



Using Science to Guide Hand Hygiene Surveillance and Improvement
Prof. Eli Perencevich, University of Iowa
Broadcast live from the Infection Prevention Society conference



Ayliffe Lecture: Using science to guide hand hygiene surveillance and improvement

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www.webbertraining.com 
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Conflicts of Interest Statement

- No financial conflicts
- Section Editor for Guidelines, Position Papers, and Invited Reviews @ ICHE
- Federal Funding
 - VA HSR&D (COIN and CREATE)
 - CDC Prevention Epicenter
 - AHRQ



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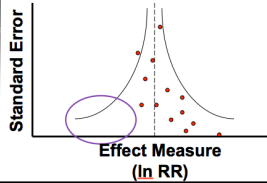
This talk will review the science behind
monitoring and improving hand hygiene



Hand hygiene basics – opportunities, barriers and effective interventions



System types and effectiveness



Publication Bias, Hawthorne



Hand hygiene is important...



<http://xkcd.com/1161/>



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Hand hygiene is important...



Sneeze into your elbow!!

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<http://xkcd.com/1161/>

Hand Hygiene at Crossroads

- “Hand Hygiene Compliance: are we kidding ourselves?”¹
- Targets set at >90%, met by most facilities
- 2009-2014 Systematic Review²
 - Mean compliance before intervention – 34%
 - After intervention – 57%
- What should be the target? – Fair monitoring
 - Achievable
 - Beneficial

FOR MORE INFO...

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1. Mahida N. JHI 2016 (92) 307-8 2. Kingston L. et al. JHI 2016:309-20

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Veterans Health Administration

- VHA is largest integrated health system in US
- 168 VA Medical Centers
 - 132 Community-Living Centers (Nursing Homes)
- 1,053 Outpatient Clinics
- Serves over 9 million enrolled veterans
- Centralized medical records and policies



Hand Hygiene 2015: Complicated

- CDC Guideline for Hand Hygiene in Health-Care Settings (2002) - **56 Pages**
- WHO Guideline on Hand Hygiene in Health Care (2009) - **270 pages**

- VHA DIRECTIVE 2011-007
 - Effective: March 1, 2011
 - Expired: February 29, 2016



2012 VHA Hand Hygiene Survey

- VHA Hand Hygiene Workgroup
- 141 VA healthcare systems participated

- Administered through the Office of the Deputy Under Secretary of Healthcare Operation Management (DUSHOM) Office
 - ▣ “the staff member responsible for their facility’s hand hygiene program”



51-Item Intranet-Based Survey

- Three areas of focus:
 1. **How hospitals measured HCWs hand hygiene**
 2. **Which intervention strategies should be recommended to improve compliance**
 3. **Facility threshold/goal for compliance**

FOR MORE INFO...

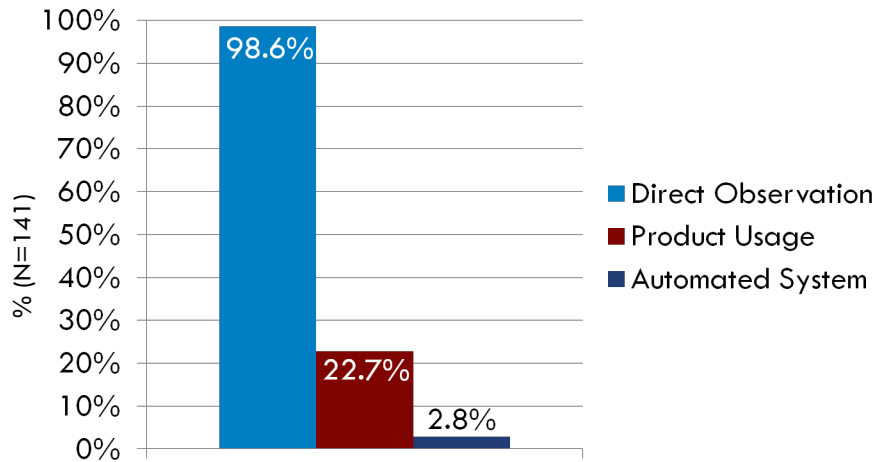
Reisinger HS et al. Am J Infect Control 2013 Nov;41(11):989-93



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How did VHA measure compliance in 2012?

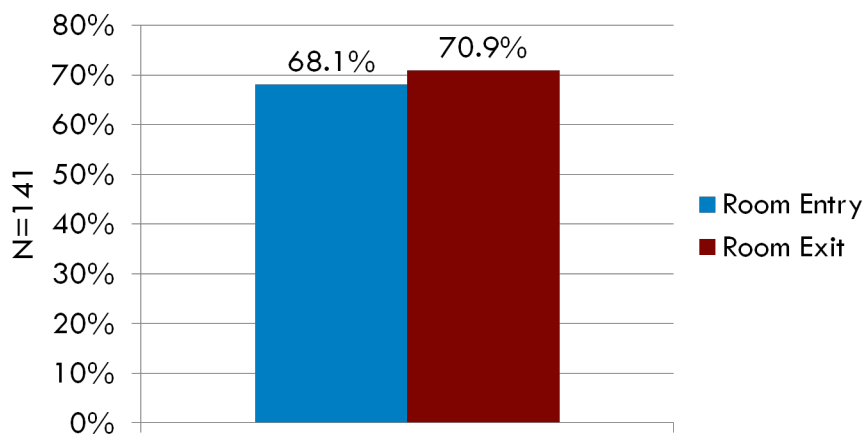


FOR MORE INFO...

Reisinger HS et al. Am J Infect Control 2013 Nov;41(11):989-93



When did they measure compliance?



