive training in hand hygiene during the previous year, or were uncertain if they had received training**

Ashraf MS et al. *Infect Control Hosp Epidemiol* 2010;31:758

45

### Challenges to Improving Hand Hygiene in LTCFs

- **Barriers affecting hand hygiene in LTCFs**
  - Staffing shortages of nurses and CNAs
  - Limited financial resources of LTCFs
  - Insufficient hand hygiene product availability
  - Limited in-house infection prevention/control resources
- **HCW beliefs that affect hand hygiene practices in LTCFs**
  - Too busy to wash hands
  - Senior personnel and colleagues don't wash hands
  - Absence of soap & water, sink, or alcohol-based handrub
  - Didn't wash because I wore gloves
  - Repeated handwashing will damage my skin
  - Just went into the resident's room to talk

Smith A et al. *Am J Infect Control* 2008;36:492

Ashraf MS et al. *Infect Control Hosp Epidemiol* 2010;31:758

Herzig CTA et al. *J Am Med Dir Assoc* 2016;17:85

46

## Challenges to Improving Hand Hygiene in LTCFs: Attitudes of HCWs Regarding Hand Hygiene

- Self-reported attitudes regarding hand hygiene among LTCF personnel

Indication for Hand Hygiene	Nurses	CNAs	Others
Wash hands when visibly dirty	60.5%	56%	45%
Wash hands when not visibly dirty	62%	57.4%	42.8%
Wash hands after removing gloves	61.2%	62%	44%

Ashraf MS et al. Infect Control Hosp Epidemiol 2010;31:758

47

## Hand Hygiene Promotion Campaign in LTCF

- **Comprehensive hand hygiene promotion campaign, conducted in 174-bed LTCF, included:**
  - Installation of touch-free alcohol-based handrub dispensers
  - Alcohol wipes placed in common areas and on food trays
  - Educational program for HCWs and for residents
  - Posters promoting hand hygiene located throughout the facility
  - Monitoring of hand hygiene compliance during the intervention
- **Results**
  - Significant reduction in rate of lower respiratory tract infections
  - Slight reduction in skin and soft tissue infections
  - No change in MRSA, VRE or C. difficile infections
  - Overall hand hygiene compliance during the intervention = 54%

Schweon SJ et al. Am J Infect Control 2013;41:39

48



### Cluster Randomized Controlled Trial of Hand Hygiene Promotion with Pocket-Sized Containers in LTCFs

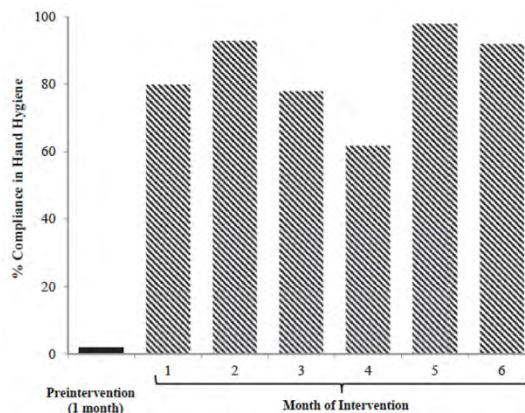
- Trial involved 6 LTCFs in Hong Kong
- After a 3-month pre-intervention period, LTCFs were randomized and the intervention in 3 LTCFs included:
  - Pocket-sized containers of alcohol-based handrub
  - Reminder materials
  - Education for all HCWs
- Hand hygiene was directly observed and infections recorded
- Results:
  - Adherence to handrubbing increased from 1.5% to 15.9%
  - Total adherence to hand hygiene increased from 25.8% to 33.3% ( $p = 0.01$ )
  - Incidence of serious infections, pneumonia and deaths due to infection decreased significantly in intervention facilities

