Hand hygiene is not the «be all & bud all» of Infection Control

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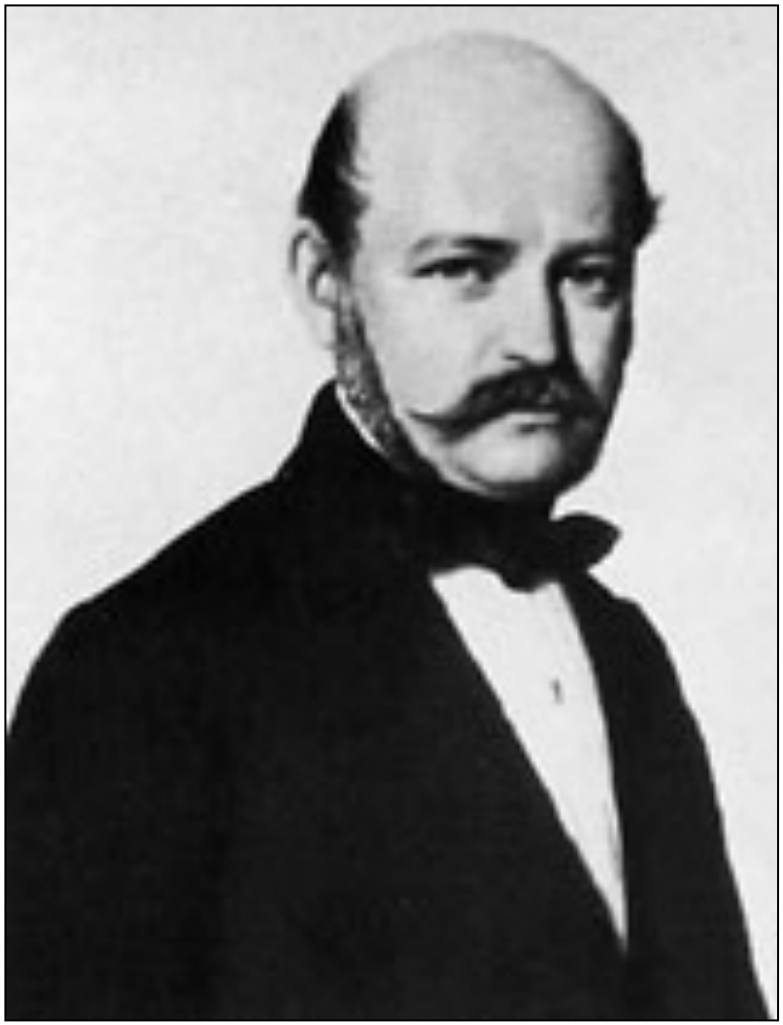
Let us start with
the mother of all hand hygiene studies



Die Aetiologie, der Begriff

und

die Prophylaxis

des

Kindbettfiebers.

Von

Ignaz Philipp Semmelweis,

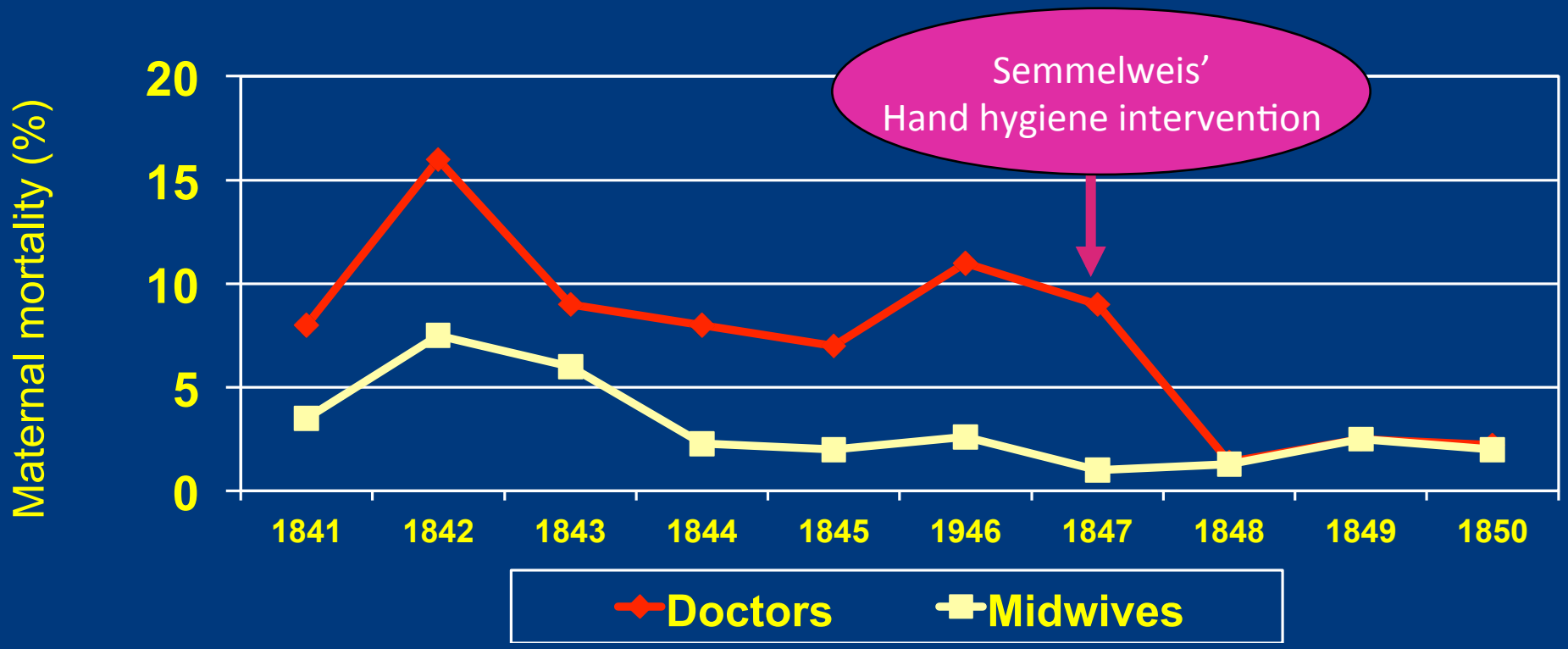
Dr. der Medicin und Chirurgie, Magister der Geburtshilfe, o. ö. Professor der theoretischen und practischen Geburtshilfe an der kön. ung. Universität zu Pest etc. etc.

