Scientific Basis for Current Hand Hygiene Guidelines and Future Trends

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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

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

Semmelweis IP, 1861
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

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

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

Semmelweis 1861
**NIH-Sponsored Prospective, Controlled Trial of Handwashing**

- No Handwashing by Nurses
- Index Case with S. aureus
- Handwashing with Hexachlorophene Soap


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

<table>
<thead>
<tr>
<th>Group</th>
<th>% Acquiring S. aureus</th>
<th>Avg. Hrs Exposure</th>
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<tbody>
<tr>
<td>No Handwashing</td>
<td>92% *</td>
<td>35 Hrs</td>
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<tr>
<td>Hexachlorophene Handwashing</td>
<td>53% *</td>
<td>133 Hrs</td>
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* O.R. = 9.9  95% CI = 2.6 - 45  p = 0.0001


**HCW Handwashing Compliance**

1985 1988 1995
CDC APIC HHG
HWG HWG HHG

Percent Compliance 90 80 70 60 50 40 30 20 10

'81 '86 '90 '95 2000
Factors Associated with Poor Handwashing Compliance

**Observed Risk Factors**
- Physician (rather than nurse)
- Nursing assistant (not nurse)
- Male sex
- Working during the week
- Wearing gowns/gloves
- Activities with high risk of cross-transmission
- High number of opportunities for hand hygiene per hour of care

**Self-Reported Risk Factors**
- Handwashing causes irritation and dryness of skin
- Sinks inconveniently located
- Lack of soap and paper towels
- Often too busy/insufficient time
- Patient needs take priority
- Belief that wearing gloves obviates the need for hand hygiene
- Forgetfulness
- Disagreement with guidelines

Adapted from Pittet D. Infect Control Hosp Epidemiol 2000;21:381

Relative Efficacy of Hand Hygiene Agents In 22 Published Studies

<table>
<thead>
<tr>
<th>Year</th>
<th>Least Effective</th>
<th>Most Effective</th>
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<td>2016</td>
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Hand Hygiene by Handwashing

- 1995 APIC Guideline recommended use of alcohol-based handrubs primarily:
  - If handwashing facilities were insufficient or inadequate
  - Interruption of water supply
- However, hand washing with soap & water continued to be the only form of hand hygiene performed in most hospitals in the United States and many other countries

Larson EL. Am J Infect Control 1995;23:251
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
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

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


Electrical Capacitance of Dorsal Hand Skin Surface

N = 29

* Low Corneometer reading = dry skin

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
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

Frequency of Skin Contamination at Various Body Sites

<table>
<thead>
<tr>
<th>MRSA Patients</th>
<th>VRE Patients</th>
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</thead>
<tbody>
<tr>
<td>40%</td>
<td>38%</td>
</tr>
<tr>
<td>13-25%</td>
<td>29%</td>
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<tr>
<td>30-39%</td>
<td>86%</td>
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</tbody>
</table>

Contamination of HCW Bare Hand After Touching Patient Colonized with MRSA

Before Hand Hygiene | After Use of Alcohol Hand Rub

Bonnet MJM et al. Lancet 1996; 348:1615
Environmental Sites Positive for MRSA in Rooms of 38 Patients Colonized or Infected with MRSA

![Graph showing the percent of surfaces positive for MRSA in different environmental sites.]

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

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

![Graph showing the percent of skin contamination in patients with CDAD, asymptomatic carriers, and non-carriers.]


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

![Graph showing the percent positive for various skin sites.]