Yeung WK et al. *Infect Control Hosp Epidemiol* 2011;32:67

49

### Improving Meal-Time Hand Hygiene Among Residents

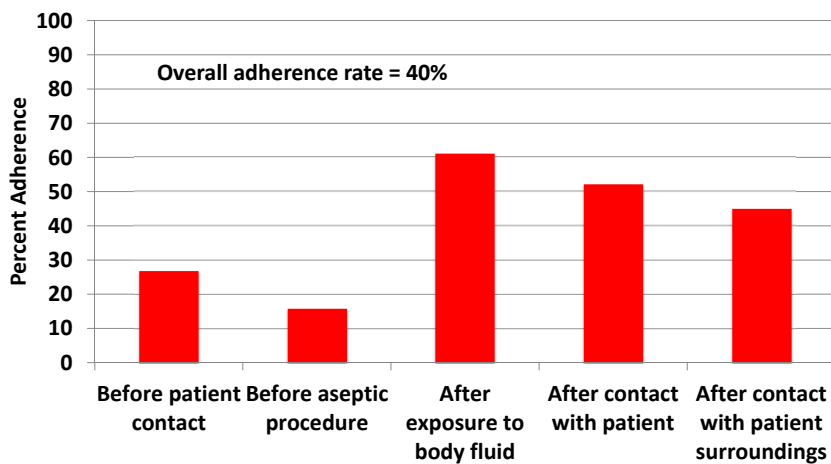
- 1-month baseline: Observations of meal-time hand hygiene by residents
- Barriers to hand hygiene
  - Inaccessible products
  - Difficult to use products
- 6-month interdisciplinary intervention to engage residents & staff
- Meal-time HH improved from 2% to 85% among residents



O'Donnell M et al. *Am J Infect Control* 2015;43:162

50

### HCW Adherence to Recommended Hand Hygiene Recommendations in a Pediatric LTCF



Loyland B et al. Int J Qual Health Care 2016;28:74

51



### Workflow Diagram: PO Feeding

- 3 Pediatric LTCFs each formed teams of personnel

- 6 workflow diagrams illustrated HH opportunities

- Diagrams were validated

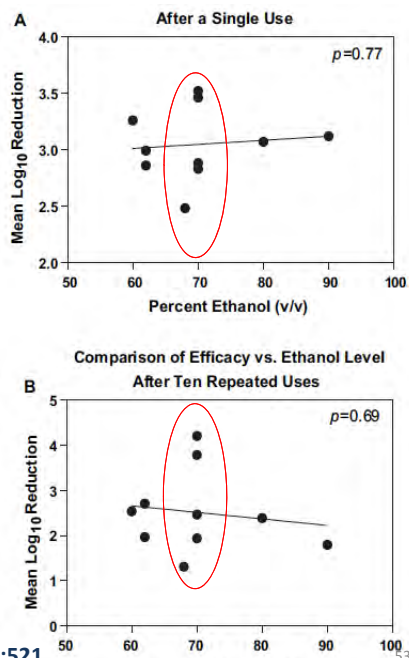
- Timing of HH opportunities was emphasized



Carter EJ et al. J Pediatr Nurs 2015;30:e17

### Importance of Product Formulation

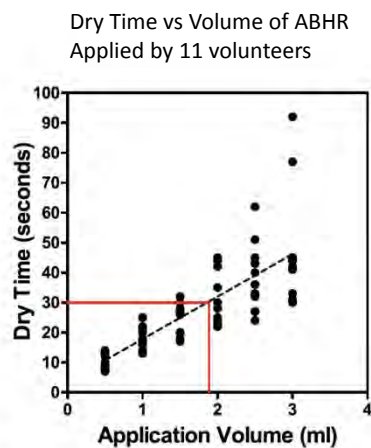
- 2 novel alcohol-based hand rub (ABHR) products containing 70% ethanol were compared to 9 other products with alcohol concentrations of 60% - 90%
- Both new products met efficacy requirements for USA and Europe
- Product efficacy did not correlate with alcohol concentration
- Conclusion: Formulation greatly influences the efficacy of products



Edmonds SL et al. Am J Infect Control 2012;40:521

### Factors Influencing Efficacy of ABHRs

- Influence of the volume of ABHR used, product format, and alcohol concentration on
  - Dry-time (time it takes for product to dry on hands)
  - Antimicrobial efficacy
- Volume of ABHR applied to hands is the primary factor affecting dry-time
- Amount of time that the product remains wet on hands greatly influences antimicrobial efficacy
- Product format did not affect dry-time