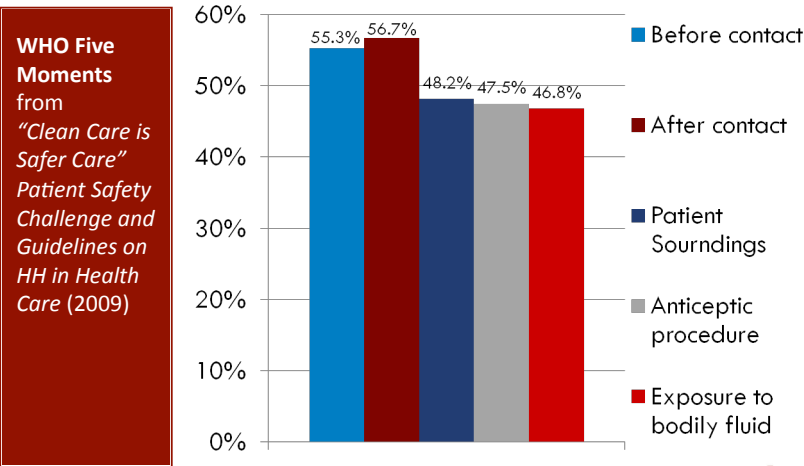
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Which WHO Moments?



Reisinger HS et al. Am J Infect Control 2013 Nov;41(11):989-93



Having a (hand hygiene) moment

16 Moments For Hand Hygiene

- entering patient room
- before touching a patient
- before handling medication
- before clean/antiseptic procedure
- before putting on sterile gloves
- after removing gloves
- after exposure to body fluid
- after visibly dirty/soiled
- moving from a contaminated body site to another body site during the care of the same patient (say that one three times while rubbing your belly and head)
- after touching equipment or patient surroundings
- after touching a patient
- exiting a patient room
- before eating
- after using the restroom
- when preparing food
- after delivering food (if worker touches patient, bed linens, or objects in the room)

<http://haicontroversies.blogspot.com/2011/11/im-having-hand-hygiene-moment.html>



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Which Opportunities?

- Compare compliance using WHO “My 5 Moments” vs “Before & After” or “Before” (2009-201)
- **Before & After** may provide a surrogate marker of overall hand hygiene compliance

Table 1

Number of opportunities and hygiene compliance according to the three models

	My 5 Moments	Before & After	Before
No. of opportunities	5577	3946	2149
Compliance	62% (61–64) ^a	61% (60–63) ^a	52% (50–54) ^a

^a 95% confidence interval.



Stewardson A. et al. J Hosp Infect Volume 77, Issue 4, April 2011, Pages 358–359

Feasibility of “WHO My 5 Moments” vs Entry/Exit in the US?

- 3 hospital (6 ward, 5 ICU) study comparing ability to monitor WHO M5M vs Entry/Exit compliance
- Question: Could we “see” it?
- WHO M5M in ICU vs Ward
 - M5M observed during 39% of episodes of care in ICU
 - Compared to 28% observed on wards, $P < 0.01$



Chung N. et al, Am J Infect Control. 2016

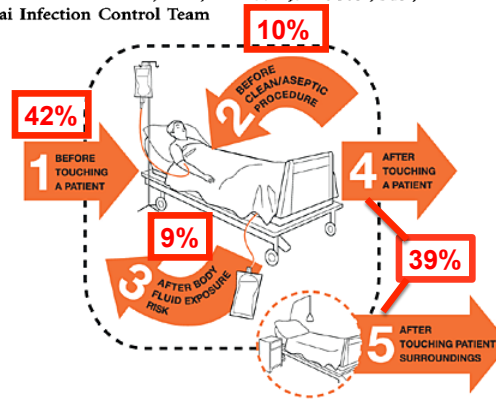
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Entry/Exit captures most WHO M5M Opportunities

Rate of Healthcare Worker–Patient Interaction and Hand Hygiene Opportunities in an Acute Care Setting

Laura Goodliffe, MPH;^{1,2,*} Kelsey Ragan, MPH;^{2,*} Michael Larocque, BSc;² Emily Borgundvaag;² Sophia Khan;² Christine Moore, BSc;² Liz McCreight, CIC;² Brenda L. Coleman, PhD;^{1,3} Allison J. McGeer, MD;^{1,2} for the Mount Sinai Infection Control Team

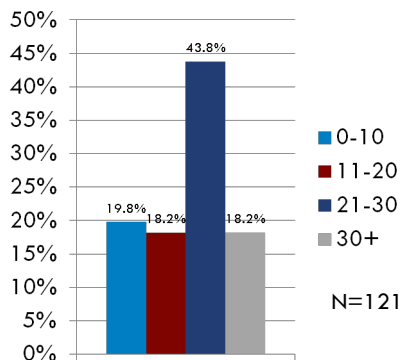
- 257 hours
- 1605 opportunities
- Mean 4.2 op/hour
- 77% RN, 8% MDs



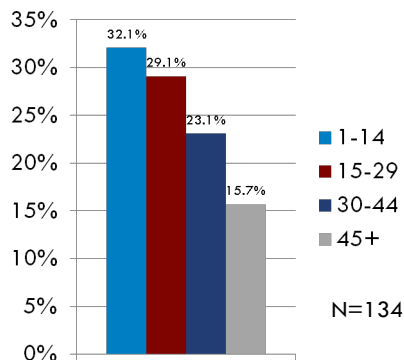
ICHE 35:7 (July 2014), pp. 826-832

How much monitoring happens?