Pest, Wien und Leipzig.

C. A. Hartleben's Verlags-Expedition.

1861.

Maternal mortality from childbed fever at Allgemeine Krankenhaus, Vienna, Austria



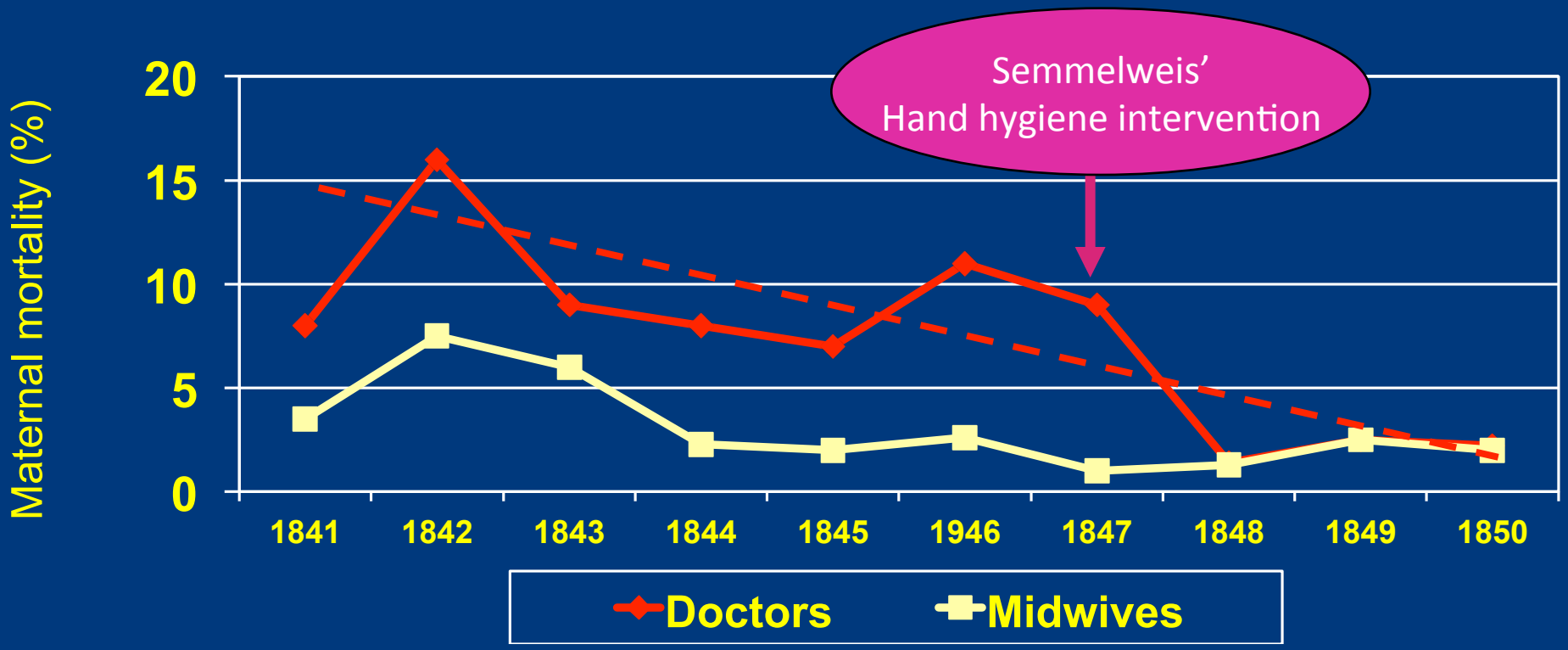
Adapted from: Hosp Epidemiol Infect Control, 2nd Edition, 1999 (CDC)

But.....

Was Semmelweis right?

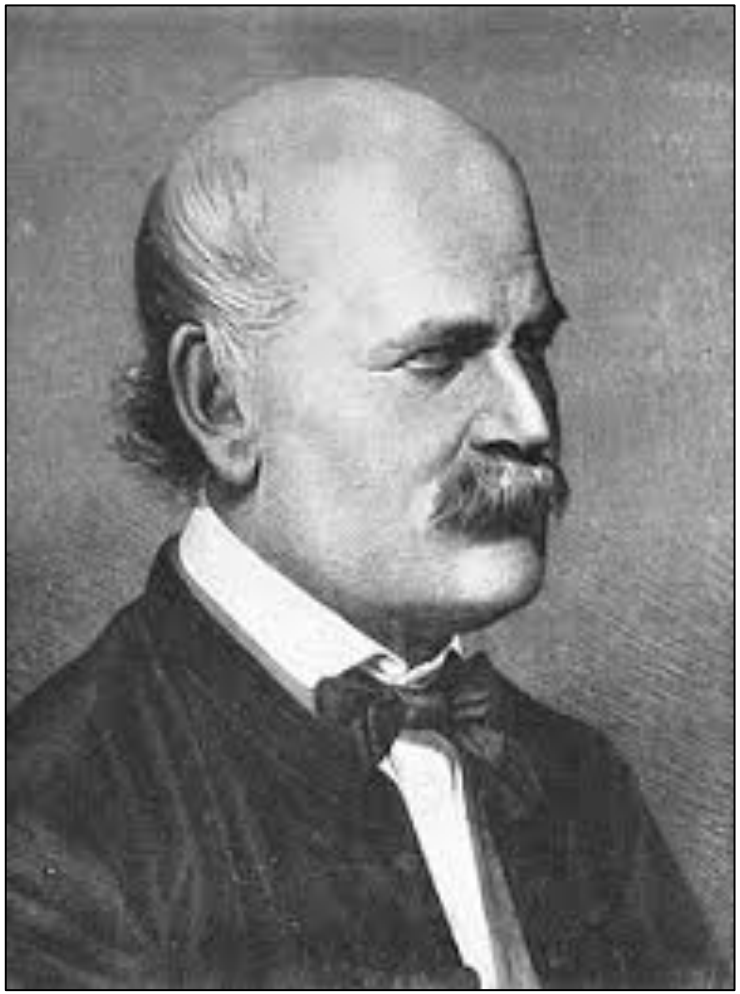
Fake old news:

