Hand Hygiene – The 100% Solution?
Prof. Yves Maillard, MgGill University Faculty of Medicine
A Webber Training Teleclass

Hand Hygiene:
The 100% Solution?

A CRITICAL APPRAISAL

Yves Longtin MD, FRCPC
Associate Professor,
McGill University Faculty of Medicine

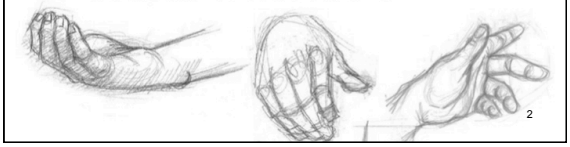
Hosted by Bruce Gamage
President, IPAC - Canada

Jewish General Hospital | McGill Faculty of Medicine / Faculté de médecine

www.webbertraining.com February 6, 2014

Objectives

- Review the role of HH to prevent healthcare associated infections (HAI)
  - State of knowledge
- Explore the relative contribution of hands and other vectors of transmission in hospitals
- Try to go "beyond the usual pep talk on HH"…



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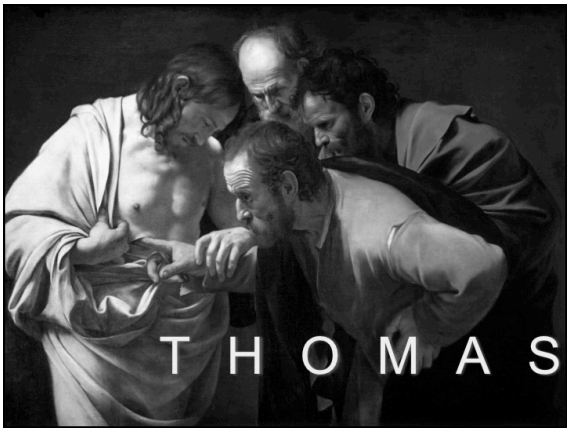

Healthcare associated infections

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Morbidity and Mortality

- Risk of acquiring a HAI when hospitalized
  - 5-10% (developed countries)
    - USA
      - 4.5%
      - 1'700'000 cases
      - 100'000 deaths
  - >25% developing countries?

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Morbidity and Mortality

Rank[1]	Cause of death (Based on the *Tenth Revision International Classification of Diseases, 1992*)	Number	Percent of total deaths
…	All causes	2,416,425	100.0
1	Diseases of heart I00–I09,I11,I13,I20–I51	700,142	29.0
2	Malignant neoplasms C00–C97	553,768	22.9
3	Cerebrovascular diseases I60–I69	163,538	6.8
4	Chronic lower respiratory diseases J40–J47	123,013	5.1
5	Accidents (unintentional injuries) V01–X59,Y85–Y86	101,537	4.2
5	**Nosocomial Infections**	**100,000**	
6	Diabetes mellitus E10–E14	71,372	3.0
7	Influenza and pneumonia J10–J18	62,034	2.6
8	Alzheimer's disease G30	53,852	2.2
9	Nephritis, nephrotic syndrome and nephrosis .N00–N07,N17–N19,N25–N27	39,480	1.6
10	Septicemia A40–A41	32,238	1.3
11	Intentional self-harm (suicide) *U03,X60–X84,Y87.0	30,622	1.3
12	Chronic liver disease and cirrhosis K70,K73–K74	27,035	1.1
13	Assault (homicide) *U01–U02,X85–Y09,Y87.1	20,308	0.8
14	Essential (primary) hypertension and hypertensive disease I10,I12	19,250	0.8
15	Pneumonitis due to solids and liquids J69	17,301	0.7
…	All other causes Residual	400,935	16.6

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Hand hygiene, either by handwashing or hand disinfection, remains the single most important measure to prevent nosocomial infections.[1] The importance of this simple procedure is not sufficiently recognised by health-care workers (HCWs),[2] and poor compliance has been documented repeatedly.[3-5] Although some previous

Pittet D et al. Lancet 2000

A dogma in medicine?

- Justifies colossal investments
- Assumes that any level of improvement is beneficial
- Assumes that resources invested in HH promotion does not divert funds from other evidence-based strategies

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Most frequent sites of infection and their risk factors

Most common sites of health care-associated infection and the risk factors underlying the occurrence of infections

World Health Organization

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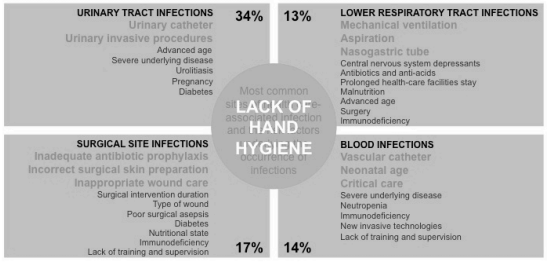
Most frequent sites of infection and their risk factors



World Health Organization

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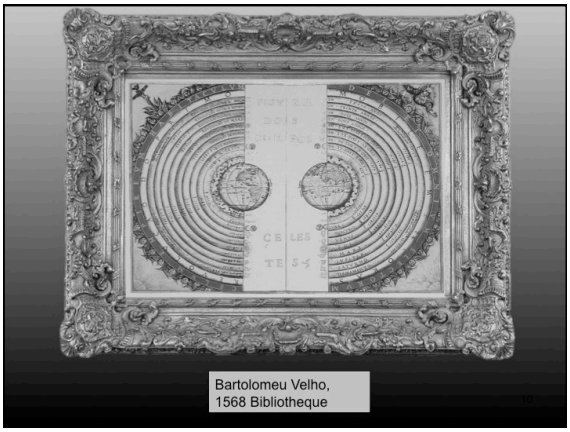

Bartolomeu Velho, 1568 Bibliotheque

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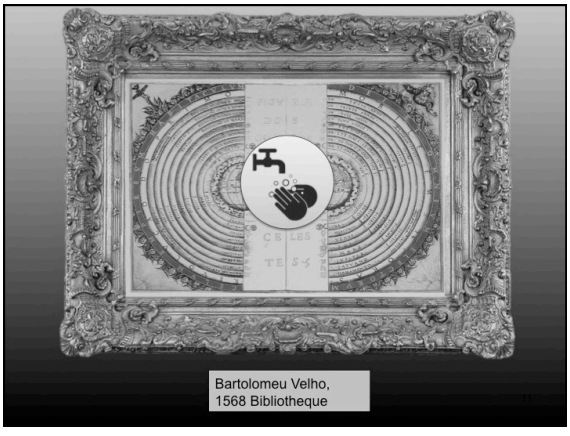

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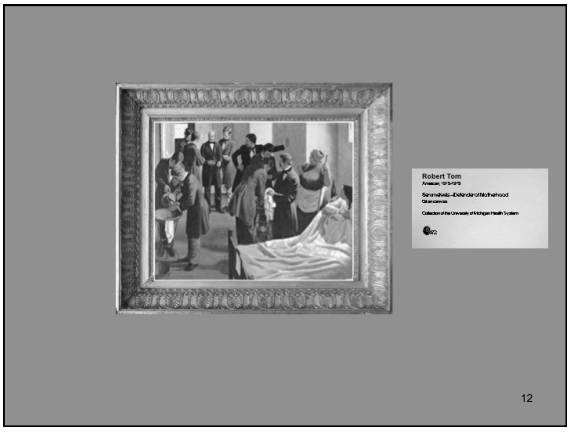

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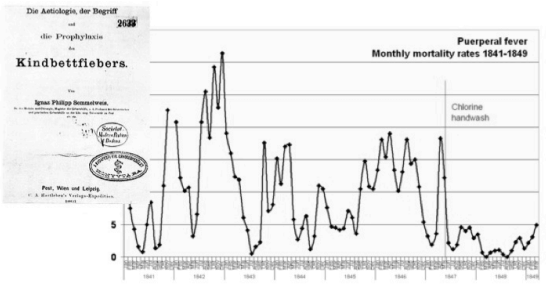

Puerperal fever monthly mortality rates for the First Clinic at Vienna Maternity Institution 1841–1849. Rates drop markedly when Semmelweis implemented chlorine hand washing mid-May 1847

