

Hand Hygiene

87. Hand Hygiene (HH) Before Glove Use? Is This Really Necessary? Do We Do It? A Closer Look at HH Compliance (C)

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Background: The CDC HICPAC guideline recommends that health-care workers' (HCWs) hands are decontaminated before: 1) having direct contact with patients 2) donning sterile gloves when inserting a central intravascular catheter and 3) inserting urinary catheters, peripheral vascular catheters, or other invasive devices that do not require a surgical procedure (IB recommendations). There is no specific recommendation for HH prior to donning non-sterile gloves (NSGs). One investigator reported antiseptic hand washing and use of NSGs over unwashed hands confer similar reductions in the number of microorganisms and concluded that there is no additional benefit of prior hand washing (Crit Care Med 1995; 23:1211-1216). However, JCAHO has interpreted the CDC HH guidelines to mean HH should be performed prior to contact with the patient and/or environmental (P/E), even when NSGs are worn. Should contact with a gloved hand be considered "direct" patient contact? Should HH be required before donning NSGs for P/E contact?

Objective: To evaluate how the use of NSGs affected HH C before P/E contact in our institution.

Methods: All inpatient units undergo monthly audits that consist of 30 HH observations, defined as performing HH prior to and after P/E contact. During FY07 11,965 HH opportunities were observed for HH C rate of 26%. HCWs must have been C with both events to be deemed C. To increase our understanding of HH non-compliance (NC), HH C before and after P/E contact were considered independently. For HH observations before P/E contact, NSG use was also assessed. Over 1 month, 690 opportunities occurred on 23 units. Overall HH NC and NC with and without NSGs were calculated and compared. Additionally an adjusted (A) C rate defined as HH or an acceptable barrier (glove) prior to contact with the P/E was calculated. Education was redeployed emphasizing the importance of HH 'before' P/E contact and HH C was redefined in FY08 so that before and after opportunities are now considered independent events and C rates followed.

Results: 299/690 (43%) HH opportunities were deemed NC. Of these, 199/299 (67%) occurred before P/E contact and 100 (33%) occurred after P/E contact. Of the 199 NC before P/E contact, 174 (87%) opportunities occurred when NSGs were worn. Only 25/199 (13%) opportunities were deemed NC when no gloves were worn. 391 (57%) HH opportunities were deemed C. An additional 174 patient interactions used NSGs prior to P/E contact for a total of 565/690 representing an AC rate of 82%. HH C in FY08 has increased to 45%.

Conclusions:

1) HCWs do not routinely decontaminate their hands prior to donning NSGs.

- 2) There are no studies supporting the use of HH prior to NSG use and one study that found HH added no additional benefit with use of NSGs.
- 3) If gloves were an acceptable barrier, the AC would be 82%.
- 4) Education that included the importance of HH 'before' P/E contact helped to impact HH behavior, but is it necessary to enforce HH 'before' NSG use?

88. The Impact of Finger Rings on Bacterial Transfer from the Hands of Health Care Workers during Hand Shakes

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Background: Use of finger rings among health care workers (HCW) has been a matter of controversy in health care for a long time, and different guidelines are given regarding ring wearing. Studies published on this topic are few and often small, and the results are to some degree contradictory. CDC has therefore concluded that further studies are needed to establish if wearing of finger rings results in increased risk of pathogen transmission in health-care settings.

Objective: To investigate the impact of finger rings on transfer of bacteria from the hands of HCW during hand shakes.

Methods: One hundred HCW wearing one or more finger rings on one hand and 100 HCW without rings (donors) were asked to shake hands in a standardized manner with a person wearing sterile gloves (recipient). The donors were invited to participate at random without prior notice during routine clinical work. They were not allowed to wash or disinfect their hands before sampling, but the time since last hand washing and disinfection was recorded. Both hands of the donors and the gloved hands of the recipients were sampled with the glove juice technique after the hand shake. Quantitative culture and identification was done by conventional microbiological methods.

Results: Significantly more bacteria ($p = 0.008$) were recovered from the hands of HCW with rings compared to HCW without rings (Table 1). Also, bacterial transfer during hand shakes was significantly higher from hands of HCW with rings ($p=0.003$). In addition, a positive correlation was observed between ring use and the use of wrist watch as well as a negative correlation between watch use and frequency of hand disinfection. No difference was found between the number of colony forming units (CFU) on the hand with and without rings of the subjects wearing rings on one hand. No correlation was found between the use of rings and the occurrence of or transfer of *Staphylococcus aureus*. However, carriage of one or more species of Gram negative rods was more frequently observed in the group of HCW with rings: 64 % vs. 44% ($p= 0.005$) for any Gram negative rod, 35 % vs. 20% ($p = 0.018$) for Enterobacteriaceae. There was also a trend towards increased transfer of Enterobacteriaceae from HCW with rings: 9 % vs. 3 % ($p = 0.074$).

Conclusions: The results show that the use of finger rings increase the total bacterial load on both hands of health care workers, including the hand without rings when rings are carried on one hand only. Finger rings also enhances bacterial transfer from the hand during hand shakes. Whether or not this is due to the rings themselves, to concomitant watch use, infrequent use of hand disinfection among ring and watch users or a combination of these remains to be clarified.

Table 1. Total number of bacteria recovered from donor hands and transferred to recipient hands.

Table 1. Total number of bacteria recovered from donor hands and transferred to recipient hands				
Study group	Hand	Number of hands	Number of CFU on donor hands (median)	Number of CFU transferred to recipient hands (median)
Ring	Hand without ring	100	1,305,000	2,075
Ring	Hand with ring	100	1,336,250	1,800
No ring	Hand without ring	200	512,500	875

89. Compliance of Healthcare Workers with Infection Control Contact Precaution Procedures

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Background: During the last 10 years significant attention has been given to increasing healthcare worker (HCW) compliance with established hand hygiene practices. Similar to other institutions, UMass Memorial Medical Center has introduced multiple programs to promote appropriate hand hygiene practices. Recent studies suggest there has also been low HCW adherence to the use of appropriate procedures when caring for patients on contact precaution, a key measure that prevents the transmission of multi-drug resistant pathogens. We questioned whether educational activities to improve hand hygiene might influence HCW compliance with contact precaution techniques.

