Hand Disinfectant Practice: The Impact of an Education Intervention

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Abstract: The primary hypothesis of this study was that a lecture on basic hygiene routines could be associated with an increase in the use of disinfectant for hand hygiene. A secondary hypothesis was that the lecture could positively affect the staff's knowledge of and attitudes toward basic hygiene routines.

A quasi-experimental design including one ward of the department of orthopedics in a Swedish university hospital was adopted.

During the pre-intervention test period the consumption of hand disinfectant was measured for 30 days and a questionnaire was distributed to all staff. The hospital hygiene nurse subsequently provided a lecture on basic hygiene routines to all employees on the ward. During the post-intervention test period the hand disinfectant consumption was measured for another 30 days, and the questionnaire was distributed once again. A follow-up measurement was performed 9 months after the intervention.

After the lecture on hygiene routines, the consumption of hand disinfectant increased by 93%. Nine months after the intervention, the consumption was still 21% higher than before the intervention. The result of the questionnaire showed that the employees considered themselves applying the disinfectant more thoroughly after the intervention. Some employees changed their perspective on basic hygiene routines after the lecture and stopped using watches and private clothes at work.

Our findings suggest that a single education session, a hygiene lecture, could be a simple and cost-effective method to increase the use of hand disinfectant, thereby reducing the number of nosocomial infections on the wards.

Keywords: Hand disinfectant, hygiene routines, education, questionnaire.

INTRODUCTION

The importance of hygiene and cleanliness to limit the spread of infections has been emphasized from the days of Florence Nightingale. Infections acquired during hospital stay might affect up to 10% of patients in the USA [1]. In Scandinavia, there is no official registration of nosocomial infections, but a Swedish prevalence study revealed almost 10% hospital-acquired infections in hospitalized patients during 2003, 2004 and 2006 [2].

The link between hand hygiene and infection rate in hospitals is demonstrated in several studies. Improved hand hygiene (i.e. increased use of soap and water, and hand disinfectant) reduces the infection rate [3, 4]. Pittet *et al*. describe that the prevalence of nosocomial infections among hospitalized patients decreased from 16.9% in 1994 to 9.9% in 1998. During the same time period, use of hand rub solution and compliance with hand-hygiene regimens improved from 48% to 66% among the staff [3].

Compliance with hand-hygiene recommendations is usually estimated to be below 50%, varying between different hospital wards, between professional categories of healthcare workers, and depending on working conditions [5]. In Pittet *et al*.'s studies the hand-washing frequency was higher for nurses and for nursing assistants, than for physicians. The hand washing frequency was lowest in intensive care units and highest on medical wards. During periods with many hand washing opportunities, compliance with hand hygiene recommendations decreased [3, 5, 6]. In a review by Larson and Kretzer [7], compliance rates were reported as 49% among nurses and 26% among other health care workers. Hand washing rates among pediatric and adult units were for nurses 63% and for physicians 36%. A proper technique for hand washing is not always practiced [7, 8].

BASIC HYGIENE ROUTINES

Basic hygiene routines in the hospital where the study was conducted include hand disinfection with hand disinfectant, before and after every patient contact. If hands are or feel dirty, hands are to be washed with soap and water. Rings, bracelets and watches should not be worn in direct work with patients. Gloves should be used when being in contact with urine, feces, blood and other body fluids. Protective clothing should be used in direct patient contact. Sometimes mask or visor is advised. Nails should be kept short and free from nail polish. Long hair should be secured, piercing should be avoided, and no private clothes should be used [9].

EDUCATION

In a review of 14 studies on the effect of continuing medical education for physicians, Davis *et al*. [10] concluded that "interactive continuing medical education sessions that

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enhance participant activity and provide the opportunity to practice skills can effect change in professional practice and, on occasion, health care outcomes". In another review, including 69 studies, O'Brien *et al*. [11] concluded that educational outreach visits alone or combined with other interventions have effects on prescribing (of drugs) that are relatively consistent and small, but potentially important. The educational outreach visit was defined as the use of a trained person from outside the ward meeting the healthcare professionals and providing information with the intent to change their performance. In a Norwegian study, information about hand hygiene combined with increased availability of hand disinfectant significantly increased the use of hand disinfectant [12].