Observations per month per ward/unit/clinic



Minutes per observation period



Reisinger HS et al. Am J Infect Control 2013 Nov;41(11):989-93

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Barriers to Compliance: Need more than feedback to improve hand hygiene

- ❑ Skin dryness and irritation
- ❑ No time to wash, nursing workload
- ❑ Inconvenient sinks, hand hygiene dispensers
 - ▣ Fire codes in US
- ❑ Carrying something in your hands when entering
- ❑ Compliance not individually tracked*



Recognizing the barriers, what interventions have been proven to increase compliance?

Searching for an Optimal Hand Hygiene Bundle: A Meta-analysis

Marin L. Schweizer,^{1,2,3} Heather Schacht Reisinger,^{1,2} Michael Ohl,^{1,2} Michelle B. Formanek,^{1,3} Amy Blevins,⁴ Melissa A. Ward,² and Eli N. Perencevich^{1,2}

¹The Center for Comprehensive Access and Delivery Research and Evaluation, Iowa City Veterans Affairs Health Care System; ²Department of Internal Medicine, Carver College of Medicine; ³Department of Epidemiology, College of Public Health, and ⁴Hardin Library for the Health Sciences, University of Iowa, Iowa City

- ❑ Systematic Review 2000 to April 2012
- ❑ 8148 articles identified, 65 fully reviewed
- ❑ 45 studies included (RCT and Quasi-experimental)



Schweizer et al. Clin Infect Dis 2014 Jan;58(2):248-59

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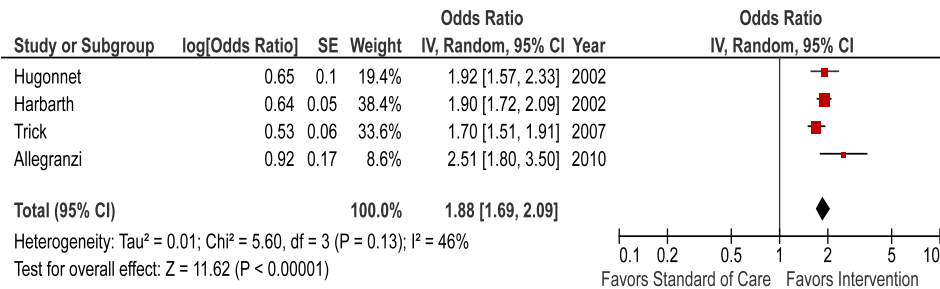
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WHO Multimodal Hand Hygiene Improvement Strategy

- Education
- Access to dispensers/pocket size hand rub
- Reminders
- Institutional Safety Climate (Administrative Support)
- Feedback*
 - 27 studies, only one analyzed alone



There is strong evidence for WHO bundle



Schweizer et al. Clin Infect Dis 2014 Jan;58(2):248-59

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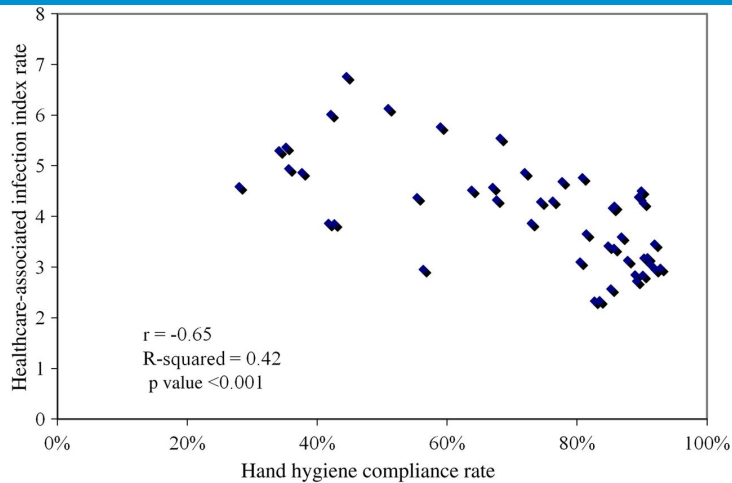
How much hand hygiene is enough?

- No matter how we measure it, when can we be satisfied that we are preventing infections?



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Is there a target threshold for hand hygiene compliance associated with reduced infections?



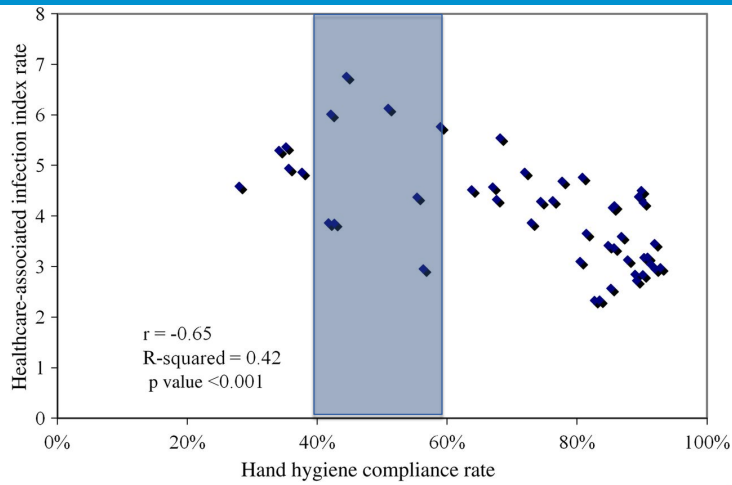
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Kirkland KB, et al. BMJ Qual Saf 2012;21:1019-26