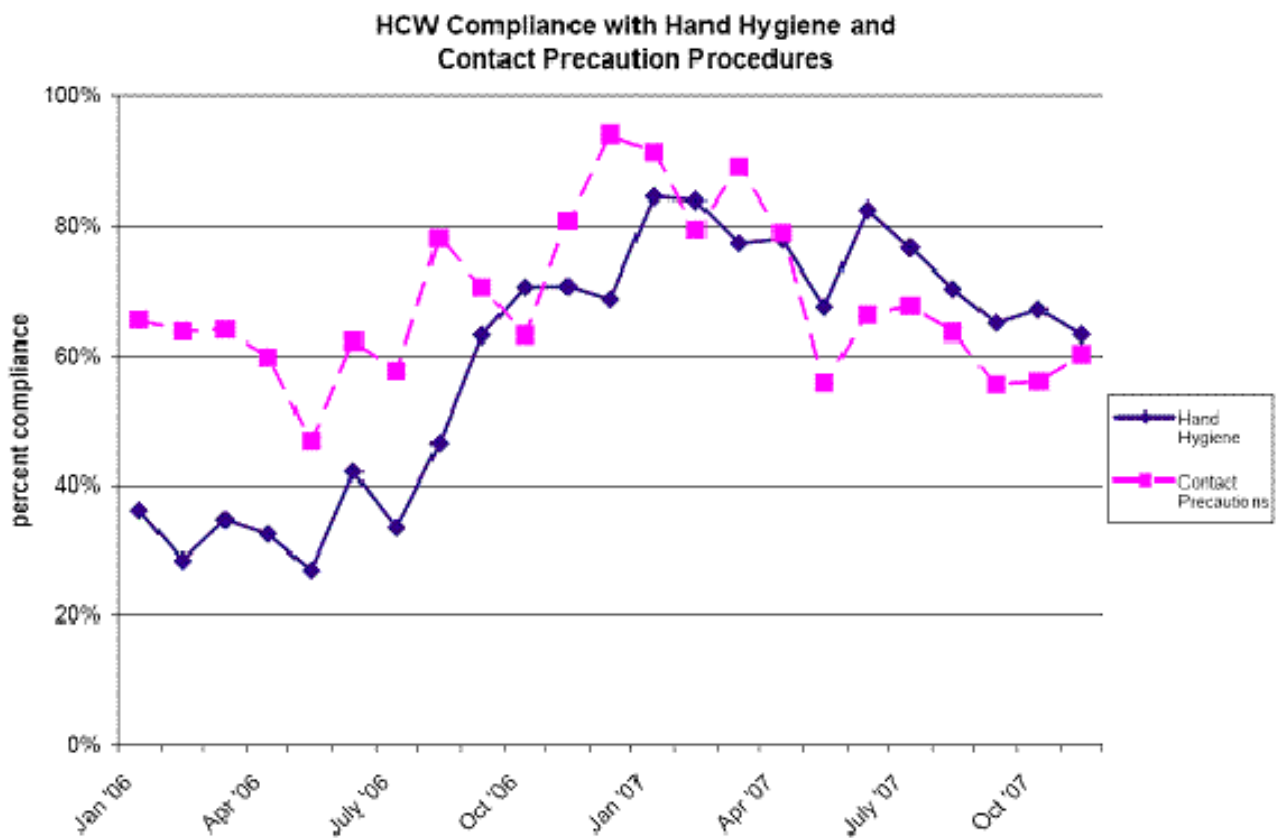
Objective: To evaluate the adherence of HCWs in a tertiary care medical center to infection control practices, and determine any relationship between compliance with appropriate hand hygiene and contact precaution procedures.

Methods: Anonymous observers monitored HCW compliance with both hand hygiene and contact precaution procedures by observing HCWs on a given medical unit on any given day. An overall comparison of hospital data by month for complete hand hygiene compliance and complete contact precaution compliance was performed, as well as a matched comparison comparing each encounter of HCWs with a patient on contact precautions to the next sequential encounter in the database with a patient not on contact precautions.

Results: Between January 2006 and November 2007, a total of 15,620 patient encounters were observed; 3710 were with patients in contact precaution. Monthly glove compliance averaged 75% and ranged from 61% to 97%, gown compliance

averaged 69% and ranged from 47% to 94%, complete compliance (both gloves and gowns) average 68% and ranged from 47% to 94%. Overall, intensive care units (ICU) performed better than regular floors. ICUs had 71% glove compliance, 73% gown compliance, and 71% complete compliance, compared to the regular floor compliances of 65%, 56%, and 56% respectively. Rates of appropriate hand hygiene practice and contact precaution practices are shown in the figure. A chi-square test found that compliance with the two practices were dependent on one other by a significant result of $\chi^2(3, n=15,620) = 366, p < 5E-79$ for the overall comparison and $\chi^2(1, n=1706) = 23.1, p < 5E-23$ for the matched comparison.

Conclusions: In our institution adherence with both hand hygiene and contact precautions improved during a time period when only education directed at appropriate hand hygiene was undertaken. Given the difficulty in sustaining a high rate of HCW adherence to infection control practices, it may be beneficial to make use of this carry over effect as educational programs focused on one form of compliance will likely increase both forms of compliance.



90. Accepting Reminders to Perform Hand Hygiene from Co-workers and Patients: Attitudes of Physicians and Nurses

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Background: Healthcare workers (HCWs) tend to overestimate their hand hygiene performance. Novel strategies to improve HCW hand hygiene practices have included encouraging staff and patients to remind HCWs who forget to cleanse their hands. HCWs are however unaccustomed to receiving this individual-level feedback HCW acceptance of this strategy has not been described.

Objective: During a hand hygiene campaign at our 500-bed tertiary care hospital, we conducted a survey to evaluate HCW attitudes towards staff and patient feedback.

Methods: HCWs completed an anonymous survey distributed at faculty meetings, resident conferences, and nursing units.

Results: Of the 326 completed surveys, 55% were by physicians (58% faculty, 42% residents or fellows), and 32% by nurses. Eighty-nine percent of respondents agreed that any staff member should be encouraged to remind HCWs to cleanse their hands; 81% agreed that patients/family should be encouraged to remind HCWs. Of those who disagreed with the feedback strategy, 18 were physicians (10% of physician respondents) and 3 were nurses (3% of nurse respondents). The most frequently cited reasons for objecting included the following: it is not patients' responsibility to remind staff, patients/staff may not see that the HCW had previously cleansed his/her hands, or reminders are embarrassing/inappropriate. Sixteen percent of nurses and 14% of physicians reported being reminded by co-workers during the nine-month period after roll-out of the campaign. Similarly, 15% of nurses and 8% of physicians reported that patients/families had reminded them to cleanse their hands. After being reminded, 81% reported being more careful about hand cleansing; the others reported no change.

Conclusions: HCWs articulated acceptance of hand hygiene reminders from staff and patients. This represents a positive cultural step, especially since a concern about giving feedback has been that HCWs would take offense and counterproductive interactions would result. The mildly embarrassing yet memorable experience of being reminded may instead positively influence a HCW's hand hygiene habits. However, a major challenge of this feedback strategy is spurring staff and patients to routinely voice reminders. Multi-faceted approaches are needed to improve HCW self-awareness of personal hand hygiene performance and the potentially serious infection consequences of failing to maintain these precautions.

91. Hand-Hygiene: Measuring Health Care Workers' Adherence after Implementing Educational Intervention

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Background: Hand-hygiene is described as the single most important procedure for preventing infections in the health care setting. Despite this evidence, the lack of compliance has been reported ever since and several studies with focus on it. The ultimate challenge is to transpose the knowledge from scientific studies to a specific health care setting; adequate recommendations in hand-hygiene according to ones reality and needs, especially in developing countries.

Objective: To measure the impact of an educational intervention for hand-hygiene procedure at a tertiary Brazilian Hospital, through the volume of alcohol-based hand rub used per 1,000 patient days.

Methods: This study was done in a tertiary Brazilian hospital with 196 beds in 2007 year. The Nosocomial Infection Control Service elaborated an incentive strategy to improve the hand-hygiene procedure with 37 expositive classes for all Health Care Workers (HCWs), with "Glo-germ" practices too, during April and May; and increasing the numbers of automated dispersers of alcohol-based hand rubs at the hospital.