The primary hypothesis of this study was that a lecture on basic hygiene routines could increase the use of disinfectant for hand hygiene. A secondary hypothesis was that the lecture could positively affect the staff's knowledge of and attitudes toward basic hygiene routines.

MATERIALS AND METHODOLOGY

Design and Setting

This study with a quasi-experimental design was conducted on a ward of the orthopedic department at a Swedish university hospital. The orthopedic department was chosen because the hygiene nurse providing the lecture had not previously provided it at that unit. The staff on the ward served as their own control group, with data collection before and after the intervention. Data collection periods were chosen to ensure a minimum of staff change. To avoid epidemic outbreaks, like calici virus or influenza, the test periods were performed out of "influenza season". Diagnoses cared for on the ward were for example trauma patients, fractures of the shoulder, hip and knee, prosthetic replacements, and vertebral compression fractures. The ward had 28 beds and 53 employees (after the intervention 54 employees) with a mean age of 44 years. Of all employees, 85% were women. The employees comprised physicians, nurses, assistant nurses, physiotherapists and occupational therapists.

Intervention

All employees took part in a 40-minute education session, provided by the same hygiene nurse, using the same teaching material, but on three different occasions to cover all staff. It was given on August 22-24, 2007. The lecture, based on basic hygiene routines and the patients' safety, contained information about how to prevent nosocomial infections by following basic hygiene routines. These include not wearing watches and rings, wearing gloves, sometimes mask or visor, and emphasize the importance of washing hands with soap and water and using hand disinfectant.

Data Collection

The pre-intervention period lasted from April 30 until May 30, 2007. The post-intervention periods were from August 29 to September 28, 2007 and from April 30 to May 29, 2008. The pre-intervention test was performed in May because that period occurred before summer vacation, thus there were no extra employees working. The first post-intervention period in September was chosen because it followed closely after the intervention and the ward was just reopened after summer closing. A second data collection period was applied to see how long the effect would last.

Hand Disinfectant

The hand disinfectant used was DAX Handdesinfektion 70 (ethanol, 2-propanol, 2-butanol, Aqua, propylene, Glycol, Glycerine), 70% vol. Alcohol Denat. (Opus Health Care AB, Malmö, Sweden). The disinfectant meets the European standard for hand disinfectant according to EN 1276, prEN 12054, and EN 1500 [13].

When the pre-intervention period started, all hand disinfectant bottles were removed and replaced with new bottles, at 8.30 A.M. During the pre-intervention test, we measured how much disinfectant the ward ordered. The employees changed to new bottles from storage when the dispensers were empty. At the end of the period, all hand disinfectant dispensers in the ward were again removed and replaced with new bottles at the same time in the morning, whereafter the remaining amount of disinfectant was measured. This procedure was repeated in August 2007 and in May 2008.

Questionnaire

A questionnaire consisting of 15 multiple-choice questions was prepared. The design of, as well as the content of, some of the questions were inspired by an evaluation by Larson and Lusk [14], describing five components of hand washing quality: frequency, agent use, appropriateness, duration and technique. The questionnaire used in September contained an additional question concerning whether the staff's view on hygiene routines had changed after the education. Space for free-text answers was provided on some questions. Examples of questions were: How often do you use hand disinfectant when you have contact with a patient? For how long do you apply the hand disinfectant? Do you have enough knowledge about hand disinfectant?

To test its face validity, the first version of the questionnaire was distributed among 27 employees on the ward for Infectious Diseases. After receiving the employees' comments, the questionnaire was modified to its final version.

A total of 53 questionnaires about basic hygiene routines were distributed to the staff on the orthopedic ward on May 31. Since the forms were not coded, a reminding letter was sent to all employees. In the same way, 54 questionnaires were sent to all employees on September 28. The answers were treated anonymously.

Ethical Aspects

An application to conduct the study was given to and accepted by the head nurse and the chief physician. Since the measuring of disinfectant consumption did not relate to specific individuals at the unit, but rather the staff as a group, staff members were not informed about the consumption part of the study. Such information would have seriously risked biasing the data collection. The questionnaire was accompanied by a letter asking for participation. According to Swedish law at the time of the study, an application to the

research ethics board was not required for a study that did not involve patients.