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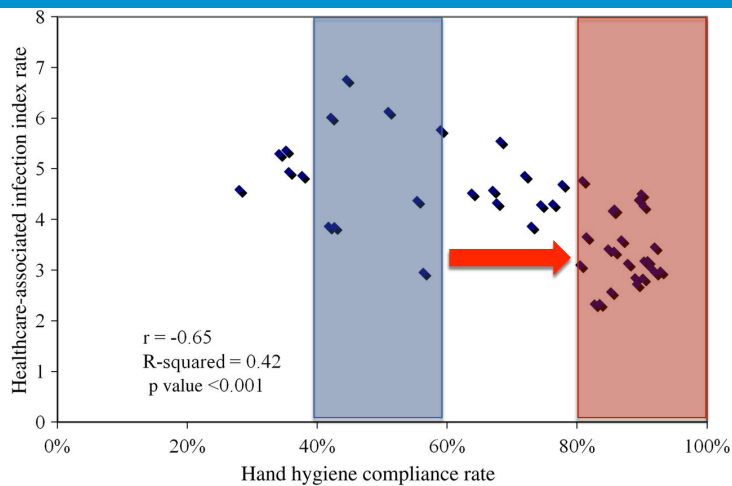
Most of hospitals have compliance around 40-60%



Kirkland KB, et al. BMJ Qual Saf 2012;21:1019-26

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Hand hygiene compliance threshold?



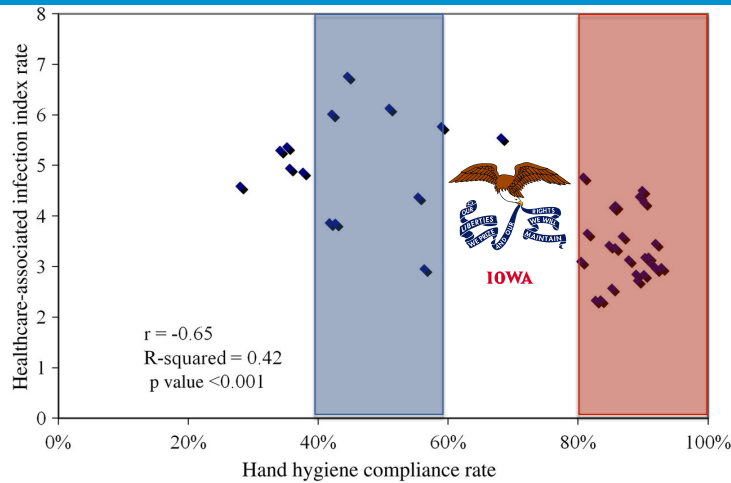
Kirkland KB, et al. BMJ Qual Saf 2012;21:1019-26

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Hand hygiene compliance threshold?



Kirkland KB, et al. BMJ Qual Saf 2012;21:1019-26

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But what about automated systems?

Automated and electronically assisted hand hygiene monitoring systems: A systematic review

Melissa A. Ward MS^a, Marin L. Schweizer PhD^{a,b}, Philip M. Polgreen MD, MPH^a, Kalpana Gupta MD, MPH^{c,d}, Heather S. Reisinger PhD^{a,b}, Eli N. Perencevich MD, MS^{a,b,*}

- Systematic review: 1 Jan 2000 – 31 March 2013
- 3,463 articles identified, 42 included
 - Enhanced direct observation
 - Video monitoring
 - Electronic dispenser counters
 - Automated monitoring networks

Ward M et al. AJIC 2014

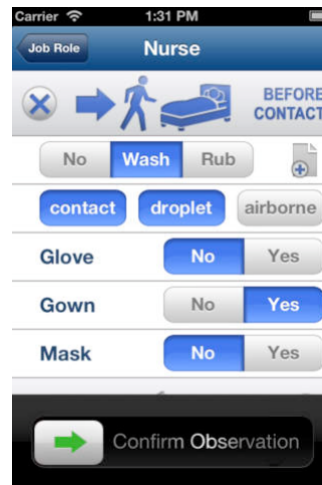
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Enhanced direct observation systems

- 5 studies
- iScrub – free
- Customizable, time-stamped
- Email spreadsheet
- May simplify audit-feedback
- No evidence of benefit



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<http://compepi.cs.uiowa.edu/index.php/Research/iScrub>

Video-monitoring shows potential to improve compliance

- 4 studies
- Generally associated with improved compliance
- Placement important
 - 5 moments
- “Big Brother”
- Costs - \$50,000 plus \$1000/month in 17 bed unit



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Ward M et al. AJIC 2014

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Third-party remote video monitoring effective intervention in MICU and SICU

- 2 year study
- Camera of sinks/
dispensers
- Sensor for Entry/Exit
- Monitors in India
- Pre-feedback **10%**
- Post-feedback **81.6%**
- At 75 weeks **87.9%**



Armellino D et al. Clin Infect Dis 2012
Armellino D et al AJIC 2013



Electronic Dispenser Counters



- 15 studies
- Time-stamped
- Can't determine
appropriateness, lacks
denominator
- Associated with
improved accuracy vs
direct observation*

*Morgan DM AJIC 2012

*Marra AR ICHE 2010



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Counters with feedback not effective

- 6-month intervention vs control step-down units
- Intervention: counts given to individual nurses 2x/week, placed in chart, compared to other nurses

Outcome Variable	Intervention Unit	Control Unit	p
Alcohol Gel	33.6	30.2	.54
CHG	7.5	5.6	.59
Total	41.1	35.8	.56



Marra AR ICHE 2008

But when the Positive Deviance model applied, hand hygiene increased

- Same step-down units (SDU) and counters
- 9 month study – 3 x 3-month periods

	Pre-intervention		PD East SDU		PD Both SDU	
	East	West	East	West	East	West
alcohol dispense/ 1000 pt-days	46,890	44,460	62,000*	33,570	57,930	43,980
L / 1000 pt-days	136	115	250*	126	239	205