Maternal mortality from childbed fever at
Allgemeine Krankenhaus, Vienna, Austria



Adapted from: Hosp Epidemiol Infect Control, 2nd Edition, 1999 (CDC)

Semmelweis' study:



- Before-after study with no control group
- Do not prove anything
- Just hitchhiking on a trend?
- 170 years old
- Not relevant in 2017

A Causal Link Between Handwashing and Risk of Infection? Examination of the Evidence

Elaine Larson, PhD, FAAN

ABSTRACT

To examine evidence of a causal link between hand-

(29.1%), behavioral studies (10.9%), methodologic studies (2.8%), studies linking handwashing to infection (3.3%), and other (3.1%). There was an increase in the proportion of handwashing articles published in the 1980s with the rate (9.4/10^5 citations/year) being almost double that of any other period studied. Nonexperimental and experimental studies related to handwashing were reviewed and evidence for a causal association evaluated. Except for specificity, all the elements for causality, including temporality, strength, plausibility, consistency of the association, and dose response were present. It was therefore concluded that emphasis on handwashing as a primary infection control measure has not been misplaced and should continue. [Infect Control Hosp Epidemiol 1988; 9(1):28-36.]

- 423 articles from 1879 through 1986
- 14 articles (3.3 %) linking handwashing to infection

proposed for the discrepancy between recommended and practiced handwashing behavior include busy schedules

have been generally ineffective.[11-13]

A more basic reason for the casual attitude about handwashing might be that health care personnel question the effectiveness of handwashing reducing risk of infection for patients contacted or for themselves. This attitude may be particularly true within the current health care setting because nosocomial infections are relatively rare events and are clearly precipitated by a multitude of interacting factors. Thus, it is difficult to identify the specific effect of an isolated factor such as handwashing. If handwashing is, as is generally taught, causally related to risk of infection, a review of evidence might serve to enhance motivation of patient care providers to practice the procedure with renewed vigor. If, on the other hand, the evidence linking handwashing to infection could be explained by

Larson E. ICHE 1988;9:28-36

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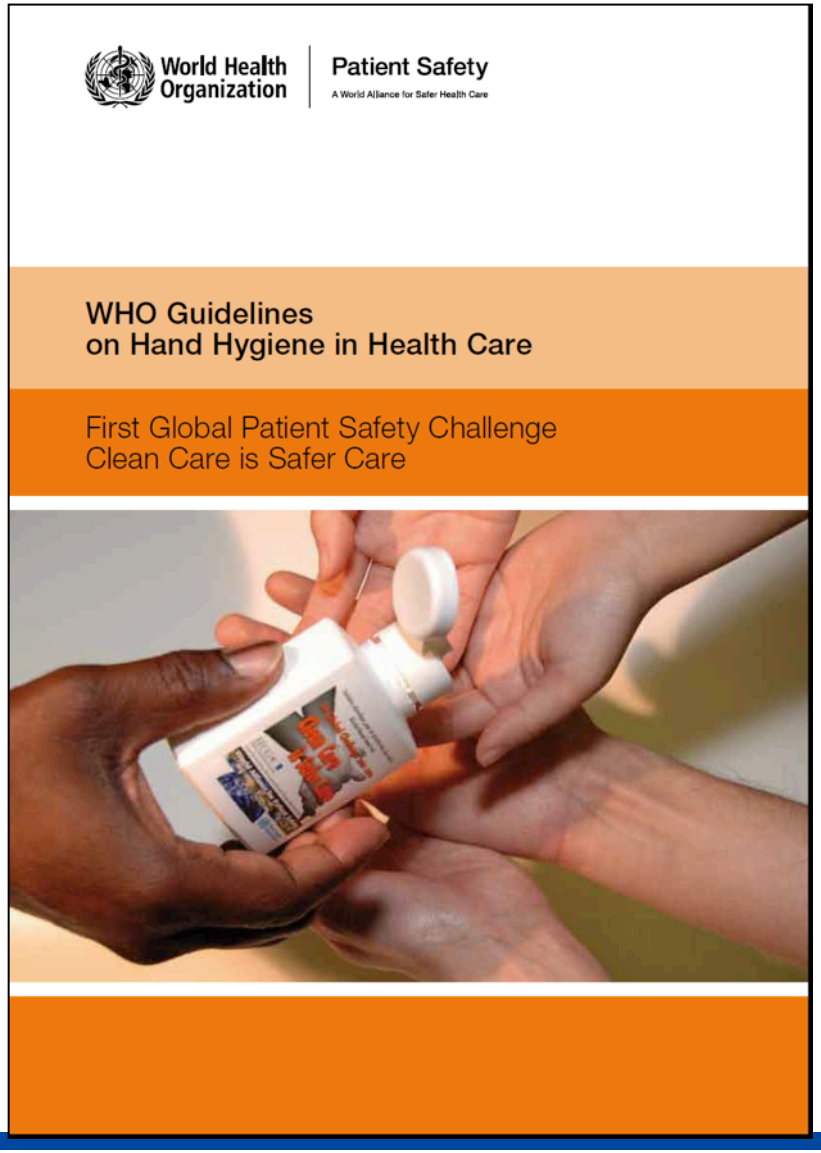
TABLE 3
PROSPECTIVE STUDIES OF THE INFLUENCE OF HANDWASHING ON INFECTIONS