Since hand hygiene is included as a natural part of ordinary work and the intervention did not directly affect any patients, approval by the research ethics board was not necessary.

Statistical Analysis

We used the χ^2 test with the web-based statistical program VassarStats (Poughkeepsie, NY, USA) to analyze differences between groups before and after the intervention. When groups were too small, the Fisher exact test was performed instead. *P* values less than .05 were considered statistically significant.

RESULTS

Consumption of Hand Disinfectant

Consumption of disinfectant during the pre-intervention period was 16.8 L and during the first post-intervention test period 31.2 L. The consumption during the second post-intervention period, May 2008, was 21.2 L. To verify the consumption before the intervention, we calculated the average consumption of hand disinfectant on the ward from the storage lists. From October 2006 to March 2007, the consumption was 15.9 L/month (Table **1**).

Table 1. Consumption of Hand Disinfectant During the Three Measuring Periods

	Pre-Intervention	Post-Intervention	9 Months Post-Intervention
Total consumption, L	16.8	31.2	21.2
Consumption per patient-day, mL	27.4	52.9	33.1

During the pre-intervention test, 613 patient-days were produced on the ward and 16.8 L of hand disinfectant was used, equaling a consumption of 27.4 mL/patient-day. During the first post-intervention test, 589 patient-days were produced, equaling 52.9 mL/patient-day. This means that the total consumption of disinfectant rose by 93% from the pre-intervention baseline. In May 2008, 641 patient days were produced, giving an average use of 33.1 mL/patient-day (Table **1**).

Questionnaire Response Rates

The questionnaire was distributed to all employees on the orthopedic ward (n=53 before and n=54 after intervention). The pre-intervention response rate was 87% (n=46) and the post-intervention response rate was 83% (n=45). The questionnaire was answered by 16 registered nurses before and after the intervention, by 8 physicians before and 9 after, by 18 assistant nurses before and 16 after, and by 4 physical and occupational therapists on both occasions.

Disinfectant Application Time

The respondents were asked to state for how long time they applied the disinfectant. Before the intervention 28.8% of the respondents declared that they applied the disinfectant for "less than five seconds". This fraction decreased to 8.8% after the hygiene session was given. The frequency for "5 to 10 seconds" increased from 57.7% to 80.0% (*P* = .039). No significant changes were seen for "more than 10 seconds". When asked how they could improve their use of hand disinfectant, 34 respondents answered "by disinfecting more often" before the intervention, versus 33 after. Seventeen respondents answered "by using better technique" on both occasions. Ten respondents, finally, answered "by disinfecting for a longer time" before the intervention, versus 17 after. Other comments were "I want the hand disinfectant to be more accessible" and "More disinfectant dispensers".

Knowledge and Attitudes

The respondents were also asked to state their knowledge of and compliance with basic hygiene routines (Table **2**).

If the respondents did not consider themselves following basic routines, they mentioned reasons like "lack of time", "I forget" and "carelessness". When asked why they did not use hand disinfectant, the answers were "lack of time" (9 answers before the intervention *vs* 10 after), "high work load" (6 *vs* 14), and "empty hand disinfectant dispensers" (9 *vs* 9).

Most employees stated that they wash their hands with soap and water after contact with urine, feces, secretion and blood. The most frequent comment about how to improve hand hygiene was "by washing hands more often". After the intervention, all respondents stated that they had knowledge about hygiene routines. Before the intervention, only one person claimed to lack knowledge of hygiene routines. After the intervention, 56% (n=41) answered that their perspective on basic hygiene routines had changed. They commented for example: "I have stopped using a watch and private clothes", "I am more thorough", "I use hand disinfectant more often" and "I am more aware".

There were no differences in expressed knowledge or attitudes between the various staff categories.