P < 0.01



Marra AR ICHE 2010

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Automated hand-hygiene monitoring networks

- 18 studies



- Detect when HCW enters and hand hygiene event, remind HCW, wearable component
- Audible reminder on ward entrance raised hand hygiene from 8% to 50% in HCW and visitors*
- Urgent-care, 13 HCW study with monthly reminders: 37% to 49% compliance $p < 0.01$ #

*Fakhry M et al. AJIC 2012

Sahud AG et al. JHI 2012

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Alcohol-sensing badges with audio-visual reminders

- 35-bed orthopaedics ward
- 19 nurses wore credit-card-sized alcohol sensor badge (BioVigil LLC, Santa Rosa, CA, USA) for two weeks
- Door sensor triggered by entry
- If alcohol detected – green+ping
- If alcohol not-detected – red+beep
- **31-day study**

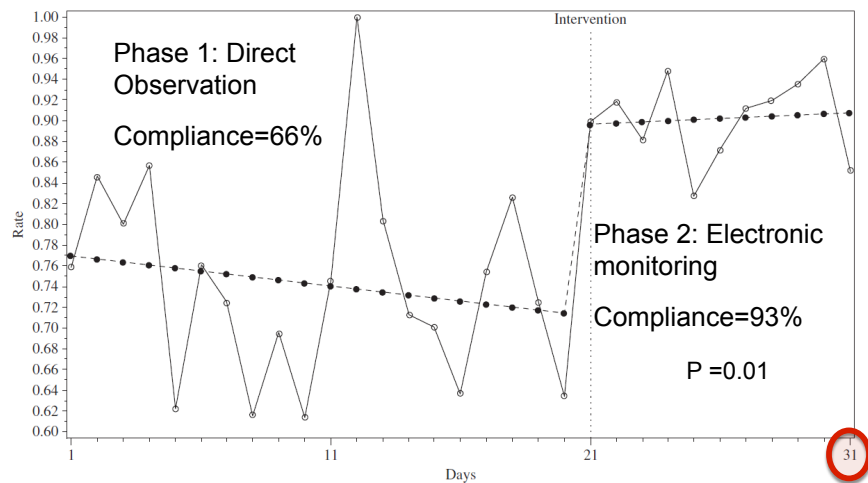
Edmond et al. JHI 2010, 76;354-372

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Alcohol sensor badge raised compliance



Edmond et al. JHI 2010, 76;354-372

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Systematic Review Recommendation – Hold off on buying these systems

- Small, uncontrolled, quasi-experimental studies
- “Limited data is currently available to recommend adoption of specific automatic or electronically-assisted hand hygiene surveillance systems...Given the restricted clinical and infection prevention budgets of most facilities, cost-effectiveness analysis of specific systems will be required before these systems are widely adopted”

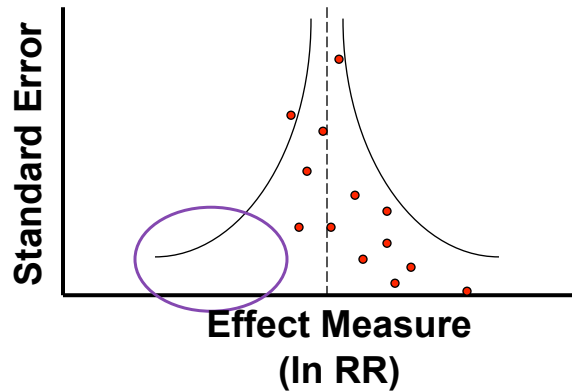
Ward M et al. AJIC 2014

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Caveat emptor - "Let the buyer beware"

- Buyers vs. sellers "information"
- "Publication Bias": investigators don't publish small and/or negative studies



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Full publication of results initially presented in abstracts
(Review)

Scherer RW, Langenberg P, von Elm E

DID THEY PUBLISH
THEIR ABSTRACTS?

THE COCHRANE
COLLABORATION®

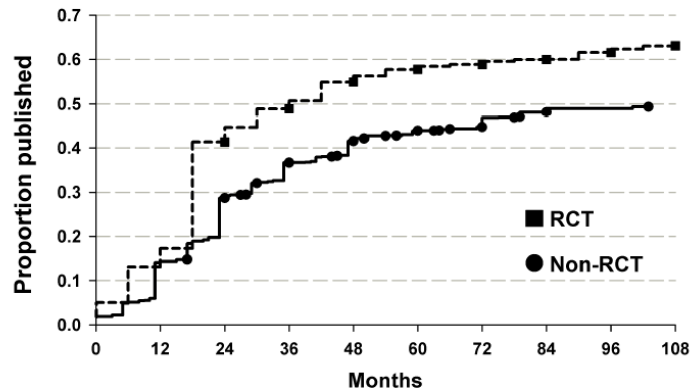
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Cochrane Database Syst Rev. 2007 Apr 18;(2):MR000005

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Figure 2. Cumulative full publication; comparison of abstracts describing randomized or controlled clinical trials (RCTs, 9 studies) with abstracts describing other study designs (Non-RCTs, 36 studies)



N = 17,344 abstracts for non-RCTs and 2,917 abstracts for RCTs
Circles and squares show points where data censored because reports stopped follow-up.

Cochrane Database Syst Rev. 2007 Apr 18;(2):MR000005

Which abstracts are likely to be published?