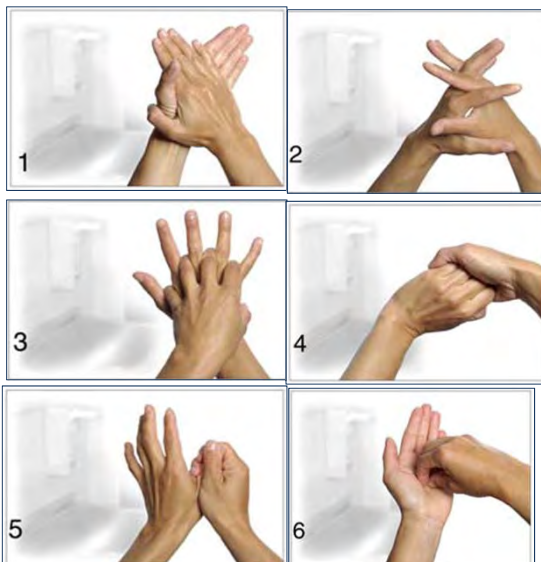


Macinga DR et al. BMC Infect Dis 2014;14:511

54

### Compliance with WHO Recommended Hand Hygiene (HH) Technique

- Observational study was conducted in large Swiss hospital with established HH program
- HH was performed in 93.2% of 2,662 opportunities observed
- Compliance with steps 1-6:
  - Step 1: 92%
  - Step 2: 83.6%
  - Step 3: 48.8 %
  - Step 4: 21.5%
  - Step 5: 42.5%
  - Step 6: 19.5%
- Compliance with performing all 6 steps: 8.5%

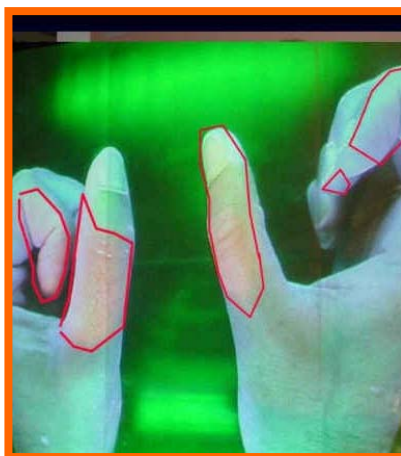


Tschudin-Sutter S et al. Infect Control Hosp Epidemiol 2015;36:482

55

### Checking Hand Hygiene Technique

- **Hand hygiene technique issues include:**
  - Is alcohol-based handrub applied to all surfaces of the hands?
  - What is the duration of handrubbing?
- **Fluorescent dye can be added to alcohol-based handrub to check for surfaces commonly missed**
  - Thumbs
  - Fingertips



Widmer A et al. Infect Control Hosp Epidemiol 2004;25:207

56

### **Improving Monitoring of Hand Hygiene Performance**

- **Direct observations by expert observers**
- Self-report by health-care workers
- Direct observations by patients
- **Consumption of hygiene products such as towels, soap, and alcohol-based handrub**
- **Automated monitoring systems**

57

### **Monitoring Hand Hygiene Compliance Using Direct Observation by Trained Observers**

- **Advantages**
  - **Determine compliance with all 5 Moments for Hand Hygiene**
    - Automated methods cannot monitor Moments 2 and 3
  - **Evaluate hand hygiene technique**
    - Duration of hand rub
    - Is hand hygiene performed at appropriate times during episode of care
  - **Provide immediate feedback to healthcare personnel**
    - Real-time coaching
    - Identify barriers to hand hygiene

Boyce JM Am J Infect Control 2017 (in press)

58

## Monitoring Hand Hygiene Compliance Using Direct Observation by Trained Observers

- **Limitations**
  - Lack of standardized methods precludes comparison of hospitals
  - Evaluates < 1% to 2% of all hand hygiene opportunities
  - Hawthorne effect may overestimate compliance rates by 300%
  - Time-consuming
    - Average number of hand hygiene opportunities (HHOs) that can be observed in 1 hr of observation = 18 (range 3.3 – 41.4)
    - In a hospital with a 70% compliance rate, it is estimated it would require 153 observations per nursing unit per time period (e.g. month) to accurately detect a 10% change in compliance
    - Many hospitals have difficulty providing sufficient auditors