Results: The volume used of alcohol-based hand rub was 2,000 ml /1,000 patient days, before the educational intervention and after it became 11,000ml / 1,000 patient days, with an increase of 450%.

Conclusions: We concluded that the educational intervention and appropriate antiseptic is capable to improve satisfactorily hand-hygiene procedure, and it is a responsibility of all HCWs, mainly nosocomial infection control group.

92. Using Managing Towards Daily Compliance Methodology as a Pilot to Improve Hand Hygiene on an Oncology Nursing Unit

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Background: Hand hygiene compliance among healthcare workers has been reported to be only 40% yet hand hygiene is one of the simplest and most effective infection prevention strategies. Our institution launched an enterprise wide initiative to improve hand hygiene involving an awareness campaign with messaging from the CEO, healthcare worker (HCW) education/training and placement of alcohol based hand rubs outside and inside of each patient room. We also introduced the Managing Towards Daily Compliance (MDC) methodology to improve hand hygiene compliance. MDC is a quick cycle method of observing practices and responding to successes and non-compliance. The objective is daily management of all groups of workers towards complying with standard operating procedures. Daily management is accomplished by a multidisciplinary team on the selected unit.

Objective: To pilot the use of MDC methodology to increase and sustain hand hygiene compliance to >85% on an inpatient Oncology unit.

Methods: The team leader was the Nurse Manager who identified team members from other HCW disciplines that routinely interact with patients on the unit. Team members included: nursing, medical staff, radiology, dietary, environmental services, patient transportation, phlebotomy and respiratory therapy. Each team member observed at least 5 episodes of hand hygiene daily and huddled the following day to share their results. Any HCW present on that unit was randomly observed and results included in the nursing unit's compliance rate. Results were recorded on a board during the daily huddles. Names of the observed individuals

were included if available. Action items were assigned to team members. Team members were also responsible for providing feedback to their area. Initial time spent on daily huddles was 15-20 minutes because many of the action items involved clarification of hand hygiene procedures and standardization of collection methodology. As the pilot progressed, daily huddles lasted only 5 minutes. Once the compliance goal was reached and sustained for at least a week, huddles decreased in frequency. Any time that compliance fell below 85%, daily huddles were resumed.

Results: The MDC pilot was initiated in June, 2007. Baseline compliance was 24%. During the first week of the pilot, 252 observations were collected, average compliance 50%. Compliance improved to 94% within 5 weeks of implementation ($p < 0.001$). An average of 180 observations were collected by the team per week. Ongoing compliance has remained $> 85\%$. 4 additional units have utilized the technique with similar success.

Conclusions: MDC may be an effective strategy to improve and maintain hand hygiene compliance within a hospital. Daily huddles allow for rapid-cycle improvements. Results may not be easily generalizable because the pilot unit was a specialty based and closed unit with strong nursing leadership and strong team champions.

93. Prospective Assessment of Hand Hygiene Practices at a Tertiary Care Pediatric Hospital

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Background: Hand-hygiene (HH) is one of the most effective measures to prevent the transmission of nosocomial pathogens, yet health care worker (HCW) adherence to hand hygiene policy often falls below desirable levels. Monitoring adherence is recommended to guide improvement activities. Here we report the results of observational monitoring at our tertiary care pediatric centre over a 12 month period from January to December, 2006.

Objective: To document adherence to hospital HH policy, and identify opportunities for improvement.

Methods: A single unobtrusive observer recorded 5016 opportunities for HH and classified observations as "adherent" if the HCW followed institutional policy, or "non-adherent." Data on the professional category (nurse, physician, other), the location within the hospital where the episode took place, and on the indication for the HH (e.g., before and after patient care; see Table) were also recorded. Analysis included descriptive statistics as well as a multiple variable logistic regression model.

Results: The overall adherence rate was 61% (95% CI, 60 to 62%). HCWs differed significantly in their adherence with HH policy: 63% of nurses versus 44% of physicians ($p < 0.0001$) and 58% of other HCWs (e.g., physiotherapists, occupational therapists; $p = 0.0046$). Significant differences also existed between different locations within the hospital: adherence in the Neonatal Intensive Care Unit was the highest (69%, $p = 0.0010$ relative to reference category - inpatient wards), while the Emergency Triage (48%, $p < 0.0001$) and Pediatric Intensive Care Units had the

poorest adherence rates (56%, $p=0.035$). Significant differences were also observed depending on the indication for HH: higher rates were observed after personal body functions (75%, $p<0.0001$ relative to reference category - before and after patient contact); the lowest rates after removing gloves (54%, $p<0.0001$) and after contact with body fluids (44%, $p=0.038$).

Conclusions: Opportunities for improvement in HH practices remain, particularly among physicians, in emergency and intensive care units, and after glove removal as well as contact with patients' and HCWs' own body substances. These findings justify continued emphasis on HH promotion programs and further studies into the factors that influence HH adherence rates in a pediatric setting, in order to develop contextually specific improvement strategies.

Table: Summary of disaggregated adherence rates, and results of multivariable logistic regression model.

	<i>n</i> (total <i>n</i> =5016) ¹	Adherence (%) ²	Adjusted OR (95% CI) ³	<i>p</i>
Practitioner				
Nurse	4113	63	1.0 ⁴	
Physician	441	44	0.43 (0.35 to 0.53)	<0.0001
Other	462	58	0.75 (0.61 to 0.91)	0.0046
Location				
Inpatient wards	2594	62	1.0 ⁴	
Pediatric Intensive Care Unit	449	56	0.8 (0.65 to 0.98)	0.035
Cardiac Care Unit	465	59	0.89 (0.73 to 1.1)	0.28
Neonatal Intensive Care Unit	467	69	1.44 (1.16 to 1.78)	0.0010
Dialysis Unit	425	58	0.85 (0.69 to 1.05)	0.14
Daycare Unit	456	61	0.92 (0.74 to 1.13)	0.41
Emergency Department Triage Desk	160	48	0.49 (0.36 to 0.68)	<0.0001
Indication				
Before and after contact with a patient	3803	61	1.0 ⁴	
After taking off gloves	853	54	0.67 (0.57 to 0.78)	<0.0001
After personal body function, such as blowing one's nose	282	75	1.78 (1.35 to 2.36)	<0.0001
After contact with secretions, excretions, blood and body fluids.	32	44	0.47 (0.23 to 0.96)	0.038

After contact with items in the patient's environment	19	68	1.2 (0.45 to 3.16)	0.72
Before performing invasive procedures	15	80	2.33 (0.64 to 8.42)	0.20

1 number of observations (opportunities for hand hygiene)

2 Percentage of opportunities where hand hygiene was judged "adherent" with institutional policy.

3 Based on multiple variable logistic regression analysis

4 Reference category

94. Control of MRSA and VRE: Long-term Success of an Alcohol-based Hand-hygiene Program

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Background: In 2005, we reported (ICHE 26:650-653) the benefit of introducing an alcohol-based hand rub (ABHR) in reducing rates of methicillin-resistant *S. aureus* (MRSA) and vancomycin-resistant enterococci (VRE) across a medical center. That study evaluated data from 3 years before and 3 years after the introduction of ABHR. Some questioned, however, the durability of long-term success with such a program. Objective: To examine 7 years of data now available on rates of MRSA and VRE following institution-wide utilization of ABHR and to compare this with the 3-year data prior to the ABHR program.