- "Positive" results (RR = 1.30; CI 1.14-1.47)
- Oral vs. poster (RR= 1.28; CI 1.09-1.49)
- Higher quality of abstracts (RR=1.30, CI 1.00-1.71)

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Real-time location system (RTLS) [abstract](#)

- Before/After QE Design
 - 10-month study
- RTLS badges
- IR beacons installed in rooms
- Outcome: directly observed entry-exit compliance



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Boyce JM IDWeek 2012 #37759

RTLS electronic monitoring system associated with lower compliance

- 36% decline in entry compliance ($p=0.191$)
- 32% decline in the exit compliance ($p<0.001$)

- The average accuracy of the badge RTLS system was 60%
 - False-negative results led to HCW frustration

- Negative study – not published

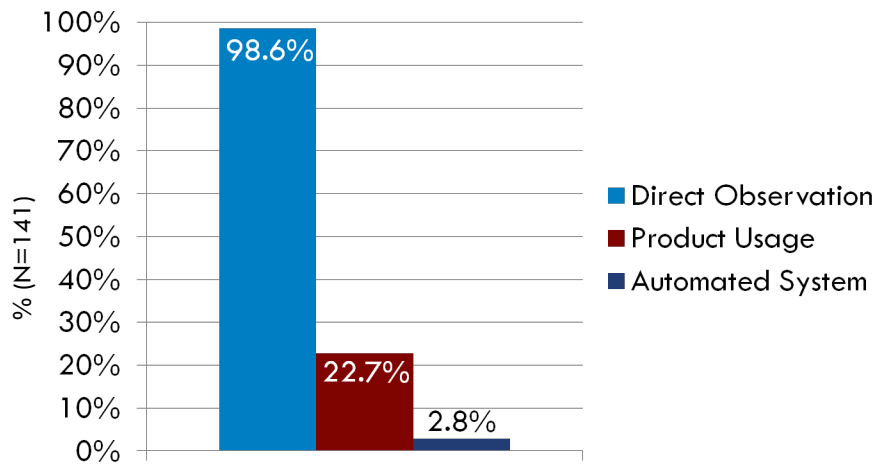
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Boyce JM IDWeek 2012 #37759

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Reminder: Most use direct observation



FOR MORE INFO...

Reisinger HS et al. Am J Infect Control 2013 Nov;41(11):989-93

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But if direct-observation is so terrible, shouldn't we just buy a system anyway?

- Hand hygiene opportunities are too numerous
 - Night and weekend shifts
 - Too much time/money to monitor
 - Do we need to count every one?

- Hawthorne Effect

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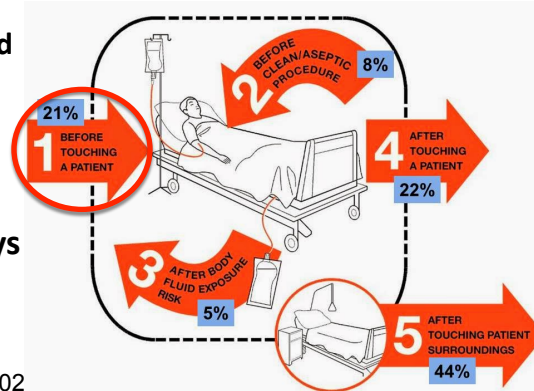
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Lots of hand hygiene opportunities going on

Estimation of hand hygiene opportunities on an adult medical ward using 24-hour camera surveillance: Validation of the HOW2 Benchmark Study

Thomas Diller MD, MMM^{a,b,c,d,*}, J. William Kelly MD^{c,e,f}, Dawn Blackhurst DrPH^{a,b,c},
 Connie Steed MSN, RN, CIC^f, Sue Boeker BSN, RN, CIC^f, Danielle C. McElveen MA^b

- 12 beds in gen med ward
- Video – 5 moments
- 72 op/patient/day
- 75% RN, 5% MD
- If 140,000 patient days
 - 10 million/year!!!



Am J Infect Control. 2014 Jun;42(6):602

How many observations needed?

- Prospective cohort, 3 hospitals
 - 7,743 HCW visits
 - 1,989 hours of observation
 - 3.89/hour/room
- Sample **power calculations**
 - 10% absolute compliance change month-to-month
 - 2-sided test, type I error at 5% significance, 80% power



Yin J. ICHE 2014;35 (9):1163-8

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Use chart to estimate number of opportunities and hours of direct observation

Baseline HH	Target HH	# opportunities	# hours (1 room at time)	# hours (2 rooms at time)
40	50	191	50	25
50	60	194	50	25
60	70	182	47	23.5
70	80	153	40	20
80	90	108	28	14

Yin J. ICHE 2014;35 (9):1163-8



The Hawthorne Effect is a limitation of direct-observation surveillance

- Improvement of human behavior when a subject knows they are being observed



1932

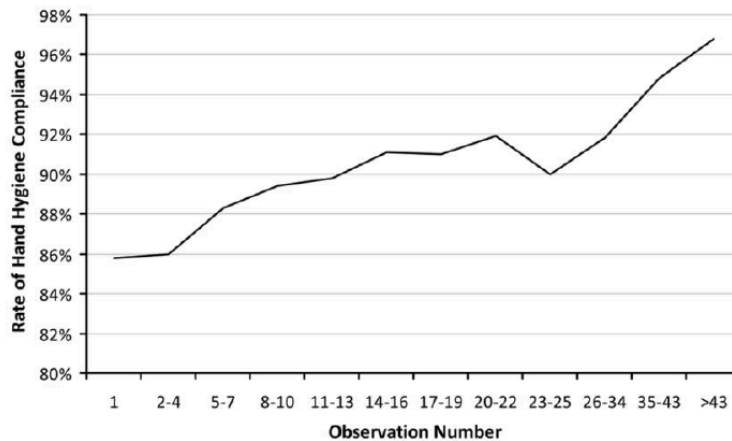
Hawthorne Works, Cicero IL



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Length of Observation Periods?