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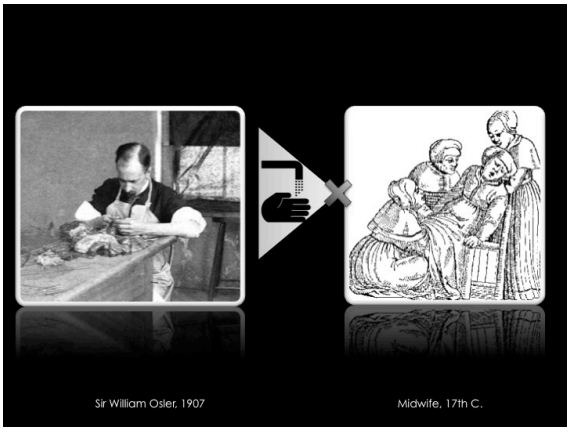

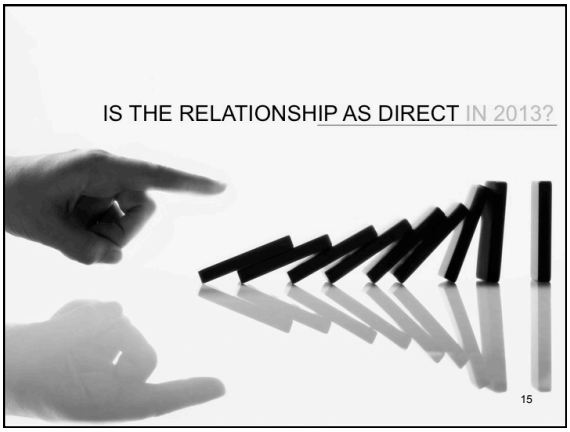

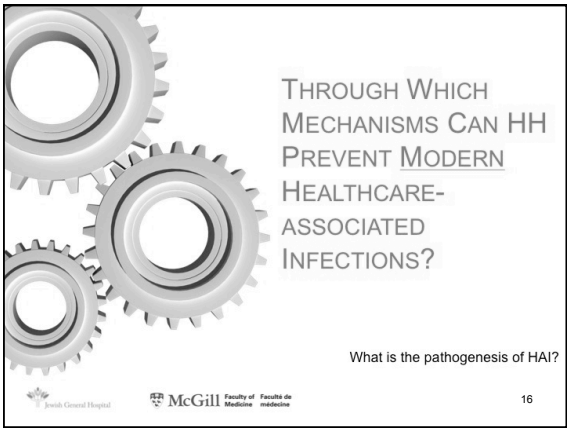

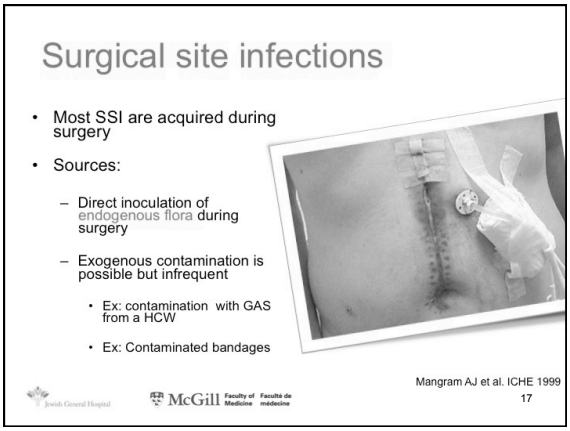

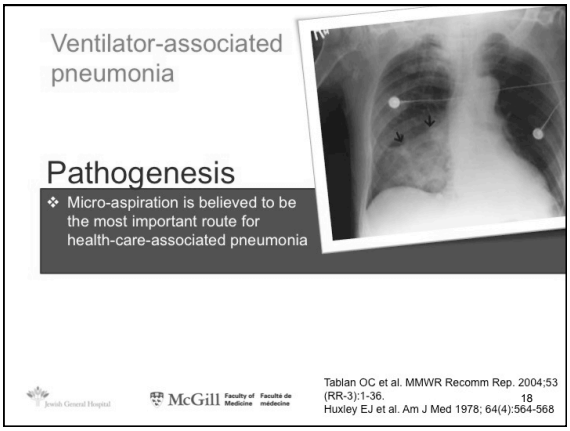

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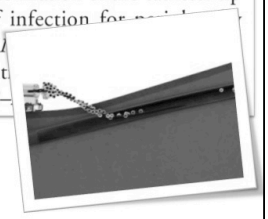
Central-line associated infections

Migration of skin organisms at the insertion site into the cutaneous catheter tract with colonization of the catheter tip is the most common route of infection for [illegible] inserted, short-term catheters (*21*
catheter hub contributes substant
zation of long-term catheters (*23–*



MMWR August 9, 2002 / Vol. 51 / No. RR-10

Catheter-associated urinary-tract infections

Pathogenesis. The most important predisposing factor for nosocomial UTI is urinary catheterization, which perturbs host defense mechanisms and provides easier access of uropathogens to the bladder. The indwelling urethral catheter introduces an inoculum of bacteria (fecal or skin bacteria in a patient's own native or transitory microflora) into the bladder at the time of insertion [78], facilitates ascension of ur[illegible]ogens from the meatus to the bladder via the catheter-m
for intraluminal spread of pathogens to
lecting tube or drainage bag have becor
promises complete bladder emptying, a
manipulated foreign body on which
via the hands of personnel. It also
cells from catheterized patients are

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Hooton TM et al. Clin Infect Dis 2010; 50: 625-653

Endogenous flora

- Critical aspect of 4 most common HAI…
- Even with perfect HH compliance, these HAI would still occur…

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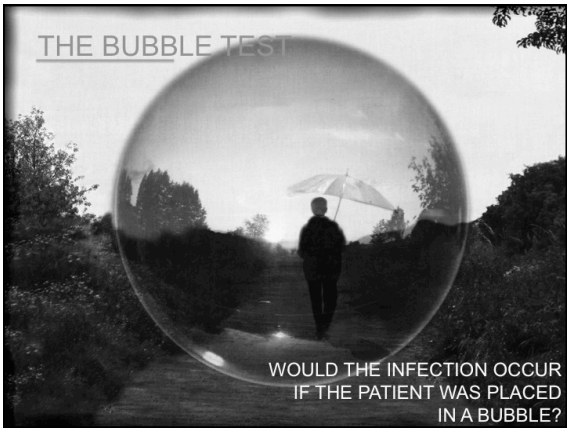
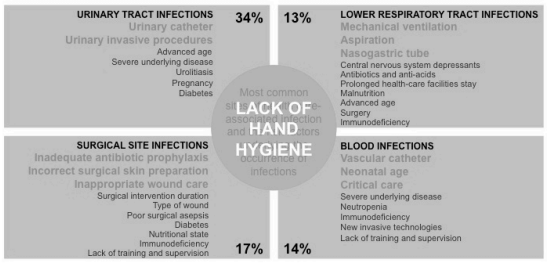
THE BUBBLE TEST



Most frequent sites of infection and their risk factors



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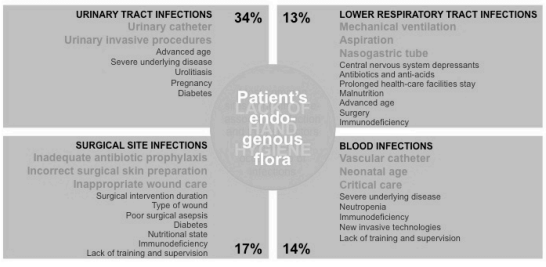
Most frequent sites of infection and their risk factors



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BACK TO HAND HYGIENE

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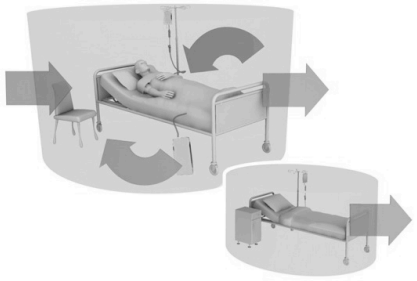
HH indications do not have the same « protective effect » against HAI