Methods: The Washington DC Veterans Affairs Medical Center is a tertiary-care teaching facility with 167 acute and 120 long-term care beds. Rates of healthcare-acquired (HA) infections of MRSA and VRE from 1998 to 2000--before an ABHR program was introduced--were compared with rates of these infections from 2001 to 2007, the 7-year period after the introduction of this program. Each case was categorized as either HA or community acquired (CA). Isolates of MRSA or VRE were categorized as HA if the patient was culture-positive >48 hours after admission without infection at time of admission, or if the patient had received inpatient or outpatient care in the facility within 30 days of onset of positive culture. Isolates that did not fall under this definition were categorized as CA. All patients with MRSA and VRE were placed in contact isolation per CDC guidelines, and there were no substantial changes in infection control practices throughout this period.

Results:

	1998-2000	2001-2007	P-value
Healthcare-acquired MRSA	0.83/1,000 BDC	0.53/1,000 BDC	< 0.001
Healthcare-acquired VRE	0.43/1,000 BDC	0.24/1,000 BDC	< 0.001

Clinically meaningful and statistically significant reductions in both MRSA and VRE occurred and have persisted over time. When analyzed separately, the reductions in HA-MRSA and HA-VRE occurred in both the acute-care and long-term-care areas. During the 10 year period of this study, CA-MRSA increased more than 4-fold and accounted for >70% of all new cases of MRSA in recent years.

Conclusions: The rates of healthcare-acquired MRSA and VRE declined following the initiation of an alcohol-based hand hygiene program. This decrease was sustained

even in the setting of a marked increase in community-acquired MRSA. The long-term success of the ABHR program is evidence that drug-resistant bacteria can be controlled in inpatient healthcare settings using current CDC guidelines without the use of active surveillance.

95. Ineffectiveness of Alcohol Hand Gels at Removal of *Clostridium difficile* Spores from Hands of Volunteers

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Background: *Clostridium difficile* (CD) presents an increasing risk due to the spore-forming bacteria's resilience in the dormant state and ease of transmission through physical contact. Routine hand washing with soap and water is the recommended protocol for effective decontamination, though healthcare workers often forgo such measures in favor of more convenient alcohol-based hand gels. However, there are limited data on the sporicidal activity of these new preparations and their impact on CD transmission is unknown.

Objective: To determine the retention of *Clostridium difficile* (CD) spores on the hands of volunteers following use of a plain water control hand rub, alcohol-based hand gel rubs, and chlorhexidine gluconate hand wash.

Methods: Non-toxigenic CD spores (previously tested for equivalence to toxigenic spores) were inoculated onto bare hands of ten volunteers and spread over the palms. Alcohol hand gel rubs using 3 different products were compared to hand washing with chlorhexidine gluconate for removal of CD spores. A plain water rub using an alcohol-equivalent volume provided the baseline upon which absolute spore reductions were determined. Palmar cultures were taken before and after hand decontamination using a plate stamping method on taurocholate-cefoxitin-cycloserine-fructose agar (TCCFA). Paired student's t-test was used to compare the Log₁₀ CFU/cm² reduction in spore counts.

Results: Hand counts following inoculation were estimated to be >3.2 Log₁₀ CFU/cm² on the basis of inoculum size and measured hand surface areas. The plain water rub resulted in a mean reduction of $1.57 \pm .11$ SD Log₁₀ CFU/cm², and was set as the zero point for all other tested products. There was a greater reduction of spores (Log₁₀ CFU/cm²) after wash with chlorhexidine gluconate (mean 0.89 ± 0.34 SD) compared with using any of the alcohol hand gel products (Isagel 0.11 ± 0.20 [$p < 0.0001$], Endure 0.37 ± 0.42 [$p = 0.009$], Purell 0.14 ± 0.33 , [$p = 0.0002$]). There was no significant reduction difference among the alcohol gels when compared to each other, and only Endure was statistically different from water control rub in spore reduction ($p = .014$).

Conclusions: Hand wash with chlorhexidine is significantly more effective at spore removal from the hands of volunteers than hand rubs with alcohol-based gels, reducing counts by nearly 1 log. Hand gel rubs, with spore reductions ranging from 0.11 to 0.37 logs, display only marginal activity and should not be relied upon for spore decontamination. The clinical significance of these findings with regard to actual hand transfers to patients in practice is not known. However, they do suggest

that a prudent approach to hand hygiene include regular hand washing when working in an environment with CD.

96. Outbreak of Multi-Drug Resistant *Acinetobacter baumannii* in Critically Ill Patients, and Hand Disinfection in an Intensive Care Unit: There is much more to be done

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Background: Hand disinfection is the most cost effective measure to prevent hospital-associated infections. *Acinetobacter* spp infections and outbreaks are difficult to control because of the persistence environment of the bacteria for long periods of time. As part of outbreak control measures we observed hand hygiene practices in an intensive care unit (ICU) in the south of Brazil.

Objective: Describe the rates of hand disinfection after an outbreak of *Acinetobacter baumannii* in an ICU.

Methods: We investigate an outbreak of multi-drug resistant (MDR) *Acinetobacter baumannii* infections in a ten-bed surgical ICU. As part of outbreak control measures hand hygiene educational program was initiated in September 13th and observations of hand disinfection were made before and after this date. This indicator was generated dividing the number of times of hand hygiene by the number of opportunities to hand disinfection.

Results: The outbreak consisted of five cases of MDR *Acinetobacter baumannii* infections in the ICU. The bacteria were resistant to all antibiotics except polymyxin. Four patients had respiratory infection, and one central venous catheter infection. All cases appeared in period of 72 days. Two patients have died. On September 13th, as part of the outbreak control measures, all the patients were transferred from the ICU to the post-surgical ward and the unit was fully disinfected (floor, walls, ceiling, beds, etc). All the material involved in patient care was cleaned with 70% alcohol. In a 24-hour period the patients have returned to the ICU. The cases were put on contact precautions until discharge. After more than 90 days after these measures and hand disinfection educational program, no further patient was identified with MDR *Acinetobacter baumannii*. Before September 13th the general rate of hand hygiene in the ICU was 16.9%; during the educational period the frequency of hand disinfection raised to 72.4% ($P<0.001$; RR 4.29; IC 3.45-5.33). For medical staff hand hygiene rates rose from 21.8% to 78.9% ($P<0.001$); for the nurses the rate was 22.6% before the educational program and raised to 76.2% ($P<0.001$); for the physiotherapists the rate was 37.5% and raised to 88.2% ($P=0.007$). In the last month of observation (december/2007) the rate of hand hygiene in the ICU decreased to 40.9% ($P<0.001$; RR 1.57; IC 1.32-1.87).

Conclusions: This work emphasizes the role of the environment in a cluster of MDR *Acinetobacter baumannii* infection in the ICU, where careful environment disinfection eliminated the MDR *Acinetobacter baumannii* infection. Also it illustrates the usual problems of educational programs with an initial excellent result and a subsequent

decrease in hand disinfection rates. New strategies must be undertaken to reinforce the need of a good compliance with hygiene of the hands.