Year Published	Investigator	Setting	Elements of Experimental Design: Intervention?	Comparison Group?	Randomization?	Blinding?	Significant Results
1861	Semmelweis	Maternity hospital (Vienna)	Yes	Sequential	No	No	Reduced mortality from puerperal fever
1977	Casewell	Critical care unit (Great Britain)	Yes	Sequential	No	No	Reduced nosocomial infection rates due to endemic *Klebsiella* strains
1981	Black	Day care centers (US)	Yes	Concurrent	No	No	Reduced incidence of diarrhea
1982	Khan	Village (Bangladesh)	Yes	Concurrent	Yes	No	Reduced incidence of shigellosis
1982	Maki	Critical care unit (US)	Yes	Crossover design	No	No	Reduced incidence of nosocomial infections
1984	Massanari	Critical care unit (US)	Yes	Crossover design	No	No	Reduced incidence of nosocomial infections
Unpublished	Shahid	Village (Bangladesh)	Yes	Concurrent	No	No	Reduced incidence of diarrhea

Larson E. ICHE 1988;9:28-36

World Health Organization 2009



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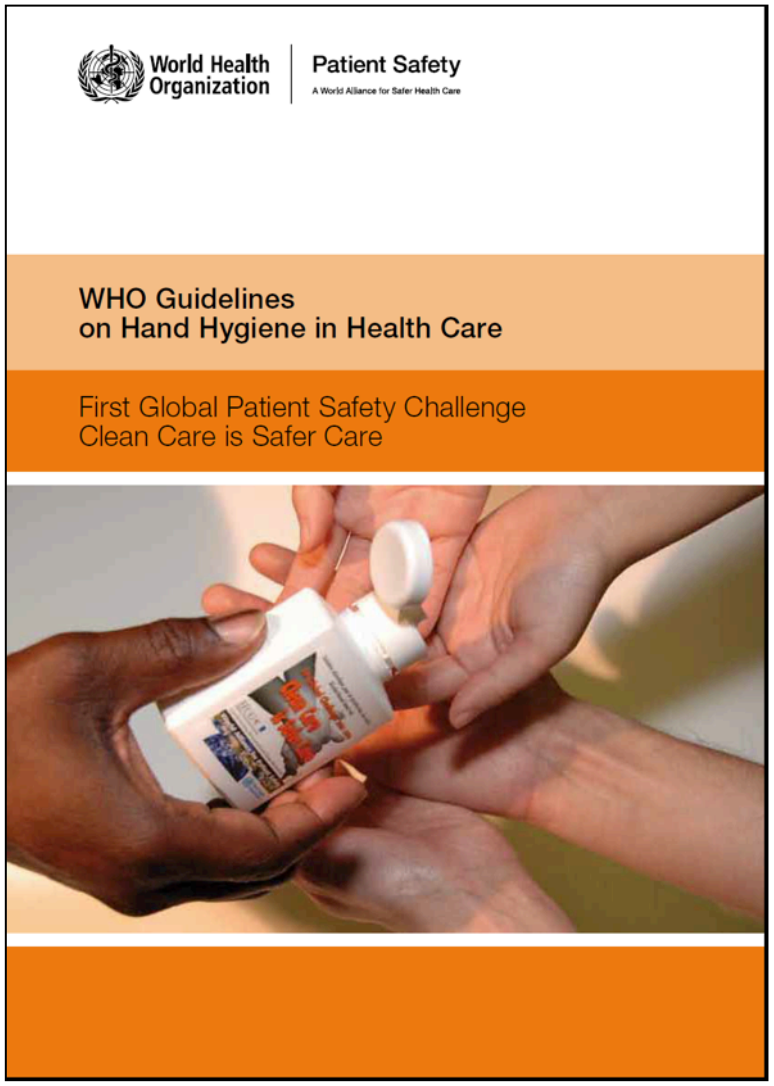

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9.

Relationship between hand hygiene and the acquisition of health care-associated pathogens

Despite a paucity of appropriate randomized controlled trials, there is substantial evidence that hand antisepsis reduces the transmission of health care-associated pathogens and the incidence of HCAI.[58,179,180] In what would be considered an intervention trial using historical controls, Semmelweis[179] demonstrated in 1847 that the mortality rate among mothers delivering at the First Obstetrics Clinic at the General Hospital of Vienna was significantly lower when hospital staff cleaned their hands with an antiseptic agent than when they washed their hands with plain soap and water.

In the 1960s, a prospective controlled trial sponsored by the USA National Institutes of Health (NIH) and the Office of the Surgeon General compared the impact of no handwashing versus antiseptic handwashing on the acquisition of *S. aureus* among infants in a hospital nursery.[52] The investigators demonstrated that infants cared for by nurses who did not wash their hands after handling an index infant colonized with *S. aureus* acquired the organism significantly more often, and more rapidly, than did infants cared for by nurses who used hexachlorophene to clean their hands between infant contacts. This trial provided compelling evidence that when compared with no handwashing, hand cleansing with an antiseptic agent between patient contacts reduces transmission of health care-associated pathogens.

A number of studies have demonstrated the effect of hand cleansing on HCAI rates or the reduction in cross-transmission of antimicrobial resistant pathogens (see Part I, Section 22 and Table I.22.1). For example, several investigators have found that health care-associated acquisition of MRSA was reduced when the antimicrobial soap used for hygienic hand antisepsis was changed.[181,182] In one of these studies, endemic MRSA in a neonatal ICU was eliminated seven months after introduction of a new hand antiseptic agent (1% triclosan) while continuing all other infection control measures, including weekly active surveillance cultures.[181] Another study reported an MRSA outbreak involving 22 infants in a neonatal unit.[182] Despite intensive efforts, the outbreak could not be controlled until a new antiseptic agent was added (0.3% triclosan) while continuing all previous control measures, which included the use of gloves and gowns, cohorting, and surveillance cultures. Casewell & Phillips[127] reported that increased handwashing frequency among hospital staff was associated with a decrease in transmission of *Klebsiella* spp. among patients, but they did not quantify the level of handwashing among HCWs. It is important to highlight, however, that although the introduction of a new antiseptic product was a key factor to improvement in all these studies, in most cases, system change has been only one of the elements determining the success of multimodal hand hygiene promotion strategies; rather, success results from the overall effect of the campaign.

