IMPACT OF EDUCATION ON KNOWLEDGE, ATTITUDES AND PRACTICES AMONG VARIOUS CATEGORIES OF HEALTH CARE WORKERS ON NOSOCOMIAL INFECTIONS

*JB Suchitra, N Lakshmi Devi

Abstract

Purpose: To assess the knowledge, attitudes and practices among the different health care workers (HCWs) on nosocomial infections. Methods: A total of 150 HCWs, doctors (n=50), nurses (n=50) and ward aides (n=50) were included. A questionnaire was administered to the HCWs to assess their knowledge, attitudes and practices on nosocomial infections. A scoring system was devised to grade those (KAP score). They were further subjected to a series of similar questionnaires at intervals of 6, 12 and 24 months after an education module. Subjects in each category of staff (n=10) were observed for compliance to hand washing practices in the ward in the post-education period. Statistical analysis was done using statistical software. Results: The study showed an increase in the number of subjects in each category scoring good and excellent in the post-education questionnaire; however this declined with the progress of time. It was observed that the compliance level to hand washing practices differed among the different HCWs. Total compliance was 63.3% and ward aides were most compliant 76.7% (adjusted Wald 95% CI= 58.80-88.48). Conclusions: Education has a positive impact on retention of knowledge, attitudes and practices in all the categories of staff. There is a need to develop a system of continuous education for all the categories of staff. In order to reduce the incidence of nosocomial infections, compliance with interventions are mandatory.

Key words: Hand washing practices, knowledge, nosocomial infections

With advances in the health care system, the threat to hospital-acquired infections (HAIs) still remains. HAIs are known to result in substantial morbidity and are estimated to cause or contribute to nearly 80,000 deaths annually in the United States. Many nosocomial infections are caused by pathogens transmitted from one patient to another by way of health care workers (HCWs) who have not washed their hands between patients or HCWs who do not practice control measures such as use of hand disinfection, glove use etc. Although Semmelweis demonstrated more than a century ago that hand washing itself was sufficient in reducing the incidence of nosocomial infections, compliance of HCWs with the recommended hand washing practices remain low. Even the spread of multi-drug resistant pathogens has not compelled HCWs to adopt recommended practices. Poor compliance is associated with lack of awareness among personnel. The other factors are personal and organisational attitudes towards interventions such as hand washing, cost containment and logistical barriers. The need for appropriate measures required for reducing the incidence of nosocomial infections is well-documented in literature. Failure to employ correct practices has been responsible for an increased incidence in nosocomial infections. Although strategies have been adopted at various institutional levels, failure in compliance has been a root cause for the increased incidence.

Studies have shown that HCWs have stated multiple reasons for non-compliance such as dryness of skin due to frequent use of skin disinfectants, being too busy, wards being full and understaffing. Pittet and colleagues have demonstrated the factors that affected hand washing. In the study, more than 2800 opportunities for hand washing were observed in multiple wards during all shifts and on all days of the week. They had demonstrated that the nurses showed better compliance than doctors.

The purpose of our study was to understand the level of knowledge, attitudes and practices among different categories of HCWs i.e., doctors, nurses and ward aides. We had applied interventions in the form of an education module designed to suit the need of each of these categories of HCWs. We studied the impact of the intervention on the level of knowledge, attitudes and practices at different intervals of time. In order to assess the efficacy of the education program, an observational study was done on individuals in the different categories for compliance with hand washing procedures.

Materials and Methods

Various levels of HCWs were enrolled in the study. Doctors (n=50) comprised of consultants, senior doctors and junior doctors. The nurses (n=50) comprised of senior and junior nurses and ward aides (n=50) comprised of senior and junior cadre staff. A questionnaire on knowledge, attitudes...
and practices on prevention of nosocomial infections, skin disinfection and hand washing, waste disposal, universal precautions and nosocomial infections was administered to the subjects enrolled for the study. The questionnaire also contained questions for data on the age of the individual, sex, number of years of hospital experience and the job cadre. Junior staffs were those staff that had ≤ 3 years of work experience in the hospital and senior staffs were those who had more than 3 years of work experience in the hospital. The questionnaire for doctors and nurses were similar in 22 out of 26 questions as compared to the questionnaire for the ward aides. The questionnaires for doctors, nurses and ward aides are found in Tables 1-3 respectively. The different categories of staff were then subjected to education modules designed for that particular category of staff. The education module was a series of lectures based on knowledge, attitudes and practices on the questionnaire that was first administered (pre-education questionnaire). A post-

| Table 1: Questionnaire on hospital acquired infections - Doctors |
|---------------------------------------------------------------|