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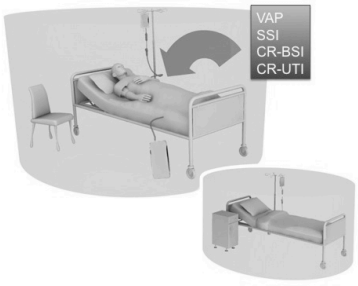
Adapted from Sax H. J Hosp Infect 2007

HH indications do not have the same « protective effect » against HAI



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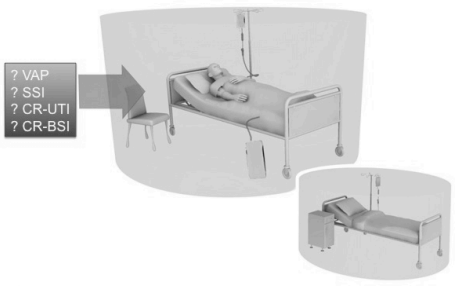
HH indications do not have the same « protective effect » against HAI



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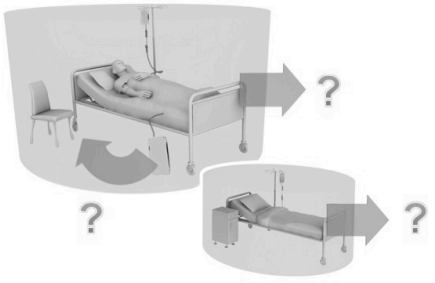
Adapted from Sax H. J Hosp Infect 2007

HH indications do not have the same « protective effect » against HAI



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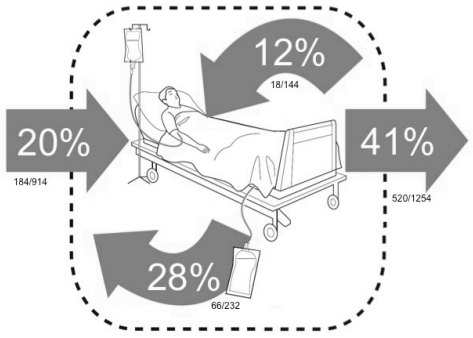
Adapted from Sax H. J Hosp Infect 2007

Compliance rate
Z Hospital



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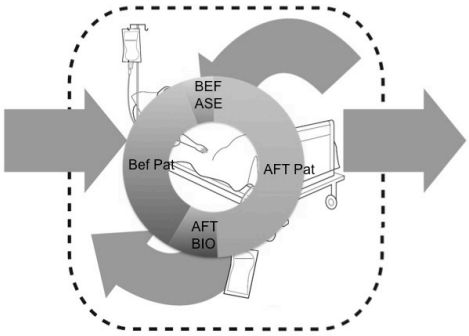
OBSERVED VOLUME OF HAND HYGIENE INDICATIONS



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Efficacy of Hand Hygiene Promotion Strategies

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Efficacy of hand hygiene

- Many studies have showed that different interventions can improve hand hygiene compliance
  - Especially if pre-intervention compliance is low!
- However, there are much less studies linking hand hygiene compliance and the risk of modern HAI!

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Published articles, hand hygiene and selected healthcare-associated infections

HAI	n	Pubmed search
Ventilator associated pneumonia	66	("hand hygiene"[MeSH Terms] OR ("hand"[All Fields] AND "hygiene"[All Fields]) OR "hand hygiene"[All Fields]) AND ("pneumonia, ventilator-associated"[MeSH Terms] OR ("pneumonia"[All Fields] AND "ventilator-associated"[All Fields]) OR "ventilator-associated pneumonia"[All Fields] OR ("ventilator associated"[All Fields] AND pneumonia[All Fields]) OR "ventilator-associated pneumonia"[All Fields])
Bloodstream infection	115	("hand hygiene"[MeSH Terms] OR ("hand"[All Fields] AND "hygiene"[All Fields]) OR "hand hygiene"[All Fields]) AND ("blood circulation"[MeSH Terms] OR ("blood"[All Fields] AND "circulation"[All Fields]) OR "blood circulation"[All Fields] OR "bloodstream"[All Fields] AND ("infection"[MeSH Terms] OR "infection"[All Fields] OR "communicable diseases"[MeSH Terms] OR ("communicable"[All Fields] AND "diseases"[All Fields]) OR "communicable diseases"[All Fields]))
Surgical site infection	88	("hand hygiene"[MeSH Terms] OR ("hand"[All Fields] AND "hygiene"[All Fields]) OR "hand hygiene"[All Fields]) AND ("surgical procedures, operative"[MeSH Terms] OR ("surgical"[All Fields] AND "procedures"[All Fields]) OR "operative surgical procedures"[All Fields] OR ("surgical"[All Fields] AND "site"[All Fields]) AND ("infection"[MeSH Terms] OR "infection"[All Fields] OR "communicable diseases"[MeSH Terms] OR ("communicable"[All Fields] AND "diseases"[All Fields]) OR "communicable diseases"[All Fields]))
Urinary tract infection	77	("hand hygiene"[MeSH Terms] OR ("hand"[All Fields] AND "hygiene"[All Fields]) OR "hand hygiene"[All Fields]) AND ("urinary tract infections"[MeSH Terms] OR ("urinary"[All Fields] AND "tract"[All Fields]) AND "infections"[All Fields]) OR ("urinary tract infections"[All Fields] OR ("urinary"[All Fields] AND "tract"[All Fields]) AND "infection"[All Fields]) OR "urinary tract infection"[All Fields])

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Distinction between prevention of transmission and prevention of infection often blurred

Example:

Study shows decrease in MRSA transmission, MRSA-BSI

If MRSA transmission is decreased, so will MRSA-BSI…

But what about global BSI rates?

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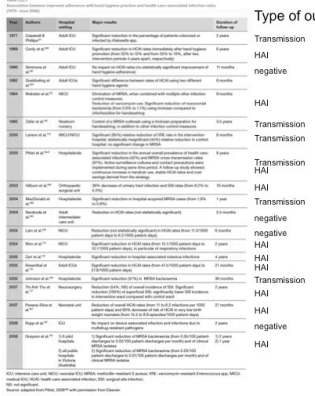
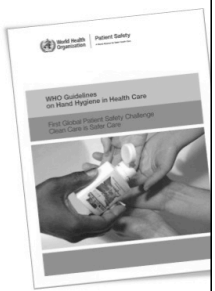


Type of outcome

Transmission
HAI
negative
HAI
Transmission
Transmission
Transmission
HAI
HAI
Transmission
negative
negative
HAI
HAI
HAI
Transmission
HAI
HAI
negative
HAI



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Why so few studies on HH efficacy?

- Efficacy is implicitly accepted?
- Lack of interest from scientists?
- Publication bias?
- Logistically near-impossible?
  - Sample size
  - Cost
  - Study design
  - Lack of reliable process and outcome indicators
  - Etc.

Hand Hygiene and ventilator-associated pneumonia

Journal of Critical Care (2011) 26, 489–495

Journal of Critical Care

ELSEVIER

Reduction in ventilator associated pneumonia in a mixed intensive care unit after initiation of a novel hand hygiene program☆

Matthew D. Koff MD[a,*], Howard L. Corwin MD[a], Michael L. Beach MD, PhD[b], Steven D. Surgenor MD[a], Randy W. Loftus MD[a]

[a]Department of Anesthesiology, Section of Critical Care Medicine, Dartmouth-Hitchcock Medical Center, 1 Medical Center Dr, Lebanon, NH 03756
[b]Department of Anesthesiology, Dartmouth-Hitchcock Medical Center, 1 Medical Center Dr, Lebanon, NH 03756

Koff MD et al. Journal of Critical Care (2011) 26, 489–495

HH and VAP

- Before-and-after study
  - 12-month control and 12-month intervention
- ICU of a single institution
- Main outcomes
  - VAP/1'000 ventilator-days
  - CLA-BSI/1'000 catheter-days
  - HH compliance (direct observation)

Koff MD et al. Journal of Critical Care (2011) 26, 489–495

HH and VAP

Results

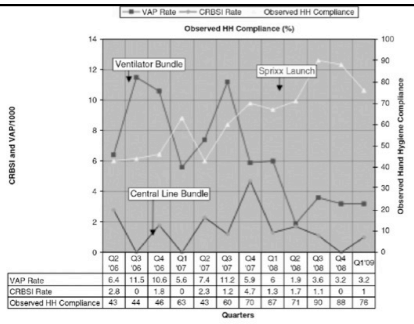
- Moderate increase in HH compliance 55% → 73% (P=0.05)
- 50% Decrease in VAP rate (!)
- No significant change in CLA-BSI rates

Table 2 Outcomes study period vs control period

	Study period	Control period	*P*
LOS[a] d (mean ± SD)	5.9 ± 7.8	5.8 ± 8.6	.79
Mortality (%)	296/1330 (22.3)	299/1262 (23.7)	.38
VAP number (number per 1000 vent days)	22 (3.7)	43 (6.9)	<.01
Eligible VAP patients (>2 days mechanically ventilated)	887	716	.01
CRBSI number (number per 10000 catheter days)	9 (1.5)	17 (2.6)	.09

[a] ICU length of stay.