Chen LF ICHE 2013; 34(2): 207-10



Evidence of Hawthorne Effect

- Prospective Cohort: March 2011 – May 2013
- 3 VA hospitals
 - 5 ICUs
 - 6 medical/surgical wards
- Research-assistant observers
 - Hallway, did not announce presence
 - Monitored for fixed 1-hour intervals
 - Opportunities Entry/Exit

Yin J. ICHE 2014;35 (9):1163-8



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Hypothesis

- If the Hawthorne effect was continuous across all time periods, expect compliance to remain unchanged during entire 1-hour observation period
- Asked whether mean hand hygiene compliance rate changed significantly over the 1-hour period
 - Fitting linear regression to the hand hygiene compliance rate



Results

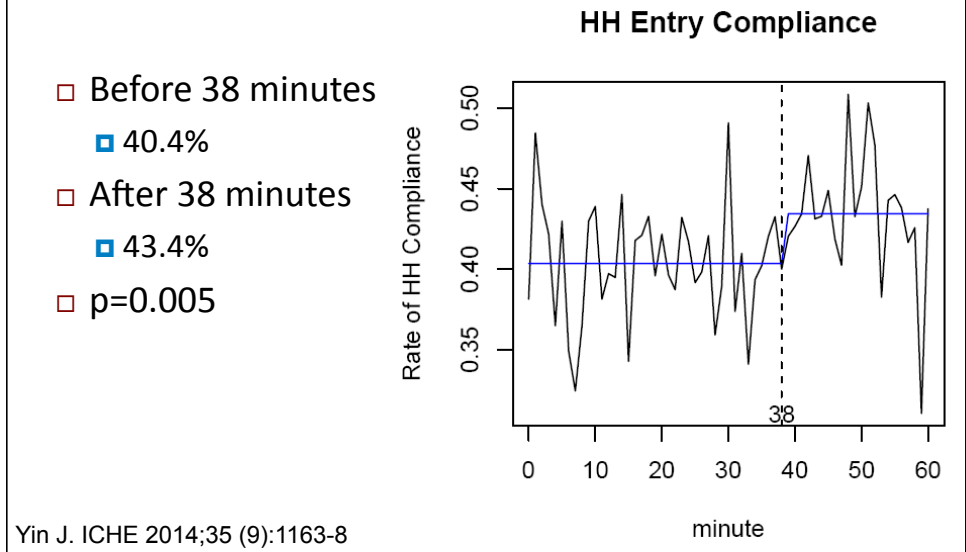
- 11,444 HH opportunities
 - 3,432 hours of direct observations
- Entry Compliance: **41.3%**
 - (4,546/11,018 opportunities)
- Exit Compliance **59.4%**
 - (6,225/10,488 opportunities)



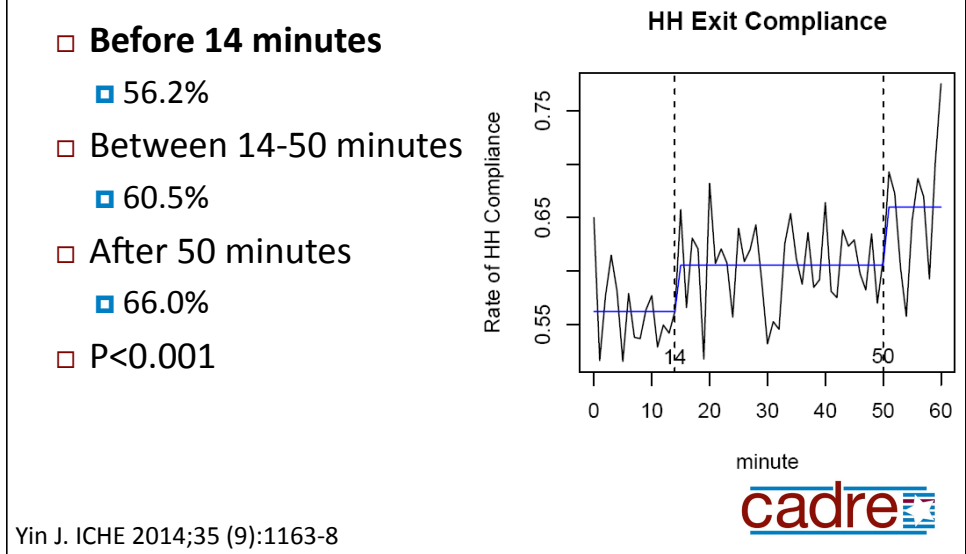
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Entry compliance shows increased bias
 after observer on ward > 38 minutes



Limiting observer time on ward to less
 than 14 minutes reduces bias



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Putting it all together



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VHA Hand Hygiene Workgroup

- Bradley Bender, MD – Chief of Staff (Gainesville)
- Elizabeth Eckstein, RN – IP (Cleveland)
- Kim Findley, RN – Assoc Clin Research (COHIC)
- Carol Keller – Systems Redesign Manager (West LA)
- Troy Knighton, Ed S – IDPIO (OPH)
- Caryl Lee, RN MSN – National Center Patient Safety
- Michael Martin – NAGE (Martinsburg)
- Richard Martinello, MD Clinical Public Health (OPH)