**Implement prevention of infection**
1. What is the vaccination regime advocated for a healthcare worker?
2. Name potentially infectious material from patients.
3. What would you do if there is a blood splash?
4. What are the immediate measures you would take when there is an exposure to blood or potentially infectious body fluids
   a. by needle stick injury
   b. on non-intact skin
   c. mucosal exposure
5. What are the recommendations for patients known to harbour blood borne pathogens with regard to admission, patient care and waste disposal?
6. Should you recap a needle before disposal? Y/N

**Waste disposal and hand washing**
1. Is it necessary to categorize hospital waste before disposal. Y/N
   If Y, name the categories and give examples for each
2. How would you dispose infected material from patients?
3. State whether True (T) or False (F) If false give the correct statement
   Hand washing is necessary
   a. Before performing invasive procedures.
   b. Between susceptible patients
   c. Before and after touching wounds, however it is not necessary when gloved.
   d. On joining and completion of duty
   e. In between two different procedures
   f. In between two different procedures on the same patient.
   g. Before and after meals.
4. Will hand washing prevent the spread of infection from patient to patient
5. Is hand washing done uniformly in all units in the hospital and patient population? Comment on the method and cleaning agent used. Use examples.

**Skin disinfection**
1. Name a few skin disinfectants. What is the skin disinfectant used while drawing blood?
2. What do you suppose is the function of a skin disinfectant?
3. What is the contact time for action of antiseptics on skin?
4. For what procedures would you recommend the use of skin disinfectants? Give 2 examples.
5. What is the recommended method for preparation of the skin before insertion of intravascular catheter?

**Nosocomial infection**
1. What are nosocomial infections?
2. What are the organisms commonly encountered in nosocomial infections? Give 2 examples.
3. Do you believe that a healthcare worker is at risk of acquiring a nosocomial infection?
4. Have you been similarly infected? If yes specify the disease.
5. Name 3 measures which should be taken to avoid nosocomial infection.
6. What should you do
   a. When specimen containers are soiled on the outside
   b. When lab request forms are soiled

**Universal precautions**
1. Are you aware of universal precautions Y/N
   Can you name them?
2. State whether True (T) or False (F). If false give the correct statement.
   a. Consider all patients potentially hazardous
   b. Assume all blood and body fluids contaminated by blood borne pathogens.
   c. Assume all unsterile needles and sharps similarly contaminated.
3. What is the necessity to universal precautions?
4. Do you feel universal precautions are
   a. Cumbersome
   b. Expensive
   c. Protective
   d. Compulsory
   e. Any other description
You can tick more than one option
5. Universal precautions should be observed
   a. At all times
   b. At all times, for all patients
   c. For HIV patients
   d. In the OT
This PDF is available for free download from a site hosted by Medknow Publications (www.medknow.com).

### Prevention of infection
1. Name three blood borne infections
2. Name potentially infectious material from patients.
3. What would you do if there is a blood spill?
4. What are the immediate measures you would take when there is an exposure to blood or potentially infectious body fluids
   a. by needle stick injury
   b. on non intact skin
   c. mucosal exposure
5. What are the recommendations for patients known to harbour blood borne pathogens with regard to admission, patient care and waste disposal?
6. Should you recap a needle before disposal Y/N

### Waste disposal and hand washing
1. Is it necessary to categorize hospital waste before disposal. Y/N
   If Y, name the categories and give examples for each
2. How would you dispose infected material from patients?
3. State whether True (T) or False (F) If false give the correct statement
   a. Before performing invasive procedures
   b. Between susceptible patients
   c. Before and after touching wounds, however it is not necessary when gloved.
   d. On joining and completion of duty.
   e. In between two different procedures.
   f. In between two different procedures on the same patient.
   g. Before and after meals.
4. Will hand washing prevent the spread of infection from patient to patient
5. Is hand washing done uniformly in all units in the hospital and patient population. Comment on the method and cleaning agent used. Use examples.

### Hand washing is necessary
   a. Before performing invasive procedures
   b. Between susceptible patients
   c. Before and after touching wounds, however it is not necessary when gloved.
   d. On joining and completion of duty.
   e. In between two different procedures.
   f. In between two different procedures on the same patient.
   g. Before and after meals.