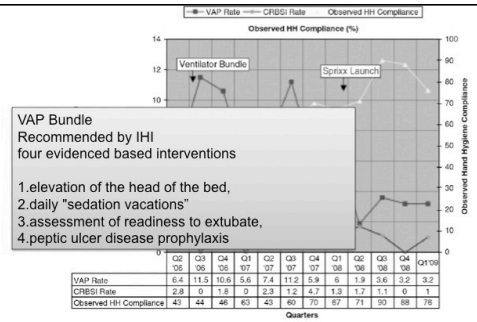
Koff MD et al. Journal of Critical Care (2011) 26, 489–495



	Q2 '06	Q3 '06	Q4 '06	Q1 '07	Q2 '07	Q3 '07	Q4 '07	Q1 '08	Q2 '08	Q3 '08	Q4 '08	Q1'09
VAP Rate	6.4	11.5	10.6	5.6	7.4	11.2	5.9	6	1.9	3.6	3.2	3.2
CRBSI Rate	2.8	0	1.8	0	2.3	1.2	4.7	1.3	1.7	1.1	0	1
Observed HH Compliance	43	44	46	63	43	60	70	67	71	90	88	78

- VAP bundle had NO impact on VAP rates, while a <20% increase in HH compliance halved VAP rates???

Koff MD et al. Journal of Critical Care (2011) 26, 489–495



	Q2 '06	Q3 '06	Q4 '06	Q1 '07	Q2 '07	Q3 '07	Q4 '07	Q1 '08	Q2 '08	Q3 '08	Q4 '08	Q1'09
VAP Rate	6.4	11.5	10.6	5.6	7.4	11.2	5.9	6	1.9	3.6	3.2	3.2
CRBSI Rate	2.8	0	1.8	0	2.3	1.2	4.7	1.3	1.7	1.1	0	1
Observed HH Compliance	43	44	46	63	43	60	70	67	71	90	88	76

- VAP bundle had NO impact on VAP rates, while a <50% increase in HH compliance halved VAP rates???

Koff MD et al. Journal of Critical Care (2011) 26, 489–495

HH and modern HAI

- Overall, there are very few data to support the hypothesis that HH can prevent modern HAI
  - Let alone be the most important preventive measure!
- Some researchers are highly motivated to prove that HH can prevent HAI
  - Especially if your entire career depends on HH!

HH and modern HAI

- Bigger, more rigorous studies are bound to be conducted in the future
  - This should help resolve the uncertainty

Methodology for studies on hand hygiene

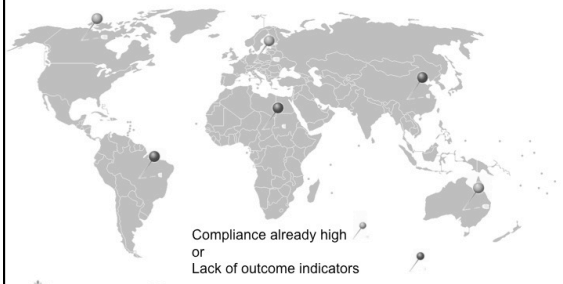
Journal of Antimicrobial Chemotherapy (2007) **59**, 833–840
doi:10.1093/jac/dkm055
Advance Access publication 26 March 2007
JAC

The ORION statement: guidelines for transparent reporting of Outbreak Reports and Intervention studies Of Nosocomial infection

S. P. Stone[1]*, B. S. Cooper[1], C. C. Kibbler[1], B. D. Cookson[2], J. A. Roberts[3], G. F. Medley[4], G. Duckworth[2], R. Lai[1], S. Ebrahim[3], E. M. Brown[5], P. J. Wiffen[6] and P. G. Davey[7]

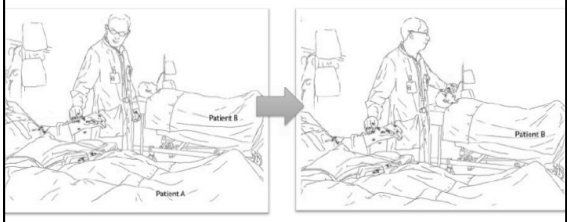
The statement is designed especially for quasi-experimental (i.e. non-randomized) study designs commonly used in hospital epidemiology: interrupted time series with and without control groups, and outbreak reports.

The "ultimate" study will probably never be conducted



Hand Hygiene and nosocomial pathogen transmission

Plausibility of the role of HH to prevent germ dissemination



Pittet D. et al. Lancet Infect Dis 2006

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Hand Hygiene and Germ Dissemination

- Objective of every HH campaign = 100% compliance
- Consequence:
  - >40HH/h in the ICU[1]
  - Up to 12 minutes/hr devoted to HH!

Pittet D et al. Ann Intern Med 1999, 130(2)126-130

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MRSA transmission

- For MRSA to be transmitted from one patient to another, a succession of errors must occur:
  1. Patient *A* must be colonized by MRSA (and contagious)
  2. The HCW must acquire MRSA (despite glove use if patient A is a known carrier)
  3. HH must be suboptimal or omitted entirely
  4. The HCW must touch a non-colonized patient B
  5. Patient B must acquire MRSA

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MRSA transmission

- For MRSA to be transmitted from one patient to another, a succession of errors must occur:
  1. Patient *A* must be colonized by MRSA (and contagious)
  2. The HCW must acquire MRSA (despite glove use if patient A is a known carrier)
  3. HH must be suboptimal or omitted entirely
  4. The HCW must touch a non-colonized patient B
  5. Patient B must acquire MRSA

The entire sequence occurs relatively infrequently!!!

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Number needed to harm

Number of beds	400 beds
Number of HH opportunities per patient per day	Approx. 10/patient/ day
Number of HH opportunities per day hospital-wide	Approx 4000 HH
Number of HH opportunities per month hospital-wide	120 000 HH opportunities

[1]Assuming that HH is the only source of transmission of pathogens

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Number needed to harm

Number of beds	400 beds
Number of HH opportunities per patient per day	Approx. 10/patient/ day
Number of HH opportunities per day hospital-wide	Approx 4000 HH
Number of HH opportunities per month hospital-wide	120 000 HH opportunities
Actual HH compliance	Approx 50%
Nº missed HH opportunities hospital-wide	60 000 per month
Nº new MRSA cases	1-3 per month
Nº new MRSA cases per missed HH opportunity[1]	20 000-60 000 missed HH/ case

[1]Assuming that HH is the only source of transmission of pathogens

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Optimal Hand Hygiene Compliance

What is the optimal HH compliance rate?