Yin J et al. Infect Control Hosp Epidemiol 2014;35:1163  
Boyce JM Am J Infect Control 2017 (in press)

59

## Monitoring Product Usage

- **Manual methods of measuring volume of soap and ABHR used**
  - Has been useful in establishing trends over time
  - Is used in Europe to compare nursing units and hospitals
  - Requires personnel time to measure, record and analyze results
  - In the U.S., a system for submitting volume measurements on-line for analysis has been associated with increased hand hygiene
    - McGuckin Methods International, Inc.
- **Limitations**
  - Personnel time
  - Cannot tell who used dispensers (HCW, visitors, patients)
  - Does not give information of hand hygiene opportunities or compliance

Pittet D et al. Lancet 2000;356:1307  
Hansen S et al. Clin Microbiol Infect 2015;21:1047  
McGuckin M et al. Am J Med Qual 2009;24:205

60

## Electronic Monitoring of Product Usage

- Electronic devices can be placed inside product dispensers
- Electronic devices record each time the dispenser is accessed (HH event)
- HH events are time/date stamped
- HH Event data can be downloaded for subsequent analysis



Larson EL et al. Am J Crit Care 2005;14:304  
 Boyce JM et al. Infect Control Hosp Epidemiol 2009;30:1090  
 Marra AR et al. Infect Control Hosp Epidemiol 2010;31:796  
 Sodre da Costa LS Am J Infect Control 2013;41:997  
 Filho MA et al. Am J Infect Control 2014;42:1188  
 Arai A et al. Am J Infect Control 2016;44:1481

61

## Electronic Monitoring of Product Usage

- **Electronic system for monitoring of HH events**
  - + **estimated number of HH opportunities**
    - Dispensers record electronically each time the dispenser is accessed (HH event) and send data to computer server
    - HH opportunities are estimated based patient census, patient-to-nurse ratio, and adjustments
    - HH compliance is estimated by software
      - $\frac{\text{\# of HH events}}{\text{\# of estimated opportunities}} = \text{estimated compliance}$

Steed C et al. Am J Infect Control 2011;39:19  
 Diller T et al. Am J Infect Control 2014;42:602  
 Conway et al. Jt Comm J Qual Pat Saf 2014;40:408  
 Kwok YL et al. Am J Infect Control 2016;44:1475

62

## Automated Group Monitoring and Feedback Systems

- **More complex electronic systems with**
  - Counting devices in dispensers, and
  - Sensors detect persons entering/exiting patient rooms
  - Can estimate hand hygiene compliance of groups of personnel
- **Dispensers record hand hygiene events**
- **Room entry = proxy for Moment 1; exit = proxy for Moments 4 & 5**
- **# of Events / # of room entries & exits = estimated compliance**
- **Can provide real-time feedback to groups of HCWs**
- **Shortcoming: cannot tell if persons entering room are HCWs or not**

Limper HM et al. Infect Control Hosp Epidemiol 2016 (Epub ahead of print)

63

## Automated Badge-Based Monitoring Systems



64



## Automated Badge-Based Monitoring Systems

- **At least 20 articles have described evaluations of a variety of badge-based systems**
- **Systems varied in the technologies used, the settings in which evaluations were conducted, and the duration of each study**
- **Electronic monitoring systems utilize individual badges worn by HCWs**
  - Monitor entry and exit into patient rooms, or proximity to patient
  - Record when HCW wearing badge accesses HH dispenser
  - Estimates compliance with WHO Moments 1, 4 & 5
  - Some systems can provide real-time reminders to HCW
  - Can give HCWs individual, real-time feedback on their performance

65

## Reviews of Automated Hand Hygiene Monitoring Systems

- **A 2014 systematic review by Ward et al. reviewed 42 articles on automated or electronically-assisted monitoring systems**
  - < 20% of articles included data on efficiency or accuracy
  - Little compelling data on impact of systems on hand hygiene compliance
  - Further studies are needed of their accuracy, cost, & cost-effectiveness
- **Srigley et al. reviewed 7 automated monitoring systems in 2015**
  - Most (6) were conducted on a single unit
  - None measured directly observed compliance
  - Study designs varied substantially and were considered to be of poor quality
  - Future studies should include control groups and system-independent measures of hand hygiene to validate system accuracy and predictive value