### Universal precautions
1. Are you aware of universal precautions Y/N Can you name them?
2. State whether True (T) or False (F). If False give the correct statement:
   a. Consider all patients potentially hazardous
   b. Assume all blood and body fluids contaminated by blood borne pathogens.
   c. Assume all unsterile needles and sharps similarly contaminated.
3. What is the necessity to implement universal precautions?
4. Do you feel universal precautions are
   a. Cumbersome
   b. Expensive
   c. Protective
   d. Compulsory
   e. Any other description
   You can tick more than one option
5. Universal precautions should be observed
   a. At all times
   b. At all times, for all patients
   c. For HIV patients
   d. In the OT

### Skin disinfection
1. Name a few skin disinfectants. What is the skin disinfectant used while drawing blood?

| Questionnaire on hospital acquired infections - Nurses |
|--------------------------------------------------------|
| 1. Name three blood borne infections                    |
| 2. What is the contact time for action of antiseptics on skin? |
| 3. For what procedures would you recommend the use of skin disinfectants? Give 2 examples. |
| 4. What is the recommended method for preparation of the skin before insertion of intravascular catheter? |
| 5. At what intervals of time should dressing be changed for central IV line? |

### Nosocomial infection
1. What are nosocomial infections?
2. What are the organisms commonly encountered in nosocomial infections? Give 2 examples.
3. Do you believe that a health care worker is at risk of acquiring a nosocomial infection?
4. Have you been similarly infected? If yes specify the disease.
5. Name 3 measures which should be taken to avoid nosocomial infection.
6. What should you do
   a. When specimen containers are soiled on the outside
   b. When lab request forms are soiled

### Table 2: Questionnaire on hospital acquired infections - Nurses

The education questionnaire that was similar in the pre-education questionnaire was administered to the enrolled HCWs at intervals of 6, 12 and 24 months. It was made mandatory that all the fields were to be filled.

Each of the fields was given a score, the KAP score. A KAP score of 1-12 was considered poor, 13-25 as fair, 26-37 as good and ≥ 38 as excellent. All the subjects in the study were graded based on scores as excellent, good, fair and poor. Ten of the subjects in each of the category were observed for compliance to hand washing practices in the ward on three different occasions. They were asked to comment on probable reasons for non-compliance to interventions such as hand washing, hand disinfections and use of gloves. The answers were categorized into individual level, group level and institutional level of preventing nosocomial infections. Statistical analysis was made using Chi-square and Fisher exact test have been used to test the significant change in study parameters in the before and after intervention. Statistical software namely SPSS 11.0 and Systat 8.0 were used for the
Prevention of infection

1. Can all patient waste be infectious?
2. Name two patient wastes that is infectious.
3. If you are asked to discard a used needle, would you
   a. recap the needle and then discard.
   b. discard directly into a sharps container.
4. If you accidentally touch patient blood, what would you do?
   a. wipe with a cotton swab
   b. wash with soap and water immediately
   c. wash under running tap water
5. What would you do if?
   a. a patient vomited on the floor.
   b. a known HIV patient vomited on the bedclothes.
   c. You saw a dressing with blood on the floor.
   d. You saw a large blood spill on the floor.

Waste disposal and hand washing

1. Is it necessary to categorize hospital waste before disposal.
   Y/N
2. Where would you discard the following
   a. Paper
   b. Needles
   c. used gloves
   d. used catheters
   e. linen stained with blood or body fluids
3. Do you wash yours hands just before giving a patient mouth care?
4. Do you wash your hands between two patients Y/N

Skin disinfection

1. What is a skin disinfectant?
2. Name one skin disinfectant.
3. Where is it used?
4. What is the use of skin disinfectant?

Nosocomial infection

1. Have you heard of nosocomial infection or hospital acquired infection Y/N.
2. Do you think you can get any infection from patients in the hospital? Y/N.
3. Have you got any such infection in the past or present. Y/N
4. If yes specify the disease.
5. What should you do
   a. When specimen containers are soiled on the outside
   b. When lab request forms are soiled

Universal precautions

1. If a known case of HIV is admitted in your ward, what precautions are taken?
2. In case there is a patient in your ward who has not been tested for HIV, what precautions would you take?
3. If the HIV status of the patient is negative, would you take any precautions? Y/N.
   IF Y, Why?
4. Do you ever wear gloves? When and Why?

Table 3: Questionnaire on hospital acquired infections - Ward aides

5. What is used to wash hands?.

Skin disinfection

1. What is a skin disinfectant?
2. Name one skin disinfectant.
3. Where is it used?
4. What is the use of skin disinfectant?