97. Willingness of Patients to Participate in a Patient Empowerment Initiative to Improve Hand Hygiene Practices in a Veterans Affairs Medical Center

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Background: "Patient-empowerment" initiatives, which encourage patients to ask caregivers if they have washed their hands, have been associated with increased compliance with hand-hygiene recommendations among healthcare workers. However, relatively little is known about the willingness of patients to participate in such initiatives.

Objective: To examine the willingness of patients in a Veterans Affairs hospital to ask healthcare workers if they washed their hands, and to test the hypothesis that providing positive feedback by thanking healthcare workers for washing would be more accepted.

Methods: Patients were presented with education regarding the importance of hand hygiene and with a "Partners in Your Care" script asking them to remind healthcare workers to wash their hands. Follow-up interviews were conducted to assess compliance with the initiative. Compliance was re-assessed using a modified script in which patients were asked to thank healthcare workers for washing their hands and/or to display a sign stating "Thanks for Washing."

Results: Of 193 patients presented with the Partners in Your Care script and given follow-up interviews, only 5 (3%) stated that they had reminded at least one healthcare worker to wash, whereas 15 (8%) stated that had not commented on hand hygiene despite observing healthcare workers who did not wash in their presence. Ninety percent of patients (173) reported that they had not commented on hand hygiene because they had observed all caregivers washing their hands; however, observations demonstrated that physician hand hygiene was performed within the patient's view only 28% of the time. Of 38 patients presented with the modified script, 17 (45%) reported that they had mentioned hand hygiene to their healthcare workers, 13 of whom stated that they thanked their caregivers. During physician work rounds, no patients were observed to comment on hand hygiene, but a majority displayed a sign thanking caregivers for washing.

Conclusions: In a Veterans Affairs hospital, patients were unlikely to remind healthcare workers to wash their hands. Empowerment initiatives may be more effective if patients are encouraged to provide positive reinforcement to healthcare workers and to display prompting visual reminders.

98. Hand-hygiene: Knowledge, Attitudes & Behavior of Internal Medicine Residents

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Background: As part of their training, internal medicine residents care for a large proportion of chronically ill patients either infected or colonized with multi-resistant bacteria.

Objective: The purpose of this study is to evaluate the knowledge, attitudes and behavior of internal medicine residents towards hand washing and to determine factors which may contribute to noncompliance to good hand-hygiene practices.

Methods: An anonymous electronic survey was sent to 52 of 53 internal medicine residents of one residency program at a public Midwestern university. The survey was composed of five domains including basic demographics, knowledge of the value of hand-hygiene, self assessment of personal adequacy with hand-hygiene, potential barriers and facilitators to compliance, and 10 case studies. The second and third year residents were combined into one group, referred to as the older residents. The responses of first year residents as compared to the older residents were analyzed using Pearson's chi square test of association or Fisher's Exact Test in those instances where appropriate. This study was approved by the University's Institutional Review Board.

Results: Of the residents eligible to participate, twenty-one (40%) responded to the survey. The residents were knowledgeable of the value of hand-hygiene but not knowledgeable regarding the appropriate use of alcohol-based hand gels. The residents reported adherence to good hand-hygiene practices except in emergency situations and when under time constraints. Barriers to good hand-hygiene included forgetfulness (older residents, $p < 0.02$), lack of time (first year residents, $p < 0.02$), and lack of motivation (older residents, $p < 0.009$). The three top facilitators for adherence to hand hygiene were more time (first year residents, $p < 0.03$), more soap (50% overall), and knowledge that someone is watching (23% overall). The three most commonly cited interventions that could further promote hand hygiene were role modeling by attending faculty (77% overall), training sessions for all residents (68% overall), and more soap.

Conclusions: The residents were knowledgeable regarding good hand-hygiene practices, with the exception of the use of alcohol-based hand gels. The first year residents were motivated, but reported that a lack of time interfered with their ability to adhere to proper hand-hygiene practices. In contrast, the older residents cited lack of motivation and forgetfulness as significant barriers. Role modeling was cited by all residents as the most important intervention for promoting good hand washing practice. Future studies are needed to explore effective interventions that will result in improved hand hygiene practices amongst internal medicine trainees.

99. Dermal Tolerance and Effect on Skin Hydration of an Improved Ethanol-based Hand Gel

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Background: Alcohol-based hand gels have become a standard in hand hygiene in the US but most of them are significantly less effective than liquid alcohol-based hand disinfectants or even antimicrobial soaps.

Objective: An improved ethanol-based gel (85%, w/w) with an efficacy equal to liquid products was investigated for dermal tolerance and skin hydrating properties which are essential to achieve a high compliance rate with hand hygiene.

Methods: For the repetitive occlusive patch test 220 subjects were studied, 207 finished the study. Sterillium Comfort Gel was applied to one site on the back under an occlusive patch during an induction phase (9 applications over 3 weeks) and 2 weeks later to a virgin site on the back during a challenge phase (1 application). Sites were graded for skin reactions using a standardized scale 24 h after removal of the patches (induction phase and challenge phase) as well as 48 and 72 h later (challenge phase). To evaluate skin hydrating properties of the gel, treated skin of 23 subjects was compared to untreated skin. The gel was applied twice a day to the forearm for 14 days. Control coreometer values were taken before application of the gel and after 1 and 2 weeks.

Results: In the induction phase none of the 207 subjects had a skin reaction. In the challenge phase one subject had a barely perceptible skin reaction at one time point. Relative skin hydration on treated skin in comparison to the untreated control fields was significantly higher after one week by 7.7% ($p = 0.0007$; paired t-test for dependent samples) and after two weeks by 14.1% ($p < 0.0001$).

Conclusions: The gel did not demonstrate a clinically relevant potential for dermal irritation or sensitization and significantly increased skin hydration after repetitive use and so could enhance compliance with hand hygiene among health care workers.

100. Comprehensive Bactericidal Activity of an Ethanol-based Hand Gel In 15 Seconds

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Background: Some studies indicate that the commonly recommended 30 s application time for the post contamination treatment of hands may not be necessary as the same effect may be achieved with some formulations in a shorter application time such as 15 s.

Objective: We evaluated the bactericidal activity of an ethanol-based hand gel (Sterillium® Comfort Gel) within 15 s in a time-kill-test.

Methods: Eleven Gram-positive (*Enterococcus faecalis*, *Enterococcus faecium*, *Listeria monocytogenes*, *Micrococcus luteus*, *Staphylococcus aureus* including MRSA, *Staphylococcus epidermidis*, *Staphylococcus haemolyticus*, *Staphylococcus hominis*, *Staphylococcus saprophyticus*, *Streptococcus pneumoniae*, *Streptococcus pyogenes*), sixteen Gram-negative bacteria (*Acinetobacter baumannii*, *Acinetobacter lwoffii*, *Bacteroides fragilis*, *Burkholderia cepacia*, *Enterobacter aerogenes*, *Enterobacter cloacae*, *Escherichia coli*, *Haemophilus influenzae*, *Klebsiella pneumoniae*, *Klebsiella oxytoca*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Salmonella enteritidis*, *Salmonella typhimurium*, *Serratia marcescens*, *Shigella sonnei*) and eleven emerging

and mainly multiresistant bacterial pathogens were tested according to the test method as described in the tentative final monograph for healthcare antiseptic products. Each strain was evaluated in quadruplicate.