Boyce JM *Infect Control Hosp Epidemiol* 2011;32:1016  
 Ward MA et al. *Am J Infect Control* 2014;42:472  
 McGuckin M *J Healthc Manag* 2015;60:348  
 Srigley JA et al. *J Hosp Infect* 2015;89:51  
 Limper HM et al. *Infect Control Hosp Epidemiol* 2016;37:1002  
 Boyce JM *Am J Infect Control* 2017 (in press)

66

## Automated Hand Hygiene Monitoring Systems

- **Further studies of electronic monitoring systems to establish:**
  - Accuracy in detecting HH events and estimates of compliance
  - Acceptance by HCW of electronic monitoring systems
  - Ability to accurately reflect compliance with 5 Moments for HH
  - Ability to improve HH compliance rates in a sustained manner
  - Effective ways to use data for feedback and training
  - Their impact on healthcare-associated infection rates
  - Cost-effectiveness

Boyce JM Am J Infect Control 2017 (in press)

67

## Direct Observation of All 5 Moments vs Automated Monitoring Moments 1, 4 and 5

- **Currently, direct observation by trained observers is the only method for establishing compliance with all 5 Moments for Hand Hygiene**
- **Inability of current automated HH monitoring systems to estimate compliance with Moments 2 and 3 is a frequently cited limitation**
- **Question: How does compliance with Moments 1, 4 & 5 compare with compliance with all 5 Moments?**
- **One study found that compliance with Moments 1 and 4 was 61%, while compliance with all 5 Moments was 62%**

Stewardson A et al. J Hosp Infect 2011;77:358

68

### **Direct Observation of All 5 Moments vs Automated Monitoring Moments 1, 4 and 5**

- Literature review identified a total of 28 studies that reported the distribution of the 5 Moments for Hand Hygiene
- A combined total of 601,988 HH opportunities were reported
- Moments 1, 4 & 5 accounted for 81.3% of all the 5 Moments
  
- 18 of the studies reported compliance with the 5 Moments
  - For all 5 Moments combined: 66.5%
  - For Moments 1, 4 & 5 combined: 64.9%
- **Conclusion: Monitoring Moments 1, 4 & 5 may give reasonable estimate of compliance with all 5 Moments**

Boyce JM Am J Infect Control 2017 (in press)

69

### **Combining Direct Observation with Automated Hand Hygiene Monitoring**

- Given its unique capabilities, direct observation should continue to be used for years to come as a qualitative measure of hand hygiene
- As more data on their accuracy, effectiveness and cost-effectiveness are generated, automated hand hygiene monitoring systems may become the main quantitative approach to measuring hand hygiene compliance
- A combination of direct observation & automated methods may
  - Provide the best information regarding hand hygiene practices
  - Become a key part of a multimodal strategy for improving hand hygiene

Boyce JM Am J Infect Control 2017 (in press)

70

## Innovation in Hand Hygiene Products

- **New formulations of hand hygiene products that are available or under development**
- **Non-alcohol based hand hygiene product**
  - Potassium oleate as primary ingredient
  - Reduces *Staphylococcus aureus* without skin damage
- **Hand rubs with activity against *Clostridium difficile* spores**
  - Acidified alcohol-based hand rub
  - Acidified alcohol + peracetic acid
- **Hand rubs with improved activity against Norovirus**

Asaoka K et al. Am J Infect Control 2016;44:e129

Nerandzic MM et al. PLoS One 2015;10:e132805

Nerandzic MM et al. Open Forum Infect Dis 2015;3:ofv206

71

## Innovation: New Dispenser Technology

- **Potential improvements in dispenser design and function**
  - Notifies HCW of empty dispenser
    - Window shows level of product
    - Sends electronic signal when empty
  - Auditory or visual cues that draw attention of HCWs →
  - Ability to alert HCWs if HH not performed upon room entry
  - Improved electronic wearable dispensers or pocket bottles
  - ? Deliver amount of product based on hand size of HCW