A) 20%
B) 50%
C) 80%
D) 100%
E) It depends…

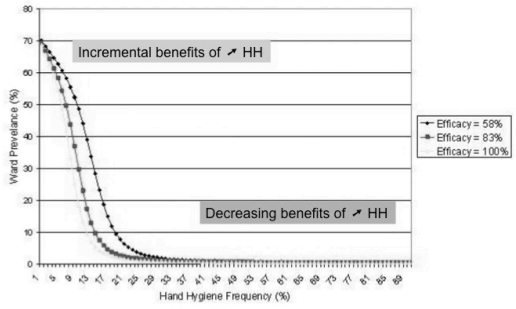
Modeling of transmission

Assumptions of model

- Computations assuming:
- Hypothetical typical medical ward
- Transmission only through HCWs' hands

Variable	n
Number of patients	20
Number of HCW	3
d/c rate	2/day
HH opportunities/day	14/p/day
Efficacy of HH	50%
Proportion of MRSA carrier admitted on ward	1%

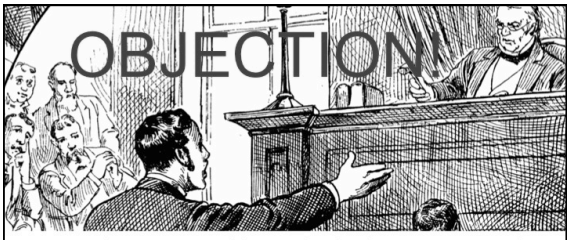
Numerous other variables including detection rate, contagiousness…



Beggs CV et al. BMC Infect Dis 2008, 8:114

Theory of decreasing returns

- HH is very effective to prevent MRSA transmission
- However…
  - The benefits are potentially highest when compliance is 20-40%
  - Above a certain level of compliance, the « return on investment » decreases gradually...



« HH is above 40% in my institution and I am still confronted with ongoing transmission »

« These models must be wrong…We still need improve HH even further »

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Potential Explanations

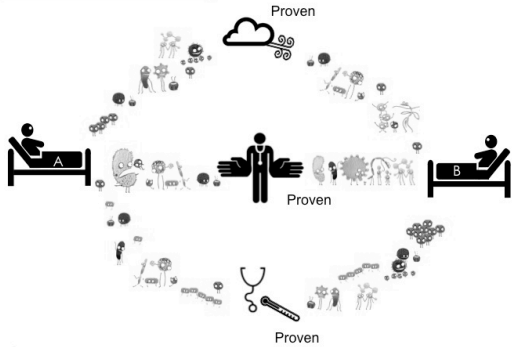
1. Hawthorne effect
   - Your compliance rate is not actually 40%
2. Admission of colonized patients
   - Regardless of *R0*, there will always be some ongoing transmission
3. Environmental contamination
   - HCWs' hands are not the only way to transmit pathogens

Potential Explanations

1. Hawthorne effect
   - Your compliance rate is not actually 40%
2. Admission of colonized patients
   - Regardless of *R0*, there will always be some ongoing transmission
3. Environmental contamination
   - HCWs' hands are not the only way to transmit pathogens
   - The alternative routes may have even lower rates of interruption

HOW CAN WE SAY THAT HANDS ARE THE MAIN ROUTE?

HOW CAN WE SAY THAT HANDS ARE THE MAIN ROUTE?



Medical Equipment

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Sphygmomanometers

- 203 BP cuffs sampled
- 45% inner cuffs with levels of contamination >100cfu/25cm2
- 13% contaminated with pathogenic microorganisms
  - A.baumanii 2%
  - MSSA 6%
  - MRSA 5%
  - Pseudomonas 1%
  - Enterobacteriaceae 1%

de Gialluly C et al. Infect Control Hosp Epidemiol 2006; 27:940-943

Privacy curtains

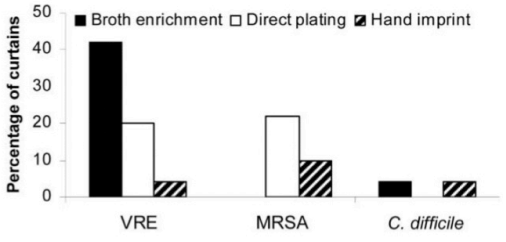
Privacy curtains

- 2 important factors to consider
  - Frequency of manipulation
  - Cleaning schedule
- Can curtains be a source of cross-transmission?

Privacy curtains

- Cleveland Veterans' Hospital
  - Curtains cleaned q 4 months or if visibly soiled
  - 50 curtains sampled on every unit
  - Culture of curtains (contact plates and swabs)
  - Glove culture after touching the curtains

Trilis F et al. Infect Control Hosp Epidemiol. 2008



Trilis F et al. Infect Control Hosp Epidemiol. 2008

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Privacy curtains

- Contamination of 200 curtains evaluated for MRSA
  - University Hospital, Nottingham, UK
  - Différent units in hospital
  - Contact plates, chromogenic media
  - « Point prevalence » study
- Results
  - 15% (31/200) contaminated by MRSA
  - Median 1CFU, range 1-13CFU

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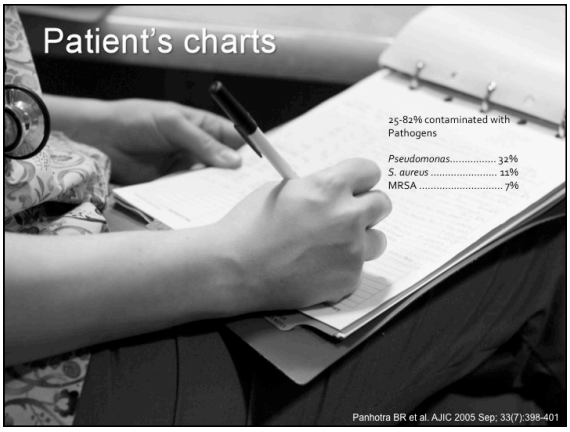
Klakus J et al. J Hospit Infect 2008



Panhotra BR et al. AJIC 2005 Sep; 33(7):398-401

What about scissors? …

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Embil JM et al. Infect Control Hospit Epidemiol 2002

Scissors: A Potential Source of Nosocomial Infection

John M. Embil, MD; George G. Zhanel, PhD; Pierre J. Plourde, MD; Daryl Hoban, PhD

- Point prevalence study
  - 232 scissors sampled
  - Swab, quantitative culture
  - Disinfection and sampling post-disinfection

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Embil JM et al. Infect Control Hospit Epidemiol 2002

Scissors: A Potential Source of Nosocomial Infection

John M. Embil, MD; George G. Zhanel, PhD; Pierre J. Plourde, MD; Daryl Hoban, PhD

- Results
  - 182/232 (78.4%) contaminated by bacteria
    - 68% shared scissors
    - 89% nurses' personal scissors

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Embil JM et al. Infect Control Hospit Epidemiol 2002

TABLE 2
MICROORGANISMS RECOVERED FROM COMMUNAL AND HEALTHCARE WORKERS' SCISSORS

	Source of Scissors, N ( )									
	Communal	Nurses	Physicians	Ambulance Attendant	Orthopedic Technologist	Pharmacist	Vascular Technologist	Laboratory Technologist	Orderly	Total
No. of isolates	121 (52.2)	85 (36.7)	7 (3.0)	4 (1.7)	11 (4.8)	1 (0.4)	1 (0.4)	1 (0.4)	1 (0.4)	232 (100)
Staphylococcus aureus	10	6	4	—	2	—	—	—	—	22 (5.5)
Streptococcus pyogenes	—	1	—	—	—	—	—	—	—	1 (0.25)
Streptococcus agalactiae	—	2	—	—	—	—	—	—	—	2 (0.5)
Enterococcus faecium	—	2	1	—	1	—	—	—	—	4 (1)
Enterococcus faecalis	2	2	—	—	—	—	—	—	—	4 (1)
Enterococcus species	—	—	—	—	1	—	—	—	—	1 (0.25)
Coagulase-negative staphylococci	99	101	11	6	24	—	—	—	1	242 (60)
Micrococcus species	12	8	—	1	3	—	1	1	1	27 (6.7)
Bacillus species	13	25	2	9	4	—	—	—	—	53 (13.2)
Viridans group streptococci	5	10	1	—	2	—	—	—	—	18 (4.5)
Diphtheroides	4	3	—	—	2	—	—	—	—	9 (2.2)
Acinetobacter lwoffi	4	2	1	—	2	—	—	—	—	9 (2.2)
Enterobacter cloacae	1	2	—	—	2	—	—	—	—	5 (1.2)
Other gram-negative bacilli*	—	3	—	—	3	—	—	—	—	6 (1.5)
Total	150 (37.2)	167 (41.4)	20 (5.0)	16 (4.0)	46 (11.4)	—	1 (0.25)	1 (0.25)	2 (0.5)	403 (100)