In addition to these studies, outbreak investigations have suggested an association between infection and understaffing or overcrowding that was consistently linked with poor adherence to hand hygiene. During an outbreak, Fridkin[183] investigated risk factors for central venous catheter-associated BSI. After adjustment for confounding factors, the patient-to-nurse ratio remained an independent risk factor for BSI, suggesting that nursing staff reduction below a critical threshold may have contributed to this outbreak by jeopardizing adequate catheter care. Vicca[184] demonstrated the relationship between understaffing and the spread of MRSA in intensive care. These findings show indirectly that an imbalance between workload and staffing leads to relaxed attention to basic control measures, such as hand hygiene, and spread of microorganisms. Harbarth and colleagues[185] investigated an outbreak of *Enterobacter cloacae* in a neonatal ICU and showed that the daily number of hospitalized children was above the maximal capacity of the unit, resulting in an available space per child well below current recommendations. In parallel, the number of staff on duty was significantly below that required by the workload, and this also resulted in relaxed attention to basic infection control measures. Adherence to hand hygiene practices before device contact was only 25% during the workload peak, but increased to 70% after the end of the understaffing and overcrowding period. Continuous surveillance showed that being hospitalized during this period carried a fourfold increased risk of acquiring an HCAI. This study not only shows the association between workload and infections, but also highlights the intermediate step – poor adherence to hand hygiene practices. Robert and colleagues suggested that suboptimal nurse staffing composition for the three days before BSI (i.e. lower regular-nurse-to-patient and higher pool-nurse-to-patient ratios) was an independent risk factor for infection.[186] In another study in ICU, higher staff level was indeed independently associated with a > 30% infection risk reduction and the estimate was made that, if the nurse-to patient ratio was maintained > 2.2, 26.7% of all infections could be avoided.[187]

Overcrowding and understaffing are commonly observed in health-care settings and have been associated throughout the world, particularly in developing countries where limited personnel and facility resources contribute to the perpetuation of this problem.[183-186,188-190] Overcrowding and understaffing were documented in the largest nosocomial outbreak attributable to *Salmonella* spp. ever reported[191]; in this outbreak in Brazil, there was a clear relationship between understaffing and the quality of health care, including hand hygiene.

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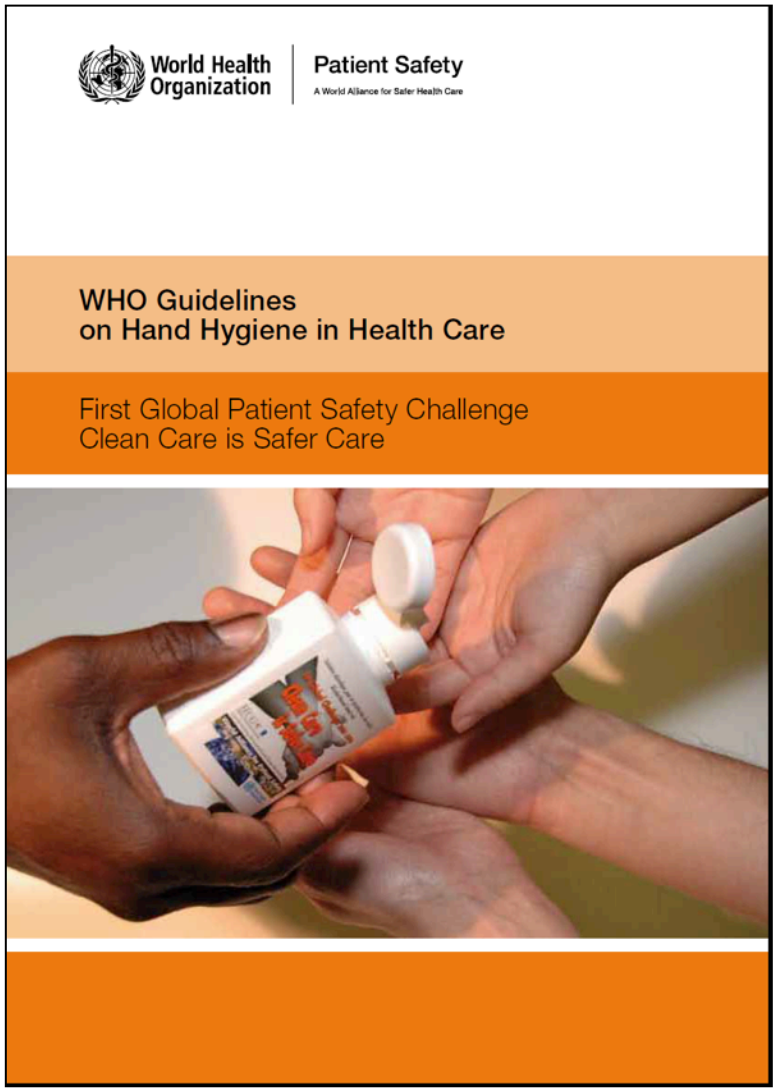