Results: The hand gel (85% ethanol, w/w) was found to reduce all 11 Gram-positive and all 16 Gram-negative bacteria by more than 5 log₁₀ within 15 s, not only against the ATCC test strains but also against corresponding clinical isolates. In addition RF > 5 were observed against all tested emerging bacterial pathogens.

Conclusions: The ethanol-based hand gel was found to have a broad spectrum of bactericidal activity in only 15 s which includes the most common species causing nosocomial infections and the relevant emerging pathogens. Future research will hopefully help to find out if a shorter application time for the post contamination treatment of hands provides more benefits or more risks.

101. Surgical Hand Antisepsis with an Alcoholic Hand Rub: Equal Effectiveness of 1.5 versus 3 Minutes of Application

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Background: Alcohol-based hand rubs offer several advantages for surgical hand antisepsis in comparison with antimicrobial soaps, and are considered as standard of care by the World Health Organization (WHO). The European standard EN 12791 requires 3 minutes application time, but some products meet the defined antimicrobial effectiveness in in-vivo experimental studies after an application of only 1.5 minutes.

Objective: To validate the short duration of surgical hand antisepsis in a clinical setting by comparing the effectiveness of 1.5 versus 3 minutes with a commercially available agent.

Design: Prospective randomized trial in a crossover design following the guidelines outlined in EN 12791. The three hours sample after application, required to assess the residual activity under the gloved hand, was adapted to "after surgery".

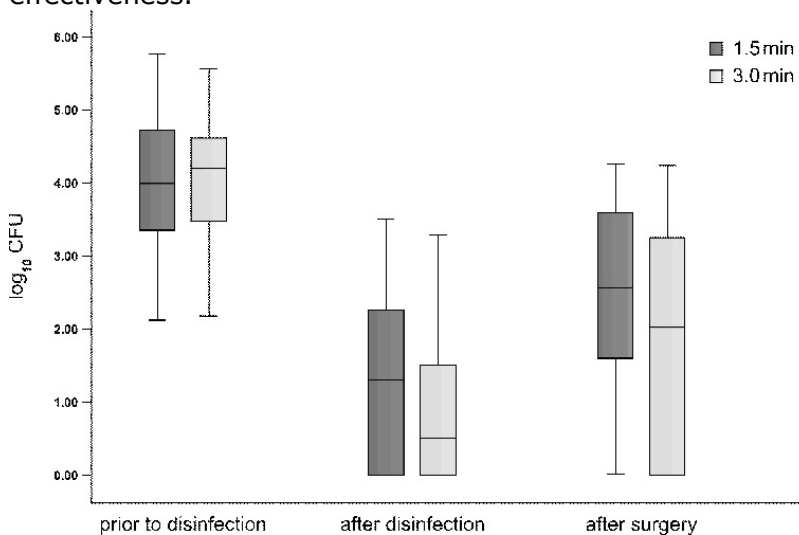
Settings: Basel University Hospital in Switzerland, with an average of 28'000 surgical interventions a year.

Participants: 32 surgeons with different levels of post-doc training and from different surgical specialties.

Main Outcome Measures: Antibacterial effectiveness of 1.5 versus 3 minutes of surgical hand antisepsis with an alcoholic hand rub (Sterillium® classic pure) by determining the log₁₀ colony-forming units before and after the alcoholic hand-rub (immediate effect) and after the procedure (sustained effect) to follow EN 12791 as close as possible.

Results: The mean reduction factor was 2.66 ± 1.13 and 3.01 ± 1.06 for the 1.5 minutes and 3 minutes group, respectively ($p=0.204$) for the immediate effect. Similarly, there was no statistically significant difference in the sustained effect between the two groups with a mean increase of 1.08 ± 1.13 and 0.95 ± 1.27 , respectively ($p=0.708$).

Conclusions: The reduced application time of 1.5 minutes with the alcoholic hand rub achieves a similar reduction factor as achieved with 3 minutes. Given the frequency of the procedure, these results allow a considerable time saving while maintaining effectiveness.



102. Development of a Reliable and Sensitive Observational Measure of Healthcare Worker Hand-Hygiene Behavior with Clear Standard Operating Procedures: The Hand-hygiene Observation Tool (HHOT)

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Background: Previously published observational measures of healthcare worker (HCW) hand-hygiene behavior (HHB) fail to provide adequate standard operating procedures (SOPs), accounts of inter-rater reliability testing or evidence of sensitivity to change.

Objective: This study reports the development of an observational tool, in a way that addresses these deficiencies.

Methods: Observational categories were developed systematically, using clinical guidelines, assessments published previously and discussion of pilot observations. The resulting HHOT is a simplified version of the Geneva tool. It records type of hand-hygiene opportunity (HHO), type of HHB, and type of HCW. Inter-observer agreement for each category was assessed by simultaneous observation of 298

individual HHOs and HHBs, by two independent observers on a Care-of-the-Elderly- and Intensive Care Unit. This used a procedure, not previously reported, that paired observed events to test inter-observer reliability accurately.

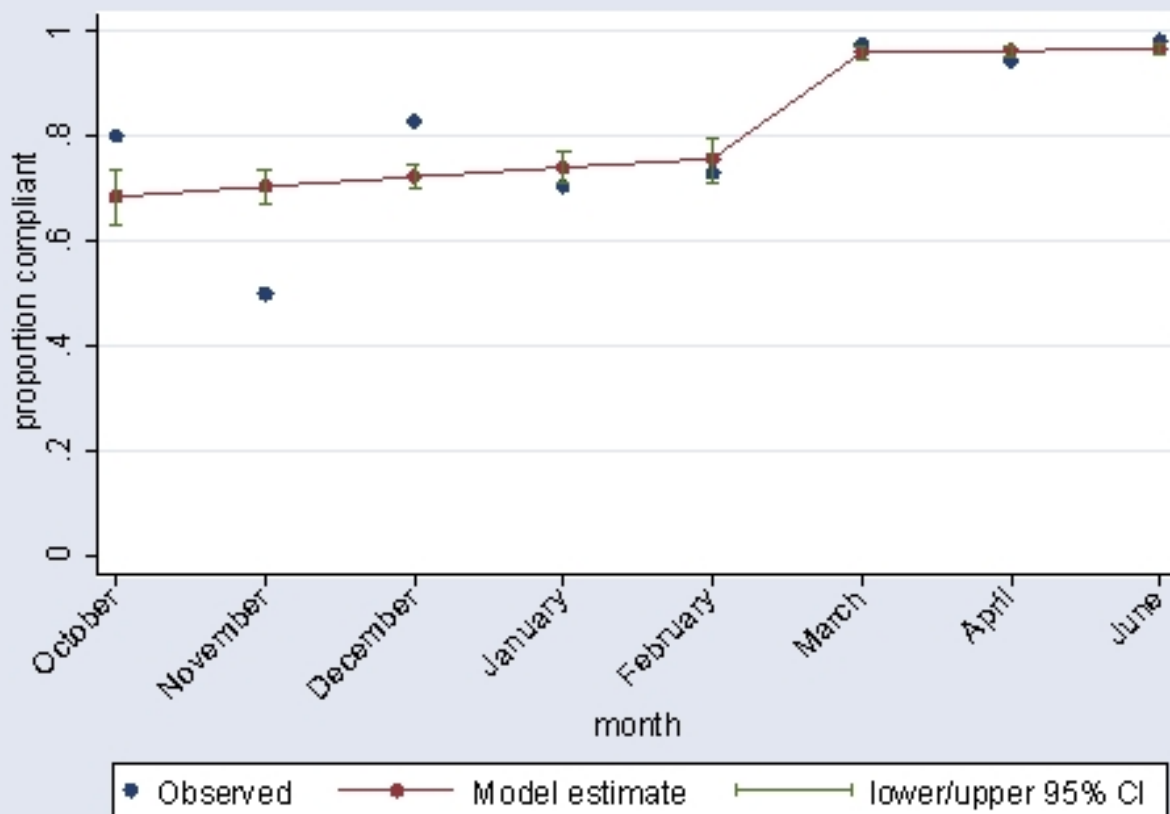
Inter-observer agreement for overall compliance of a group of HCWs was assessed by simultaneous observation of 1191 HHOs and subsequent HHB, by independent observers. Sensitivity to change was examined by autoregressive time series modelling of longitudinal observations for 8 months on ITU during an outbreak and subsequent strengthening of infection control measures.