**Enterobacter agglomerans = 2; Escherichia coli = 1; Proteus mirabilis = 1; Klebsiella pneumoniae = 1; and Pseudomonas aeruginosa = 1.*

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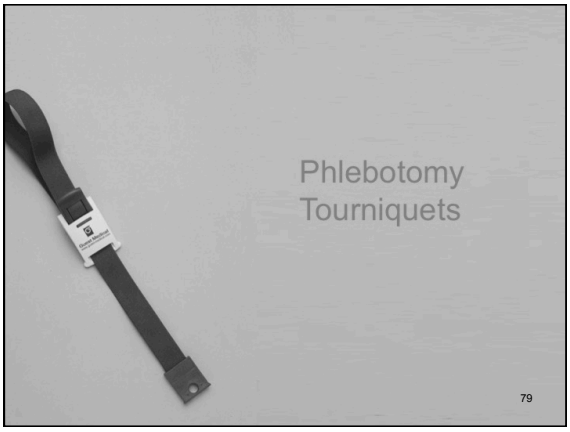

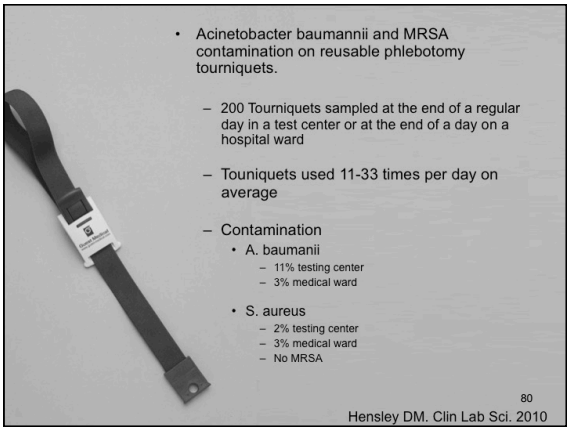

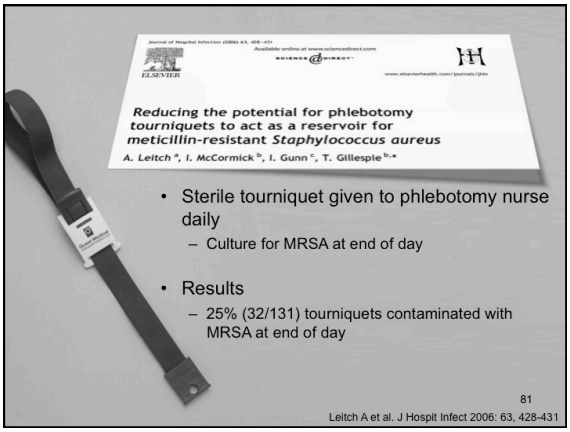

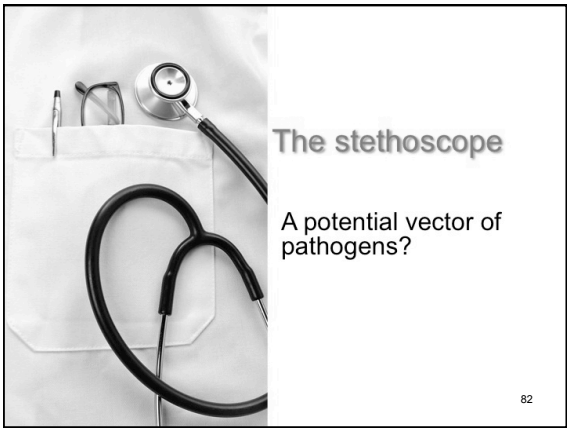

Cross-sectional studies

- Stethoscopes are selected "randomly" to assess contamination
- Results:
  - 40 articles identified
  - >2800 stethoscopes sampled
  - Significant variation in contamination levels

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Cross-sectional studies

Author	Journal	Year	n	S.aureus	MRSA	SCN	Micro-coccus	Bacillus	BGN	BNF	Entero-coccus	Coryne-bacterium
Lecat P	AJC	2009	99	0.03	0	0.75		0.00				
Femdiva L	J Hosp Inf	2009	44		0							
Youngster L	Acta Paediatr	2008	43	0.10	0.02	0.38		0.33	0.21			
Hill C	J Hosp Infect.	2006										
Matiar R	Bratisl Lek Listy	2005	110	0.10	0.02	0.72						
Sanders S	Br J Gen Pract	2005	50		0							
Crespo MP	J Clin Microbiol	2004	5									
Parmar RC	Indian J Med Sci	2004	100	0.03	0.01	0.68		0.10	0.10			
Gupta A	ICHE	2004	?									
Sanders S	Br J Gen Pract	2003	5									
Cohen SR	J Hosp Infect	2003	74	rare		0 2nd most frequent		rare	rare			
Hudson H	J Child Health Care	2003	11	11% of all Sta		0 Most frequent						
Kennedy KJ	Med J Aust	2003	134	0.04								
O'Malley A	Clinical Governanc	2003	7	1	0.86							
Gupta CH	AJC	2002	79	0.01	0.01				0.05	0.10		
Kerr JR	J Hosp Infect	2002	26	0	0	0.54	0.27	0	0.10	0		0.15
Juliana Maluf	Sao Paulo Med J	2002	300	0.59		0.51		0.15	0	0.01		0.01
Miam MW	ICHE	2001	20	0	0	0.45		0.25	0.15	0.15		
Kober P	Anasthesiol Intensi	2001	44									
Sood P	J Indian Med Assoc	2000	106	0.1	0.02	0.5						
Lange CG	ICHE	2000	82								0.036 vre	
Sengupta S	Indian J Pediatr	2000	43	0.28	0.28	0.42			0.19	0.02	0.05	
Nuñez S	Epidemiol Infect	2000	122	0.05	0	0.97	0.4	0.12	0.01	0.04		0.26
Bernard L	ICHE	1999	355	0.04	0	0.89	0.6	0.24	0.03	0.04		
Lepcat R	J Hosp Infect	1998	105	0.03		0.64						
Cohen HA	Fam Pract	1997	55	0.55	0.07	0.8		0.4 at least 0.07		0.17		
Brook I	Ann Otol Rhinol La	1997	35									
Marinella MA	Arch Intern Med	1997	40	0.38		1	0.35	0.45	0.05		0.05	0.45
Gemmé D	Schweiz Med Woch	1996	62	0	0	0.58		0.02		0.02		0.02
Smith MA	Arch Intern Med	1996	200									
Jones JS	Ann Emerg Med	1995	150	0.19								
Wright IM	J Hosp Infect	1995	24			0.67			0.04			
Boyce JM	J Clin Microbiol	1994										
Breathnach A	BMJ	1992	29	0.17		0.72						
Widmer AF	Eur J Clin Microbio	1991	109									
Eco NY	Med J Malaysia	1989										
Hardy KA	J Pediatr	1986	10									
Gotze U	Zentralbl Bakteriol	1980	16	0.69		0.31						
Mangi RJ	Yale J Biol Med	1972	50									
Gerken A	Lancet	1972	100	0.20	0.01							

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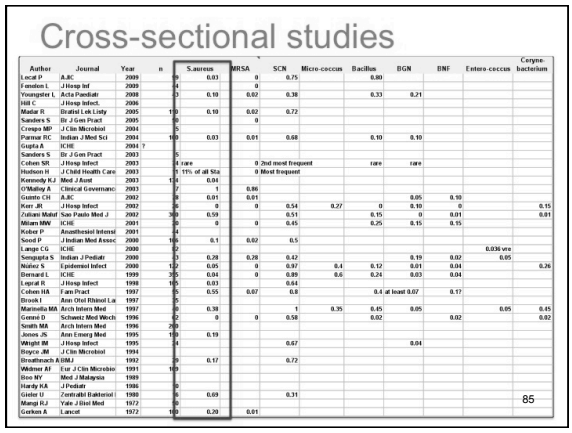