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WHO Guidelines
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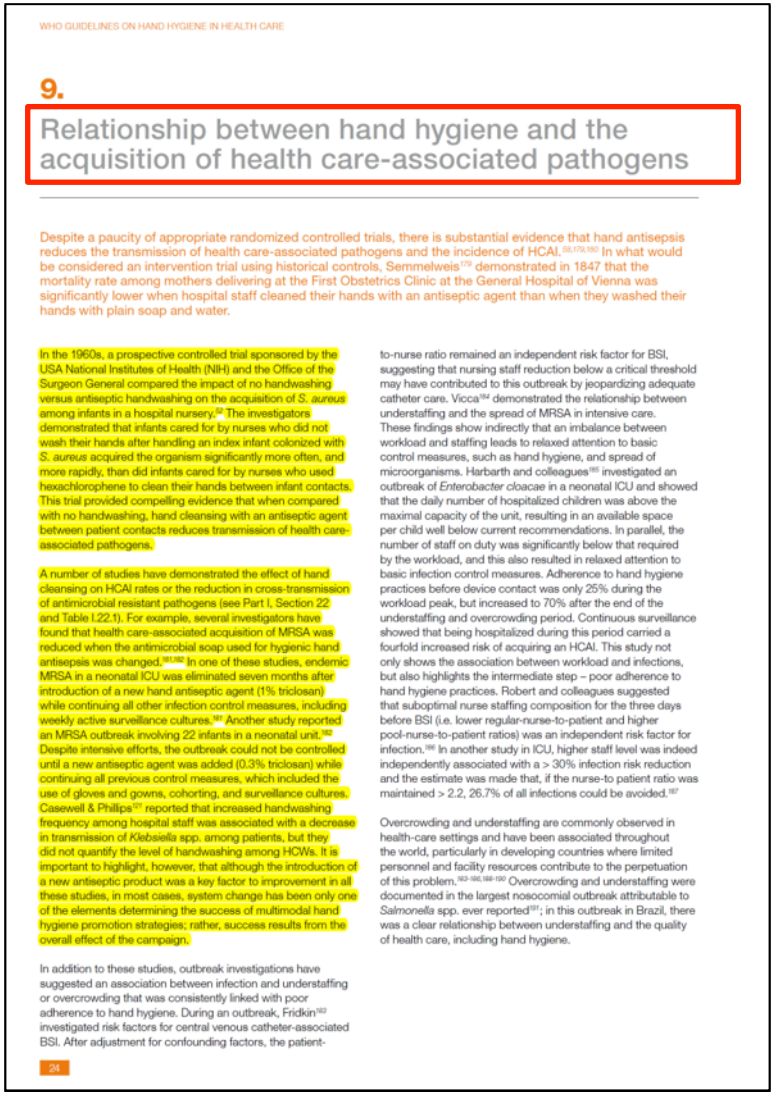
First Global Patient Safety Challenge
Clean Care is Safer Care



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1168 references

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+9 references on relationship between staffing and hospital acquired infections

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22.

Impact of improved hand hygiene

Evaluation of the effectiveness of hand hygiene guidelines or recommendations on the ultimate outcome, i.e. the HCAI rate, is certainly the most accurate way to measure the impact of improved hand hygiene, but it represents a very challenging activity. Indeed, guideline implementation should not be evaluated per se but in relation to the availability of clear instructions on how to translate it into practice and, ideally, the existence of related tools and impact of their implementation. As an illustration, in a sample of 40 hospitals in the USA, Larson and colleagues found that although most HCWs were aware of the hand hygiene guidelines with alcohol-based handrub available in all facilities, a multidisciplinary implementation programme was conducted in only 44.2% of the hospitals.[728] The impact was quite disappointing: mean hand hygiene compliance rates were no higher than 56.6%, and the correlation of lower infection rates with higher compliance was demonstrated only for bloodstream infections. The authors concluded that a real change following guideline dissemination is not achievable unless fostered by factual multidisciplinary efforts and explicit administrative support.

Difficulties to deal with this challengig issue depend firstly on the diversity of methodologies used in available studies, and this is well reflected in the very different conclusions that can be drawn from systematic reviews on the topic.[887,888]

The lack of scientific information on the definitive impact of improved hand hygiene compliance on HCAI rates has been reported as a possible barrier to appropriate adherence with hand hygiene recommendations. However, there is convincing evidence that improved hand hygiene through multimodal implementation strategies can reduce infection rates. In addition, although not reporting infection rates, several studies showed a sustained decrease of the incidence of multidrug-resistant bacterial isolates and patient colonization following the implementation of hand hygiene improvement strategies.[478,655,687,701] Failure to perform appropriate hand hygiene is considered the leading cause of HCAI and spread of multi-resistant organisms, and has been recognized as a significant contributor to outbreaks.

At least 20 hospital-based studies of the impact of hand hygiene on the risk of HCAI have been published between 1977 and June 2008 (Table I.22.1).[60,61,121,181,182,195,196,489,494,645,657,659,663,667,713-716,852] Despite study limitations, most reports showed a temporal relation between improved hand hygiene practices and reduced infection and cross-transmission rates.

Maki[195] found that HCAI rates were lower when antiseptic handwash was used by HCWs. Doebbeling and colleagues[659] compared hand antisepsis using a chlorhexidine-containing detergent to a combination regimen that permitted either handwashing with plain soap or use of an alcohol-based handrub. HCAI rates were lower when the chlorhexidine-containing product was in use. However, because relatively little of the alcohol rub was used during periods when the combination regimen was in operation and because adherence to policies was higher when chlorhexidine was available, it was difficult to determine whether the lower infection rates were attributable to the hand hygiene regimen used or to the differences in HCW compliance with policies.

A study by Larson and colleagues[713] found that the frequency of VRE infections, but not MRSA, decreased as adherence of HCWs to recommended handwashing measures improved. This strategy yielded sustained improvements in hand hygiene practices. The intervention lasted eight months, and a follow-up survey six months after the end of the intervention showed a sustained improvement in hand hygiene practices. More recently, several studies demonstrated a clear impact of improved hand hygiene on MRSA rates.[489,494,718] In a district hospital in the United Kingdom, the incidence of hospital-acquired MRSA cases significantly decreased after a successful hand hygiene promotion programme.[489] Similarly, in Australia, a hospitalwide, multifaceted programme to change hand hygiene culture and practices led to a 57% reduction of MRSA bacteraemia episodes as well as a significant reduction of the overall number of clinical isolates of MRSA and ESBL-producing *E. coli* and *Klebsiella* spp.[494] The programme was subsequently expanded to another six health-care institutions and then to the entire state of Victoria. After 24 months and 12 months of follow-up, respectively, MRSA bacteraemia and the number of MRSA clinical isolates significantly decreased both in the 6 pilot hospital and statewide (see Table I.22.1).[718] In another study, the intervention consisted of the hospitalwide introduction of an alcohol-based gel and MRSA surveillance feedback through charts.[718] Significant reductions of MRSA bacteraemia and MRSA central line-associated bacteraemia were observed hospitalwide and in the ICU, respectively, with a follow-up of 36 months. In this study, however, it is difficult to define the actual role of hand hygiene to reduce MRSA bacteraemia, because charts were a strong component of the intervention and, at the same time general infection control measures were intensified and the use of antibiotic-coated central venous catheters was initiated in the ICU.