Results: Raw inter-observer agreement for each category (%) and kappa coefficients were 77% and 0.68 (HHB); 83% and 0.77 (HHO); and 90% and 0.77 (HCW.)

Inter-observer agreement for overall compliance was very good (intraclass correlation coefficient 0.79).

Sensitivity to change was demonstrated by a rise in compliance on ITU from 80 to 98%. Odds ratio of increased compliance = 7.00 (95% CI 4.02,12.2) $p < 0.001$ (Figure).

Conclusions: The HHOT is a robustly standardised, reliable, and sensitive observational tool, with clear SOPs, available on the British Clean Your Hands campaign web site (www.npsa.nhs.uk/cleanyourhands/resources) that will facilitate its general use by others for audit, research, and behavioral interventions.



103. Compliance To Hand Hygiene Measures Of Healthcare Workers: The Observation Method Has A Marked Influence On The Results

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Background: Measurement of the compliance of healthcare workers (HCW) to hand hygiene (HH) measures is a recommended performance indicator of the quality of care.

Objective: To compare two observation methods of compliance of HCW to HH measures in order to quantify a possible Hawthorne effect when HCW know they are being observed.

Method: From March 15 to 28, 2007, four medical students divided in two teams performed direct observations on 29 wards of the two sites of the Centre Hospitalier Universitaire de Sherbrooke (CHUS). The number of HH opportunities was evaluated according to hospital ward, type of personnel, isolation precautions and type of care procedures, using a standardized form. Team 1 (Corridor) evaluated the compliance at any moment of the HCW intervention and informed the HCW that they evaluated the quality of care (and not HH specifically) only if asked by the HCW. Team 2 (Room) first asked permission to the HCW to observe the quality of care, and collected data on the compliance to HH measures for the whole duration of the HCW's intervention. Each HCW was evaluated only once by the same observer for each 30 to 45 minutes observation period. We aimed to obtain 30 to 60 HH opportunities for each ward of the two sites of the CHUS.

Results: A total of 1416 (491 at the Hôtel-Dieu and 925 at Fleurimont Hospital) HH opportunities were observed over 150 hours. Team 1 (Corridor) observed 89 opportunities in patients under isolation precautions and 835 opportunities in non isolated patients, compared to 53 and 439 opportunities for Team 2 (Room), respectively. Overall, the compliance rate measured with the Room method was 15% higher than with the Corridor method (53% vs 38%, $p < 0.0001$); the respective rates were 71.7% vs 60.7% for patients under isolation precautions ($p = 0.18$), and 50.8% vs 35.8% in non isolated patients ($p < 0.0001$). The HH compliance rates after contact with a patient or his environment were 56% with the Room method vs 39% with the Corridor method ($p < 0.0001$); this HH indication represented 71% of the total opportunities observed by the Corridor Team vs 60% for the Room Team ($p < 0.0001$).

Conclusions: Standardizing the data collection method is essential to allow valid and comparable results between hospital wards and healthcare centers. The Corridor method appears to be more efficacious and to give more accurate results than the Room method; however, it may hamper the evaluation of care procedures for which bed-side curtains are closed. Therefore, if the Room method is chosen, a 15% difference should be accounted for.

104. A Survey of Point of Care Access to Hand Hygiene in the Champlain Infection Control Network (CICN)

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Background: Hand hygiene programs are most effective when access to hand hygiene products is provided at the point of care (POC). Plans for provincial and national hand hygiene campaigns are underway but it is not clear whether the infrastructure is in place to support effective hand hygiene in most healthcare settings in Canada. The Champlain Infection Control Network (CICN) is one of 14 Infection Control Networks across the province of Ontario with a mandate to coordinate infection prevention and control activities. It services a population of 1.2 million and is affiliated with 59 long-term care facilities (LTCF) and 18 acute-care facilities (ACF) in Eastern Ontario. We conducted a survey of alcohol based hand product (ABHP) in healthcare facilities within the CICN to understand the current infrastructure for hand hygiene.

Objective: To describe the extent to which facilities in the CICN provide point of care access to ABHP.

Methods: A survey was conducted during the week of Oct. 15-19, 2007. LTCF and ACF within the CICN were invited to perform an audit of ABHP dispensers in their facilities. Sites were asked to fill out a one-page questionnaire which included questions about the intensive care unit (ICU), and one other ward within their facility with a minimum of 10 beds. Questions were related to the number of rooms, types of rooms, number of beds and the number and location of ABHP dispensers. The ratio of number of total ABHP dispensers on the ward to the number of beds on the ward was calculated and expressed as a count per 100 beds. The proportion of ABHP dispensers that were at the POC, in hallways and other areas was also calculated. POC was defined as the concurrent presence of the patient, healthcare worker and care involving contact.

Results: A total of 14 of 59 (24%) LTCF and 9 of 18 (50%) ACF participated in the survey and provided complete data. ICUs were present in 7 of the ACF and 6 (86%) provided complete data. All facilities reported that there was access to ABHP at the entrance to the facility. In LTCF 13.1% of ABHP dispensers were at the POC compared to 30.8% in ACF and 48.3% in ICUs. (See Table 1) Only 1 LTCF reported no ABHP dispensers on the ward studied. Personal ABHP dispensers were supplied to staff in 6 LTCF (33%) and 1 ACF (8%).

Table 1 - Distribution of ABHP dispensers (ABHPd) among different ward types

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Ward type	Long-term care (n=14)	Acute care (n=9)	ICU (n=6)
Ratio of ABHPd/100 beds	23.9	93	134.8
Range, Median	0-63, 16.4	42-103, 90.3	50-160, 138.5
Total # of ABHPd	107	276	89
POC (%)	14 (13.1)	85 (30.8)	43 (48.3)
Hallways (%)	38 (35.5)	151 (54.7)	33 (37.1)
Other areas (%)	55 (51.4)	40 (14.5)	33 (14.6)

Conclusions: Although ABHP is available in these settings, dispensers are not provided at the POC. Long-term care wards had the lowest ABHP dispenser to bed ratio. Hospitals and LTCF need to increase the number of ABHP dispensers available, with a particular emphasis on placing them at the POC to assist their staff in meeting the expectations for hand hygiene as outlined in national and provincial hand hygiene guidelines.