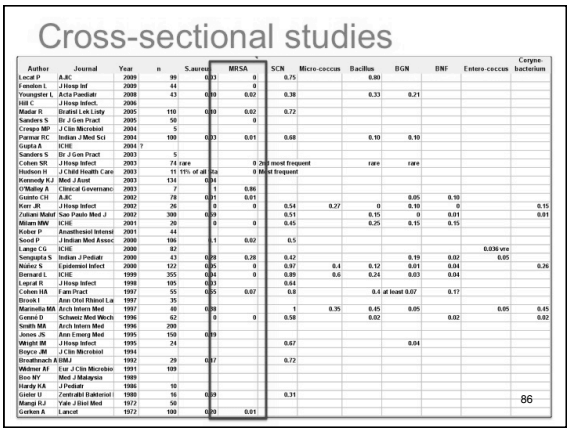

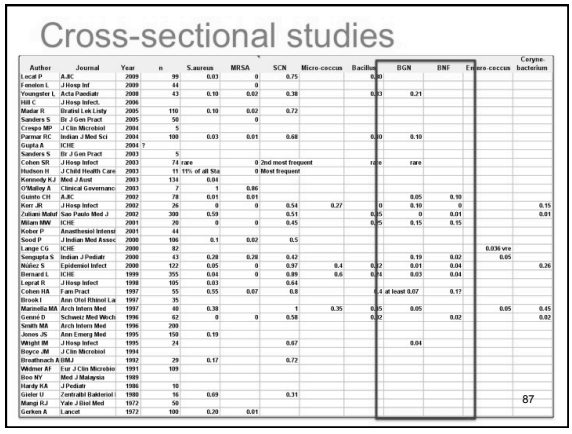

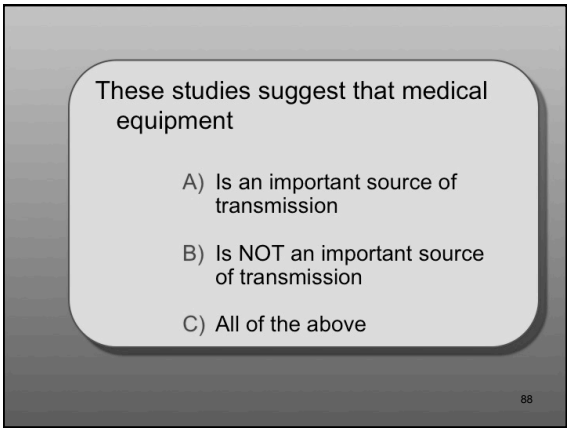

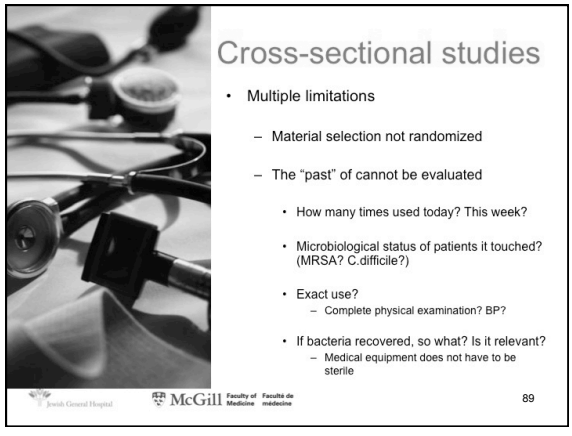

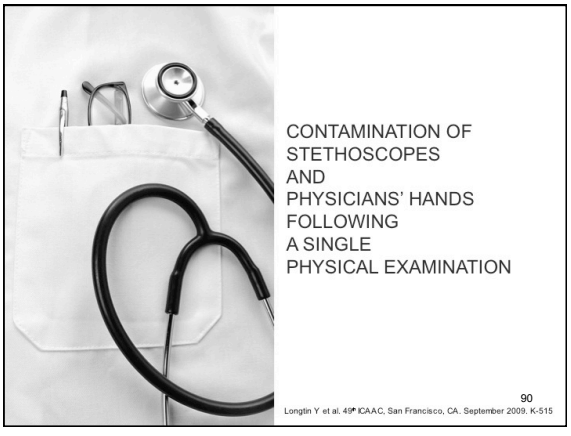

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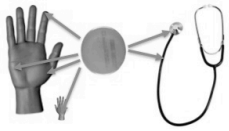
METHODS

- Study design: Structured observational study
- Convenience-based sampling (internal medicine and orthopedics)
- Performance of standardized P/E
- Sampling
  - Stethoscope and dominant hand
- Assessment of bacterial contamination CFU count
  - Total Aerobic Colony Count (total CFU)
  - MRSA CFU Count



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Longtin Y et al. 49th ICAAC, San Francisco, CA. September 2009. K-515

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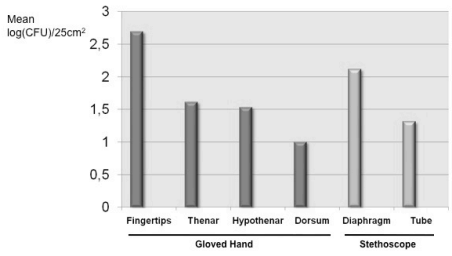
ASSESSMENT OF TOTAL CFU



Level of Contamination of Physician's Hand and Stethoscope Following a Single Physical Examination

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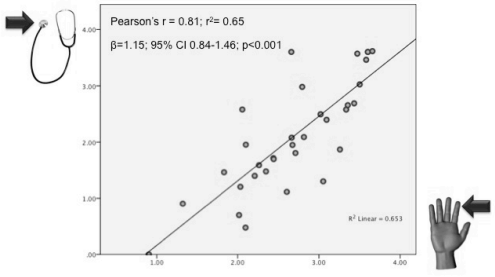
Longtin Y et al. 49th ICAAC, San Francisco, CA. September 2009. K-515

ASSOCIATION BETWEEN DIAPHRAGM CFU AND FINGERTIPS CFU



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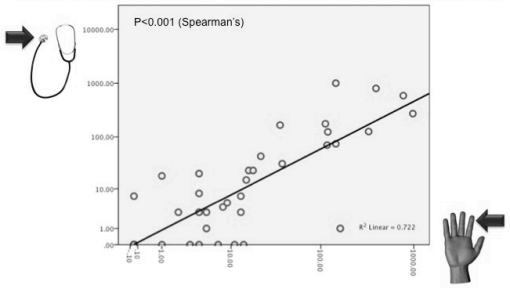
Longtin Y et al. 49th ICAAC, San Francisco, CA. September 2009. K-515

ASSOCIATION BETWEEN DIAPHRAGM MRSA & FINGERTIPS MRSA



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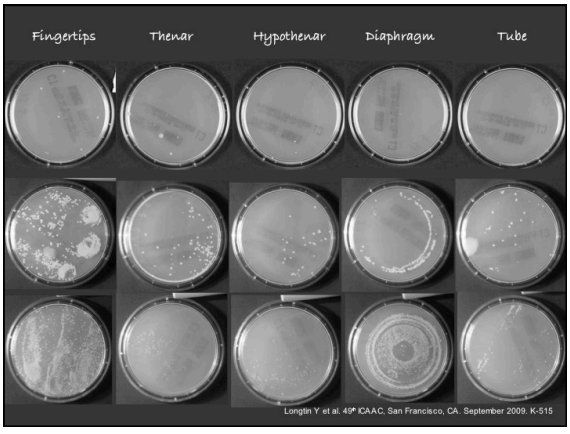

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Disinfection of small medical equipment

2007 guideline for isolation precautions: preventing transmission of infectious agents in health care settings

Jane D. Siegel, MD, Emily Rhinehart, RN, MPH, CIC, Marguerite Jackson, PhD, Linda Chiarello, RN, MS, for the Health Care Infection Control Practices Advisory Committee

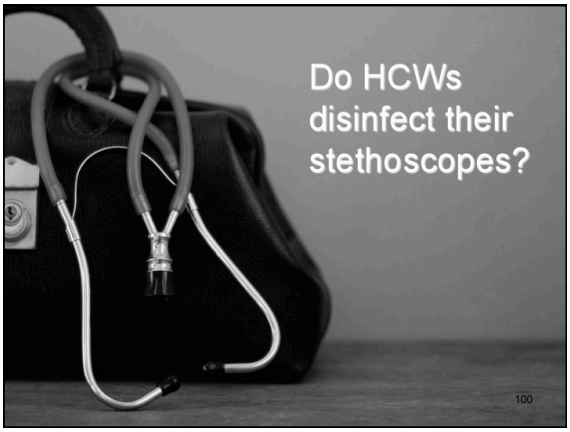
"Noncritical equipment, such as commodes, intravenous pumps, and ventilators, must be thoroughly cleaned and disinfected before being used on another patient"