In 2000, a landmark study by Pittet and colleagues[60] demonstrated that implementing a multidisciplinary programme to promote increased use of an alcohol-based handrub led to increased compliance of HCWs with recommended hand hygiene practices and a reduced prevalence of HCAI. Individual bottles of handrub solution were distributed in large numbers to all wards, and custom-made holders were mounted on all beds to facilitate access to hand antisepsis. HCWs were also encouraged to carry a bottle in their pocket. The promotional strategy was multimodal and involved a multidisciplinary team of HCWs, the use of wall posters, the promotion of bedside handrubs throughout the institution, and regular performance

feedback to all HCWs (see http://www.hopisafe.ch for further details on methodology). HCAI rates, attack rates of MRSA

cross-transmission, and consumption of handrub were measured in parallel. Adherence to recommended hand hygiene practices improved progressively from 48% in 1994 to 66% in 1997 (P <0.001). While recourse to handwashing with soap and water remained stable, the frequency of handrubbing markedly increased over the study period (P <0.001), and the consumption of alcohol-based handrub solution increased from 3.5 litres to 15.4 litres per 1000 patient-days between 1993 and 1998 (P <0.001). Importantly, increased recourse to handrubbing was associated with a significant improvement in compliance in critical care,[334] suggesting that time constraint bypassing was critical. The increased frequency of hand antisepsis was unchanged after adjustment for known risk factors of poor adherence. During the same period, both overall HCAI and MRSA transmission rates decreased (both P <0.05). The observed reduction in MRSA transmission may well have been affected by both improved hand hygiene adherence and the simultaneous implementation of active surveillance cultures for detecting and isolating patients colonized with MRSA.[889] Follow-up evaluation 8 years after the beginning of the programme revealed continuous improvement with hand hygiene practices, increased recourse to alcohol-based handrub, and stable HCAI rates; it also highlights the cost–effectiveness of the strategy.[67] The experience from Geneva's University Hospitals constitutes the first report of a hand hygiene campaign demonstrating a sustained improvement over several years; some recent further studies reported a positive impact of hand hygiene promotion with a prolonged follow-up (up to 3 years).[494,714,717,718]

More recently, a number of studies assessed the effectiveness of hand hygiene improvement to prevent HCAI in neonatal care. Following the implementation of hand hygiene multimodal strategies, Lam and colleagues[648] and Won and colleagues[714] demonstrated a significant decrease of overall HCAI rates in neonatal ICUs, whereas Pessoa-Silva and colleagues[657] observed only a decrease in very low-birth-weight neonates (Table I.22.1). A significant reduction of HCAI was also observed in adult ICU patients in a hospital in Argentina.[716] Other investigations showed an impact of improved hand hygiene on specific types of HCAI such as rotavirus[715] and surgical site infections in neurosurgery[717] (Table I.22.1). Furthermore, a recent review of the literature related to the effectiveness of handwashing against SARS transmission concluded that nine of 10 epidemiological studies showed a protective effect of hand hygiene, but this result was only significant in three in a multivariate analysis.[890]

In several other studies in which hand hygiene compliance was not monitored, multidisciplinary programmes that involved the introduction of an alcohol-based handrub were associated with a decrease in HCAI and cross-transmission rates.[429,489,645,735] The beneficial effects of hand hygiene promotion on the risk of cross-transmission have also been reported in surveys conducted in schools or day-care centres,[454,891-896] as well as in community settings.[748,749,449,754,815,830,897-900]

While none of the studies conducted in the health-care setting represented randomized controlled trials, they provide substantial evidence that increased hand hygiene compliance is associated with reduced HCAI rates. Indeed, only very few studies concluded that hand hygiene promotion had no impact on HCAI. A very early study from Simmons and colleagues showed that interventions aimed at improving handwashing practices in ICUs failed to improve them substantially and therefore to reduce HCAI.[667] A very recently published two-year, prospective, controlled cross-over trial by Rupp and colleagues has attracted much attention, including from the lay press. The authors observed that a significant and sustained improvement in hand hygiene adherence following the introduction of an alcohol-based handrub did not lead to a substantial change in device-associated infection rates and infections due to multidrug-resistant pathogens.[797] Nevertheless, it is crucial to note that although the study was, in general, well-designed and conducted, it presents key limitations that have led to harsh criticism following its publication,[901-903] including lack of screening for cross-transmission, lack of statistical power, and use of an alcohol-based handrub that fails to meet the EN 1500 standards for antimicrobial efficacy.

Methodological and ethical concerns make it difficult to set up randomized controlled trials with appropriate sample sizes that could establish the relative importance of hand hygiene in the prevention of HCAI. The studies so far conducted, although semi-experimental and of good quality in most cases, could not determine a definitive causal relationship owing to the lack of statistical significance, the presence of confounding factors, or the absence of randomization. Given that multimodal strategies are the most preferred methods to obtain hand hygiene improvement,[60,713,719,728] additional research on the relative effectiveness of the different components of these strategies would be very helpful to successful achievement of a sustainable impact.[809,904]

The unique large, randomized controlled trial to test the impact of hand hygiene promotion clearly demonstrated reduction of upper respiratory pulmonary infection, diarrhoea, and impetigo among children in a Pakistani community, with positive effect on child health.[265,449] Although it remains important to generate additional scientific and causal evidence for the impact of enhanced adherence with hand hygiene on infection rates in health-care settings, these results strongly suggest that improved hand hygiene practices reduce the risk of transmission of pathogenic microorganisms.