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VHA Hand Hygiene Workgroup

- Daniel Morgan, MD – Hospital Epi (Baltimore)
- Eli Perencevich, MD –Workgroup Chair) (Iowa City)
- Lesley Royal, RN – IP (Omaha)
- Heather Reisinger, PhD – Med Anthro (Iowa City)
- Carol VanDeusen Lukas, Ed D – COLMR (Boston)
- Amy Zoll, RN – Clinical Nurse (Kansas City)

- Lewis Radonovich, MD – COHIC, OPH (Gainesville)



DRAFT UNDERSECRETARY FOR HEALTH'S INFORMATION LETTER ESTABLISHING A STANDARD FOR HAND HYGIENE SURVEILLANCE IN HEALTH CARE SETTINGS

- (1) Monitor Hand Hygiene:
 - **“Before patient interaction”** defined as hand hygiene immediately on or before entering the space occupied by a patient.
 - **“After patient interaction”** defined as hand hygiene immediately on or before exiting the space occupied by a patient.
- (2) Duration of Direct Observation Periods
 - “monitoring by one or more personnel in a single location should persist for **no more than 15 minutes** at each location”



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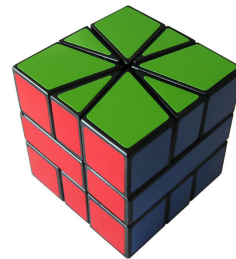
[DRAFT UNDERSECRETARY FOR HEALTH'S INFORMATION LETTER
ESTABLISHING A STANDARD FOR HAND HYGIENE SURVEILLANCE
IN HEALTH CARE SETTINGS](#)

- (3) Number of observations required per quarter
 - **Minimum of 200 before and after** (i.e., 200 before entry and 200 after exit)
 - Note: approximately 4-5 opportunities are observed per hour
 - Would require 40-50 hours of observation per quarter or about 13-17 hours of observation per month



Conclusions: Keep Hand Hygiene Simple!

- Automated systems can monitor but compliance benefits unproven
 - No randomized trials
 - No evidence for lower infections
 - Significant publication bias
- **Don't give up on direct-observation**
 - Focus on entry/exit monitoring
 - Less than 14 minutes!



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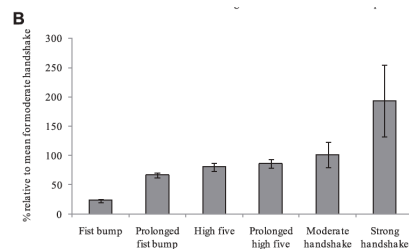
Using Science to Guide Hand Hygiene Surveillance and Improvement
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Thank you



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Fist bumps and weak handshakes only...



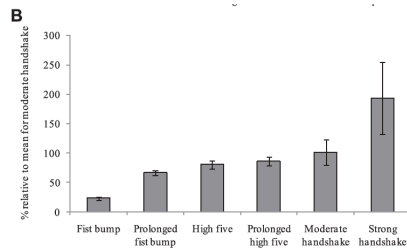
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Mela et al. AJIC 42 (8): 916-7, August 2014

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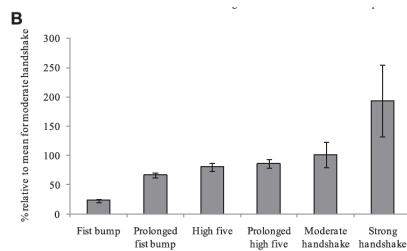
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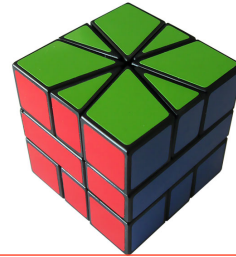
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Questions and Thank you!

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QUESTIONS?
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stopinfections.org

cadre

Coming Soon

September 29 **ADHERENCE ENGINEERING TO REDUCE CENTRAL LINE ASSOCIATED BLOODSTREAM INFECTIONS**
Prof. Frank Drews, University of Utah

October 13 **UPDATE ON STRATEGIES FOR CLEANING AND DISINFECTION OF ENVIRONMENTAL SURFACES IN HEALTHCARE**
Prof. John Boyce, J.M. Boyce Consulting
Sponsored by Sealed Air Diversey Care (www.sealedair.com)

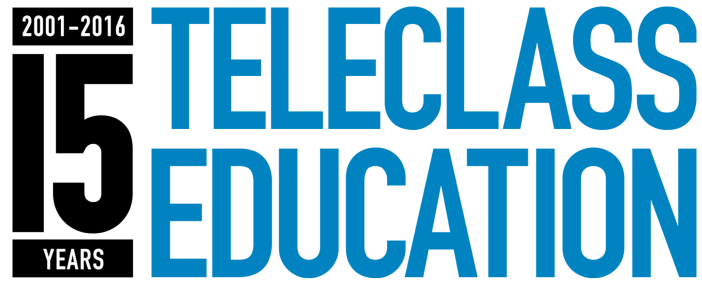
October 19 (*South Pacific Teleclass*)
TECHNOLOGY FOR MONITORING HAND HYGIENE IN THE 21ST CENTURY – WHY ARE WE USING IT?
Prof. Mary-Louise McLaws, University of New South Wales, Australia

October 20 (*FREE Teleclass*)
THE HISTORY OF CBIC AND WHY CERTIFICATION IS STILL IMPORTANT TODAY

www.webbertraining.com/schedule1.php

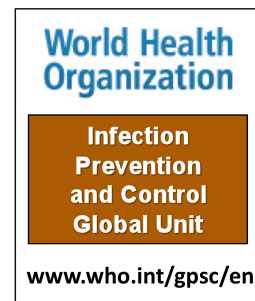
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