Siegel JD et al. Am J Infect Control 2007;35:S65-164

Hand Hygiene

Equipment Disinfection

(NOTHING)



Frequency of disinfection

- 15 articles identified
  - 1038 respondents
  - Pooling of results not possible
    - Variation on multiple-choice answers
  - Proportion of respondents who declared never disinfecting their stethoscope
    - From 10% (15/154)[1] to 90% (26/29)[2]

1. Marinella MA. Arch Intern Med 1997
2. Breathnach AS. BMJ 1992

Scissors: A Potential Source of Nosocomial Infection

John M. Embil, MD; George G. Zhanel, PhD; Pierre J. Plourde, MD; Daryl Hoban, PhD

- Disinfection practices
  - 4/92 (4%) of MDs and RNs disinfect their scissors after each use

Embil JM et al. Infect Control Hospit Epidemiol 2002

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Audit of disinfection small medical equipment

- 28 different HCWs observed
- Global compliance:
  - 18% (6/33)
  - 20% (1/5) when leaving isolation room
- Disinfection per type of equipment
  - BP machine: 33% (6/18)
  - Glucometer: 0/2
  - Stethoscope: 0/2
  - Thermometer: 0/6
  - Oximeter: 0/5

Electronic medical equipment: Trojan Horses?

- Much appreciated
- More expensive
- More difficult to disinfect

Use ↗ but cross-transmission also ↗

Glucose meter and opportunities for cross-transmission

- **Observation phase**: 1-month period (Oct. 2008)
  - 38 glucose meters
  - 11 665 glucose measurements
    - 21% done sequentially on same patient
    - 79% done sequentially on different patients
      - 60% of which within 1 hour
  - "Cost" of disinfection to prevent transmission if shared glucometers: 310 hours/month (1.9 FTE)
- **Intervention phase**: 2 Interventions to decrease sharing

Mayo Clinic, Florida (214 beds)

1) Increase in number and dedicated use on high-risk units (number Increase from 22 to 87)

2) Overall increase without assignment on low-use units (number increased from 16 to 28)

- Results
  - Dedicated equipment: decrease sequential use by 95%
  - Non-dedicated equipment: *increase* sequential use by 17%

Hellinger WC et al. Am J Infect Control 2011;39:752-6.

Sphygmomanometers

- Historically, 1 per patient bed
  - Risk of cross-transmission was low
  - Disinfection required only once at patient d/c
- New electronic ones
  - More convenient (HCWs do not use manual ones)
  - But also more expensive
  - 5-6 per ward only
    - Is it really cost saving?

Non-dedicated sphygmomanometers

- Cost-saving strategy on the short term
  - Less equipment to buy initially (lower upfront cost)
- Potential risk for patients
  - Potential for cross transmission
  - Low disinfection rate
- Costly on long term
  - Loss of productivity due to repeated disinfection
  - Cost of healthcare associated infections

Disinfection of BP machine

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Costs of disinfection

Nursing hourly wage ($/h)	30
Nursing hourly wage ($/minute)	0.5
Time required to disinfect BP machine (minutes)	1
Cost of wipe ($)	0.1
Cost of BP machine disinfection	0.6
Number patients in hospital requiring VS	500
Number of VS per day	3
Proportion of VS done with non-dedicated BP machine	0.5
Number of VS per day with non-dedicated BP machine	750
Cost of BP machine disinfection per day (assuming 100% compliance)	450
Cost BP machine disinfection per week ($)	**$3,150.00**

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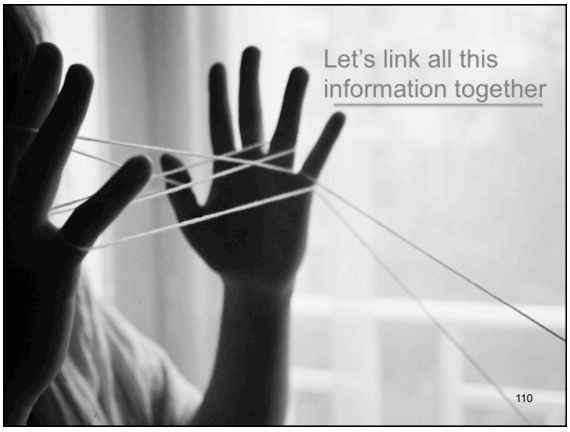

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HOW CAN WE SAY THAT HANDS ARE THE MAIN ROUTE?

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Modeling of transmission Medical Equipment

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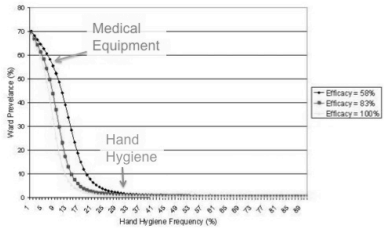
Does fomite-mediated transmission follow the same model as hands?



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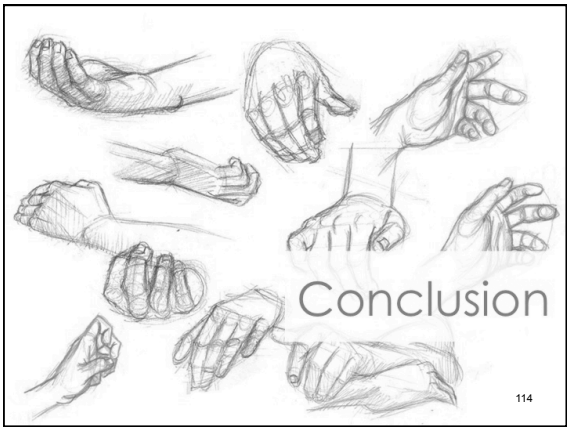

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Conclusion

- The role of hand hygiene to prevent modern HAI is still debatable
- The role of hand hygiene to prevent cross-transmission is more plausible
  - But the potential role of fomites should also be acknowledged
  - The relative contribution of each potential route should be better studied

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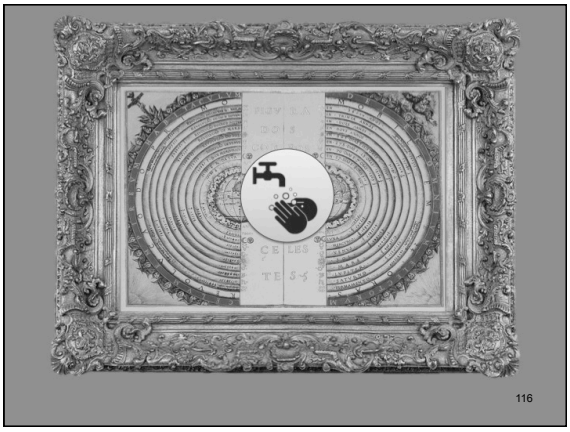

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Nicolai Copernicito Torinensis De Revolutionibus Orbium Coelestium, Libri VI
(Basel, 1566)

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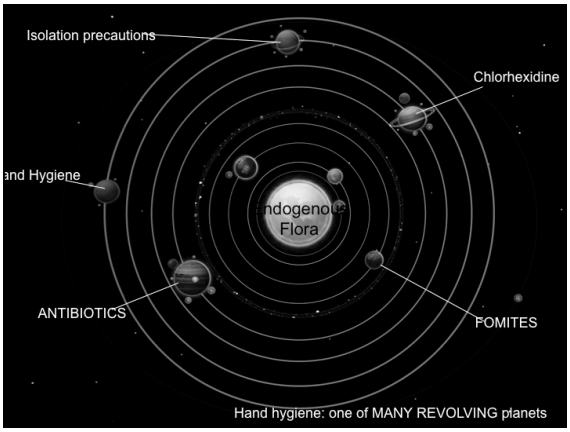

Hand Hygiene: the 100% Solution?

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A CRITICAL APPRAISAL

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