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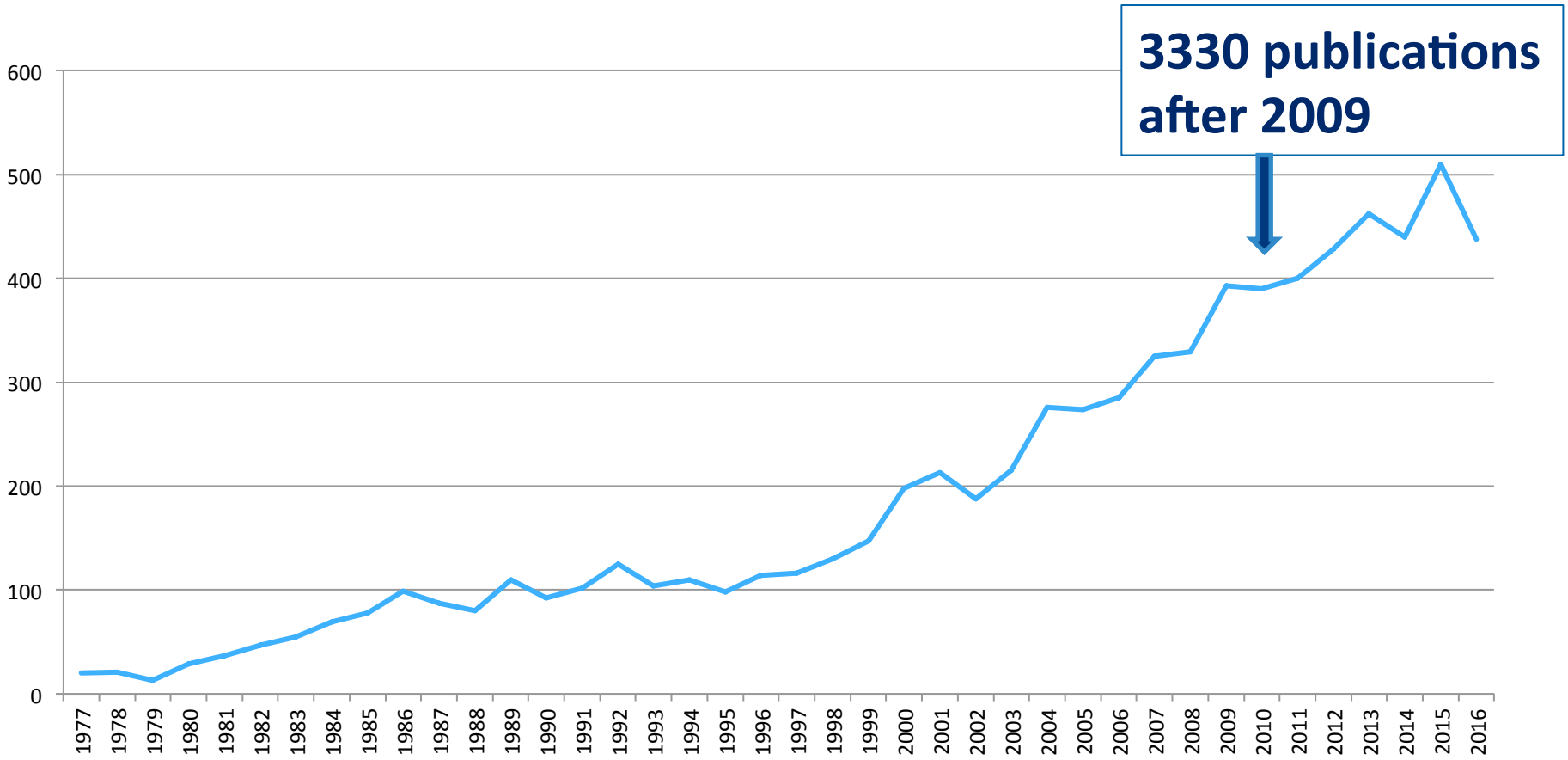
Publications on hand hygiene 1977 - 2016

Key words: Hand hygiene, hand washing, hand disinfection or hand antisepsis



An integrative review of the current evidence on the relationship between hand hygiene interventions and the incidence of health care–associated infections

Chantal Backman, RN, BScN, MHA,[a] Dick E. Zoutman, MD, FRCPC,[b] and Patricia Beryl Marck, RN, BScN, MN, PhD[c]
Ottawa, Kingston, and Edmonton, Canada

Backman C et al. ICHE 2008;36:333-48

1120 articles retrieved

35 publications, including 4 reviews met the inclusion criteria.
The remaining 31 eligible original studies included:

- 18 (58 %) before and after studies without control groups
- 4 (13 %) before and after studies with a control group
- 3 (10 %) cohort studies with no control group
- 4 (13 %) cohort studies with a control group
- 2 (6 %) randomised trials

Backman C et al. ICHE 2008;36:333-48

Conclusions

- There is a lack of rigorous evidence linking specific hand hygiene interventions with the prevention of HCAIs
- The varied nature of the interventions used and the diverse factors affecting the acquisition of HCAIs make it difficult to show the specific effect of hand hygiene alone.

Backman C et al. ICHE 2008;36:333-48

What is the risk of publication bias

in favour of studies

showing effect of hand hygiene?

Probably high!

And finally – let's look at the big five

What is the role of hand hygiene for the prevention of

Surgical site infection?

Blood stream infection?

Pneumonia?

Urinary tract infection?

Gastrointestinal infection?

Surgical site infections

- Are mainly caused by contamination of the wound in the operating theatre
- Are mainly of endogenous origin
- Even surgical hand disinfection is poorly documented

Pneumonia

- Most infections are a result of intubation/ artificial ventilation and have endogenous origin
- Preventive measures are mainy directed at reducing the risk of aspiration

Blood stream infections

- Most infections are the result of the use of intravascular catheters and the source is patient skin
- Preventive measures are primarily associated with handling of the insertion site and lines. The specific role of hand hygiene is not clear.

Urinary tract infections

- Most infections are the result of the use of catheters and have endogenous origin
- With the use of modern closed drainage systems the role of hand hygiene is likely small

Gastrointestinal tract infections

- The only infection among the «big five» with predominantly exogenous origin
- Hand hygiene plays a role in prevention, but whose hands – healhtcare workers or patients?

Conclusions

- The effect and efficacy of hand hygiene on the prevention of HCAIs are poorly documented
- Interventions to improve compliance have moderate effect and are poorly sustainable
- Resources available for IPC should mainly be directed towards other measures

If it was so simple that hand hygiene is the «be all & bud all» of IPC, then we could:

Replace

Infection control nurse

Infection control doctor