105. How Effective Are Hand Antiseptics for the Post-Contamination Treatment of Hands When Used as Recommended?

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Background: Alcohol-based hand antiseptics are often tested using 3 or 5 mL per application, but smaller volumes are likely to be applied in clinical practice.

Objective: For that reason, the efficacy of two different volumes of 4 marketed handrubs was investigated when applied to contaminated hands.

Methods: Hands of 16 volunteers were contaminated with *Serratia marcescens*. Handrub A (85% ethanol), handrub B (60% ethanol), handrub C (62% ethanol), and handrub D (61% ethanol) were applied as blinded formulations, each in single applications of 2.4 or 3.6 mL. Hibiclens (4% chlorhexidine gluconate) served as a reference treatment. Each hand rub was rubbed into hands until dry. Pre and post-values for bacterial population were obtained by the glove juice method. Neutralization of residual activity was validated.

Results: A 2.4 mL aliquot of a handrub product was sufficient to cover both hands of 96.9% of the subjects. Applied in that volume, handrubs produce a log₁₀-reduction in bacterial populations of 2.79 (handrub A), 2.26 (handrub C), 1.96 (handrub D) and 1.90 (handrub B). Applications of 3.6 mL volumes were significantly more effective for handrubs B, C, and D. The reference treatment reduced test bacteria by 2.39 log₁₀. An analysis of variance revealed that both the type of handrub and the applied volume have a highly significant influence on the mean log₁₀ reduction on artificially contaminated hands ($p < 0.001$).

Conclusions: Handrubs applied in amounts sufficient to cover both hands may not reduce the bacterial density by even 2 log₁₀-steps. Based on our findings, the general trend toward alcohol-based handrubs should not overlook evidence of significant differences in efficacy that appear to be related primarily to a product's overall concentration of alcohol.

106. A Comparative Study Exploring the Attitudes of Doctors and Nurses towards Hand-Hygiene and Alcohol-Based Hand-Rubs

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Background: Hand-hygiene substantially reduces the risk of cross-infection within healthcare. Attitudes, behaviors, poor compliance and barriers exist towards hand-

hygiene. Proper, consistent use of alcohol-based hand-rubs (ABHRs) can minimise risk from such problems. They are quick, effective and user-friendly. There is a paucity of Irish hand-hygiene research in healthcare, particularly exploration of perceived behaviors and attitudes towards hand-hygiene and ABHRs. Study results presented here provide a unique opportunity to research attitudes towards hand-hygiene and ABHRs in the Irish healthcare setting.

Objective: This comparative study aimed to explore and compare self-reported compliance, behaviors, attitudes and barriers to hand-hygiene and ABHRs among doctors and nurses in Ireland.

Methods: A quantitative positivist methodology, utilizing a cross-sectional design was used. Data collection consisted of a validated attitudinal survey comprising of a five-point Likert-scale. The study was conducted in a 426-bed Irish acute, tertiary, teaching hospital from March to May 2007. A stratified random sample (N=423) of doctors and nurses achieved a representative population. Data were analyzed descriptively and cross-tabulated. Chi-square (Pearson's) and Mann-Whitney-U statistical tests, using SPSS version 14.0. were conducted.

Results: The response rate was 59%, (N=242). The majority of respondents were nurses, 70.7% (n=171), whereas 26.9% (n=65) were doctors, however 2.5% (n=6) did not reveal their profession. Several statistically significant differences, ($p < .05$) between doctors and nurses self-reported compliance, perceived behaviors and attitudes and barriers to hand-hygiene and ABHRs were identified.

Table 1 illustrates the main findings from this study.

	Sample (%)	Nurses (%)	Doctors (%)	p-value
Compliance				
Familiar with hospital HH policy	92	98	77	<0.001
Familiar with Irish HH policy	49	60	19	<0.001
Unaware of WHO Global Patient Safety Challenge	76	68.4	95.2	<0.001
Pre-patient contact HH	81	90	58	<0.001
Post-patient contact HH	86	90	77	0.004
ABHR used >90% of time	47	55	25	0.001
ABHR used 51-90% of time	39	34	52	0.001
ABHR <10% of the time	3.5	1	11	0.001
Perceived Attitudes And Behaviours				
Adherence to HH is inconvenient	15	11	27	0.005
HH improved patient outcomes	91	96	77	<0.001
Nosocomial infection rates will decrease if hand hygiene recommendations are followed	90	95	76	<0.001
Important to act as a role model when using ABHRs	93	97	81	<0.001
Barriers				
Hands will be drier and damaged if ABHRs are used	46	44	51	.106 n/s
ABHR were unpleasant to use	32	26	46	.003
Disagreed that ABHR improve skin condition	67	67	66	.516 n/s

ABHRs = Alcohol Based Hand Rubs

HH = Hand-Hygiene

Conclusions: Notable attitudes and barriers towards hand-hygiene and ABHRs were demonstrated. Significant differences between the professions were evident within

the Irish healthcare setting. Despite provision of ongoing hand-hygiene educational programmes and the availability of local and National Guidelines on the hospital-intranet, awareness and knowledge of these guidelines is sub-optimal, particularly among doctors. Findings suggest that the level of acceptance of ABHRs among healthcare-professionals may be a formidable obstacle towards the implementation of hand-hygiene recommendations. This is one small sample and several limitations existed in the methodology, as the sample surveyed is limited to doctors and nurses. A follow on national study is necessary to determine if the attitudes identified in this study were specifically related to the ABHR used within the researcher's hospital.

107. A Controlled Trial of Measurement and Feedback of Hand Hygiene in Step-down Intensive Care Units

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Background: Hand hygiene is the cornerstone measure for nosocomial infection prevention in intensive care units (ICUs). However it is a challenge to monitor the frequency of hand hygiene events at closed rooms.

Objective: To evaluate the compliance of hand hygiene in two adult step down ICUs using electronic handwash counter and applying a feedback strategy.

Methods: We conducted a six-month prospective controlled trial comparing two twenty-bed step down ICUs, according to hand hygiene compliance (east unit (E) - feedback intervention; and west unit (W) - no intervention). Hand hygiene compliance episodes were performed by electronic handwash counters (SIGNOLTM) using periodic observational surveys. Feedback was conducted by the nurse ICU team explaining the goals and target for the process measure twice a week.

Results: Compliance of hand hygiene episodes at E unit vs. W unit was 117,579 vs. 110,718 ($P=0.63$). There were no difference in the number of liters of chlorhexidine and alcohol gel per 1000 patients-day at both units (34.0 vs. 26.7, $p=0.36$ and 72.5 vs. 70.7, $p=0.93$). However, there was a higher consumption of alcohol gel compared to chlorhexidine in both units ($P<0.001$). Nosocomial infection rates per 1,000 device days in E unit vs. W unit were: bloodstream infection 3.5 vs. 0.79 ($P=0.18$); urinary tract infection 15.8 vs. 15.7 ($P=1.0$); and pneumonia 10.7 vs. 5.1 ($P=0.13$). There were no VRE cases and only one MRSA acquisition in the W unit.

Conclusions: Compliance with alcohol gel preparations was higher than chlorhexidine. Feedback of process measures had no significant improvement in hand hygiene. Measures must be continued in place to both increase and sustain hand hygiene compliance.