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


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


Frequency of VRE Contamination of Gloves or Hands in HCWs Who Touched Only the Environment vs Those Who Touched the Patient and Environment

Hayden MK et al. Infect Control Hosp Epidemiol 2008;29:149
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
Grundmann H et al. J Infect Dis 2002;185:481
Hayden MK et al. Infect Control Hosp Epidemiol 2006;27:149
Morgan DI et al. Infect Control Hosp Epidemiol 2010;31:716

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
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
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

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

The Five Components of the WHO multimodal hand hygiene improvement strategy

1a. System change – Alcohol-based handrub at point of care
1b. System change – access to safe, Continuous water supply, soap and towels
2. Training and education
3. Evaluation and feedback
4. Reminders in the workplace
5. Institutional safety climate

www.who.int/gpsc/5may/tools/training_education/en/
Your 5 Moments for Hand Hygiene

1. BEFORE PROVIDING CARE
2. AFTER TOUCHING PATIENT
3. AFTER DIRECTING PATIENT
4. AFTER TREATMENT WITH PPE
5. AFTER TREATING PATIENT


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

WHO Guideline for Hand Hygiene in Long-Term Care

http://www.who.int/gpsc/5may/EN_GPSC1_PSP_HH_Outpatient_care/en/
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

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

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
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

Ashraf MS et al. Infect Control Hosp Epidemiol 2010;31:758
Herzig CTA et al. J Am Med Dir Assoc 2016;17:85

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

- Self-reported attitudes regarding hand hygiene among LTCF personnel

<table>
<thead>
<tr>
<th>Indication for Hand Hygiene</th>
<th>Nurses</th>
<th>CNAs</th>
<th>Others</th>
</tr>
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<tbody>
<tr>
<td>Wash hands when visibly dirty</td>
<td>60.5%</td>
<td>56%</td>
<td>45%</td>
</tr>
<tr>
<td>Wash hands when not visibly dirty</td>
<td>62%</td>
<td>57.4%</td>
<td>42.8%</td>
</tr>
<tr>
<td>Wash hands after removing gloves</td>
<td>61.2%</td>
<td>62%</td>
<td>44%</td>
</tr>
</tbody>
</table>

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

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%


Ashraf MS et al. Infect Control Hosp Epidemiol 2010;31:758
Herzig CTA et al. J Am Med Dir Assoc 2016;17:85
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


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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


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HCW Adherence to Recommended Hand Hygiene Recommendations in a Pediatric LTCF

Overall adherence rate = 40%

**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


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**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


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**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
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%


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
  – Finger tips

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
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)

- 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

Boyce JM Am J Infect Control 2017 (in press)

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
    - McGucken Methods International, Inc.

- Limitations
  - Personnel time
  - Cannot tell who used dispensers (HCW, visitors, patients)
  - Does not give information of hand hygiene opportunities or compliance

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

Marra AR et al. Infect Control Hosp Epidemiol 2010;31:796
Sodre da Costa LS Am J Infect Control 2013;41:997

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
      - # of HH events / # of estimated opportunities = estimated compliance


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)
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

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
McGuirk M. J Healthc Manag 2015;60:348
Srigley JA et al. J Hosp Infect 2015;89:51
Boyce JM Am J Infect Control 2017 (in press)
Automated Hand Hygiene Monitoring Systems

- Further studies of electronic monitoring systems to establish:
  - Accuracy in detecting HH events and estimates of compliance
  - Acceptance by HCWs 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

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%

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: 66.9%
  - For Moments 1, 4 & 5 combined: 64.9%
- Conclusion: Monitoring Moments 1, 4 & 5 may give reasonable estimate of compliance with all 5 Moments
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)

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

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

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
Average Duration of Handwashing by Healthcare Workers

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<th>Year</th>
<th>Mean/median time</th>
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<td>1974</td>
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</tr>
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<td>1982</td>
<td>12.5 seconds</td>
</tr>
<tr>
<td>1988</td>
<td>15±24.4 seconds</td>
</tr>
<tr>
<td>1998</td>
<td>20.6 seconds</td>
</tr>
<tr>
<td>1978</td>
<td>21 seconds</td>
</tr>
<tr>
<td>1989</td>
<td>24 seconds</td>
</tr>
</tbody>
</table>

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

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 nurses 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

Martinello R et al. SHEA Spring conference 2017

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
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

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


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
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