DISCUSSION

The hypothesis of this study was primarily that a lecture on basic hygiene routines could increase the use of disinfectant for hand hygiene, and, secondarily, that it could positively affect the staff's knowledge of and attitudes toward basic hygiene routines. The study design, with only one measurement of consumption over the total time frame makes inference testing impossible. We cannot state that the increased consumption was significant, but we nevertheless consider this almost doubled usage as strong support for the effectiveness of the hygiene lecture. Nine months after the intervention, the consumption was still 21% higher than before the intervention. The questionnaire also revealed an improved knowledge of basic hygiene routines. Our findings are supported by a Norwegian study, in which information about hand hygiene significantly improved the self-reported use of hand disinfectant [12]. When disinfectant was made more accessible by increasing the number of disinfectant dispensers, consumption increased by 62%.

There are some possible explanations for the positive effects associated with this single lecture. For instance, the Hawthorne effect is one factor that may have influenced the results. In this case it would imply that the consumption of

Table 2. Knowledge and Attitudes Expressed in the Questionnaire

	Pre-Intervention	Post-Intervention	Significance
Proportion of respondents considering themselves not having enough knowledge about hand disinfection	16.2%	2.2%	p = .028
Proportion of respondents considering themselves following basic hygiene routines: *always*	36.3%	25.0%	n.s.
often	61.3%	72.2%	n.s.
sometimes	2.2%	2.2%	n.s.
Proportion of respondents expressing a need for education in basic hygiene routines	43.9%	20.9%	p = .01
Proportion of respondents stating that they wash their hands with soap and water after contact with urine, feces, secretion and blood	78.0%	87.0%	n.s.

hand disinfectant increased because the staff members were aware that they were involved in a study. This is not very likely, however, since the employees were not informed about the study and did not know what the researcher was doing at the unit.

There is always a risk of positive bias in self-reporting of compliance with routines. A study on Turkish nursing students showed a self-reported hand-washing rate of 80.2% [15]. The reduced proportion of staff claiming that they always follow the basic hygiene routines, after the lecture, indicates that the education increased the awareness of self-behavior.

The external validity of the finding of almost doubled consumption of disinfectant following a single hygiene lecture, would be strengthened by a similar study. To overcome the limitation of the quasi-experimental study design, another ward could have been used as control. However, there were no comparable units that had not already received the hygiene lecture.

According to earlier reports about hand hygiene, compliance with hygiene recommendations is estimated to be below 50% [3, 5, 6]. In the present study, there was a tendency toward fewer respondents admitting to not always following the basic hygiene routines in the post-intervention questionnaire. The probable explanation is that awareness of not following the hygiene routines improved after the lecture. The results of the questionnaire also showed that the employees considered themselves applying the hand disinfectant more thoroughly after the intervention than before the intervention. This is also likely to be an effect of the lecture, although the design used allows no conclusions about causality.

The quasi-experimental design used in this study limits the possibility to control for confounding factors, such as availability of hand disinfectant during the test period, but precautions were taken to avoid such bias. Another threat to the internal validity is that the number of working hours might affect the consumption of disinfectant. During September, 9% more working hours were performed than during May (5,978 *vs* 5,448), being the equivalent of two full time employees. The explanation for this could be extra trainees during that time period. During May 2008, working hours were back to 5,464 which was only 1% more than in May 2007. Working hours were calculated only for assistant nurses, nurses and occupational therapists. Physiotherapists and physicians were excluded, since they visit the ward on a consultant basis and their time on the unit could not be calculated. This exclusion was however the same during all periods. The activity on the ward was unchanged, the patients had the same diagnoses and the workload was the same, according to a subjective judgment by the head nurse.

In summary, this study showed that after the lecture on hygiene routines the consumption of hand disinfectant increased by 93%. Nine months after the intervention the consumption was still 21% higher than before the intervention. The results of the questionnaire showed that the employees considered themselves applying the disinfectant more thoroughly after the intervention. Some employees changed their perspective on basic hygiene routines after the lecture and stopped using watches and private clothes at work.

CONCLUSION

The consumption of hand disinfectant increased and the application of hand disinfectant became more thorough after one single hygiene lecture.Health care professionals have a great responsibility to comply to basic hygiene guidelines, in order to prevent nosocomial infections. Our findings suggest that a single education session, a hygiene lecture, could be a simple and cost-effective method to increase the use of hand disinfectant, thereby reducing the number of nosocomial infections on the wards.

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