Beyfus TA et al. Am J Infect Control 2016;44:496

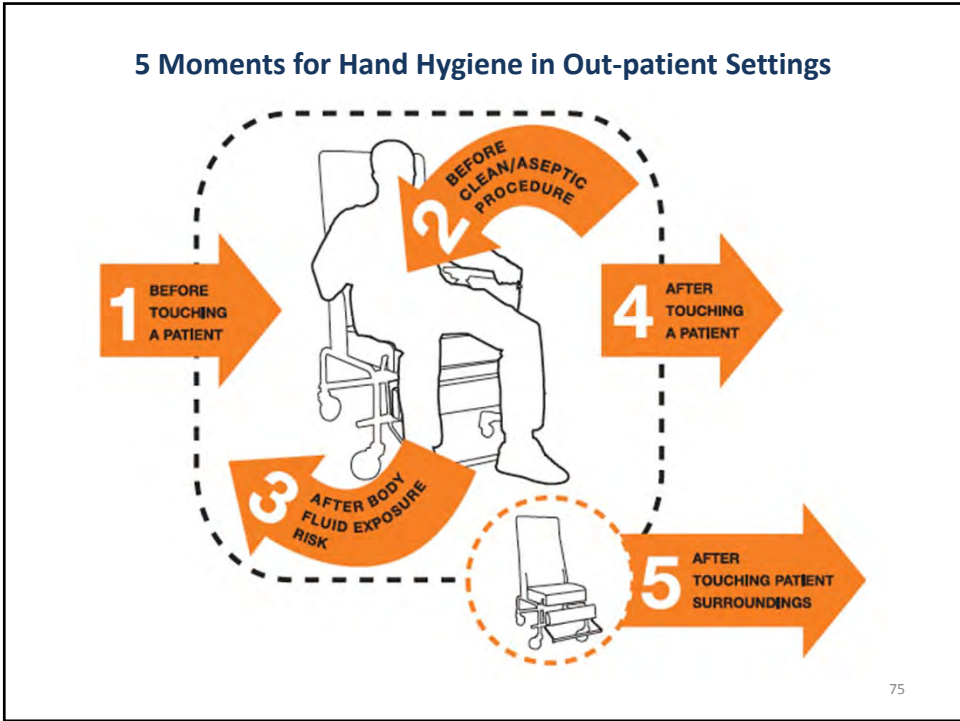
## Summary

- **Hand hygiene guidelines have led to considerable improvements in HH practices in recent years**
- **Further improvements in compliance are needed**
- **Greater understanding of factors that influence individual behavior and promote institutional safety climate is needed**
- **Continued improvement of HH products and delivery systems should facilitate efforts to improve HH compliance**
- **New approaches to monitoring HH compliance and providing HCWs with feedback will be implemented in coming years**

73

Questions?

74



### Average Duration of Handwashing by Healthcare Workers

Year	Mean/median time
1997	4.7–5.3 seconds
1994	6.6 seconds
1974	8–9.3 seconds
1984	8.6 seconds
1994	<9 seconds
1994	9.5 seconds
1991	<10 seconds
1990	10 seconds
1984	11.6 seconds
1992	12.5 seconds
1988	15.6–24.4 seconds
1998	20.6 seconds
1978	21 seconds
1989	24 seconds

Boyce JM & Pittet D MMWR 2002;51 (RR-16):1-45

76

## Preference of Alcohol Hand Rub Dose by Nurses

- Some HCWs believe that 1.1 ml of ABHR is not enough to adequately cover all surfaces of hands; some nures think it is too much
- Prospective observational study included 53 nurses on 8 nursing units in 1 hospital
- Nurses were given a special bottle that recorded each time the bottle was opened. Nurses were given a new bottle on 3 shifts
- Bottles were weighed at the end of each of 3 shifts, and average amount (ml) per application was calculated for each nurse
- Hand size was estimated using a validated method

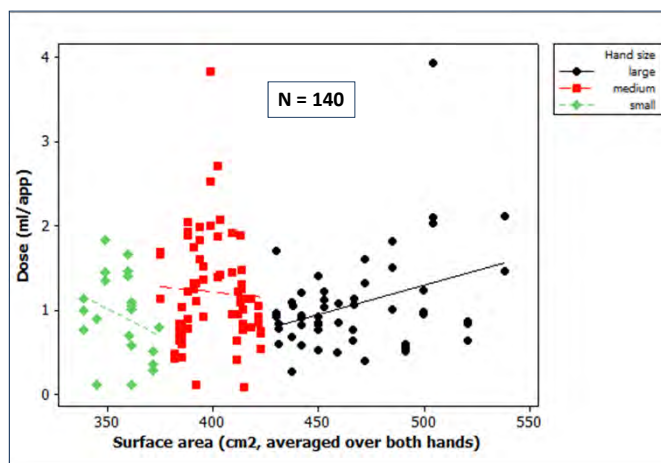


Bottle Provided by GOJO

Martinello R et al. SHEA Spring conference 2017

77

## Association Between Hand Size and ABHR Dose Volume per Application by Nurses with Small, Medium and Large Hand Size

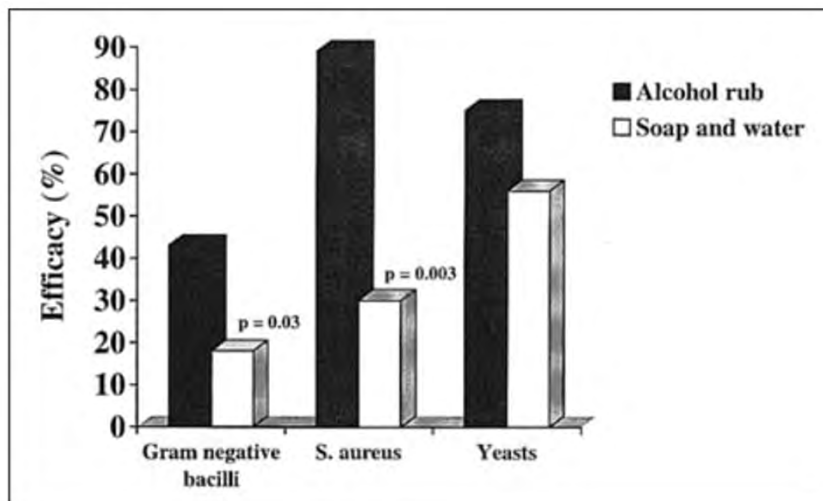


- Average dose/application was 1.09 ml

Martinello R et al. SHEA Spring conference 2017

78

### Efficacy of Soap & Water Handwashing vs Alcohol-Based Handrub in Reducing Pathogens on the Hands of LTCF Personnel



Mody L et al. Infect Control Hosp Epidemiol 2003;24:165

79

### Electronic Monitoring of Product Usage

- **Electronic system for monitoring of HH events + estimated number of HH opportunities**
- **Early studies of impact on HH compliance rates:**
  - A) **In-patient and out-patient units in community hospital (USA)**
    - Minimal, temporary increase in HH compliance
    - Number of logistical and implementation problems identified
  - B) **Medical ward and surgical ward in large hospital (Australia)**
    - Temporary increase in compliance on surgical ward
    - No increase in compliance on medical ward
    - Ward culture and personnel greatly affected results

Conway et al. Jt Comm J Qual Pat Saf 2014;40:408

Kwok YL et al. Am J Infect Control 2016;44:1475

80



## Innovations in Hand Hygiene

- **New research will provide additional insights into:**
  - Improved methods for educating HCWs regarding HH
  - Novel HH promotional methods based on
    - Behavioral theories
    - Social marketing techniques
  - Improved institutional interventions to sustain HH promotion
  - Increased use of human factors and ergonomic methods:
    - Influence hospital design to facilitate HH practices

81

## Innovation: Electronic Monitoring Systems

- **Placing sensors on the patient or on medical equipment to monitor compliance with Moments 2 & 3**
  - Example: place sensors intravenous catheters, urinary catheters, wound dressings
- **Technology for using video cameras to track position of HCWs in patient rooms, without identifying the patient or HCWs may be further developed and used for monitoring compliance**

82