Nosocomial infection

1. Have you heard of nosocomial infection or hospital acquired infection Y/N.
2. Do you think you can get any infection from patients in the hospital? Y/N.
3. Have you got any such infection in the past or present. Y/N
4. If yes specify the disease.
5. What should you do
   a. When specimen containers are soiled on the outside
   b. When lab request forms are soiled

Universal precautions

1. If a known case of HIV is admitted in your ward, what precautions are taken?
2. In case there is a patient in your ward who has not been tested for HIV, what precautions would you take?
3. If the HIV status of the patient is negative, would you take any precautions? Y/N.
   IF Y, Why?
4. Do you ever wear gloves? When and Why?

Results

A total of 150 questionnaires were analysed using appropriate statistical methods.

Table 4 shows the population profile of the different categories of staff.

Results of the pre-education questionnaire in the different categories of staff are shown in Tables 5-7.

Opinions on universal precautions among various categories of staff is shown in the Figure.

The correlation of experience and knowledge of ward aides was significantly less when compared to doctors and nurses (<0.001).

A comparative study consisting of 30 subjects with 10 subjects each in Group A (doctors), group B (nurses) and group C (ward aides) was undertaken to evaluate the hand washing practices in order to assess the efficacy of the education program. The basic demographics of the subjects is given in Table 8

Discussion

Hospital administrators should strive to create an organizational atmosphere in which adherence to recommended hand hygiene practices is considered an integral part of providing high-quality care. For such an approach to be successful, hospitals must provide visible support and sufficient resources in the form of continuous education programs. These programs should be innovative, educational and motivational and tailored to specific health care personnel. The strategies should be designed to suit the specific needs and the expected outcome for that particular category of HCW. A study conducted by Natalie at a University Hospital showed a significant difference in pre- and post-test scores after a one-hour lecture on knowledge, attitudes and practices among doctors and other HCWs on cleaning of stethoscopes. There was also an improvement in post-education answers. There was a correlation in the number of years of experience in the hospital and the position of the HCW.

In the present study, there was significant difference in
Table 4: Basic characteristics of study population

| Basic characteristics | Doctors | Nurses | Ward aids |
|-----------------------|---------|--------|-----------|
| Number                | 50      | 50     | 50        |
| Age in years (Mean ± SD) | 31.44±6.78 | 31.90±6.56 | 31.78±6.73 |
| Sex                   | Male=62.0% | Female=38.0% | Male=20.0% | Female=80.0% |
| Designation           | Junior* =70.0% | Senior** =30.0% | Junior* =34.0% | Senior** =66.0% |
| Experience in years (Mean ± SD) | 8.04 ±5.84 | 9.20 ± 6.60 | 10.20 ± 6.03 |

*Junior: < 3 years of work experience in the hospital, **Senior > 3 years of work experience in the hospital

Table 5: Assessment of knowledge, attitudes and practices of infection control in doctors

| KAP score (0-50) | Pre-education (%) | 6 months (%) | 12 months (%) | 24 months (%) |
|------------------|-------------------|--------------|---------------|---------------|
| Excellent (>31)  | 2 (4.0)           | 37 (74.0)    | 30 (60.0)     | 16 (32.0)     |
| Good (26-37)     | 5 (10.0)          | 10 (20.0)    | 12 (24.0)     | 14 (28.0)     |
| Fair (13-25)     | 21 (42.0)         | 2 (4.0)      | 3 (6.0)       | 13 (26.0)     |
| Poor (0-12)      | 22 (44.0)         | 1 (2.0)      | 5 (10.0)      | 7 (14.0)      |

Table 6: Assessment of knowledge, attitudes and practices of infection control in nurses

| KAP score (0-50) | Pre-education (%) | 6 months (%) | 12 months (%) | 24 months (%) |
|------------------|-------------------|--------------|---------------|---------------|
| Excellent (>31)  | 5 (10.0)          | 42 (84.0)    | 37 (74.0)     | 15 (30.0)     |
| Good (26-37)     | 10 (20.0)         | 2 (4.0)      | 10 (20.0)     | 12 (24.0)     |
| Fair (13-25)     | 15 (30.0)         | 3 (6.0)      | 3 (6.0)       | 15 (30.0)     |
| Poor (0-12)      | 20 (40.0)         | 3 (6.0)      | -             | -             |

Table 7: Assessment of knowledge, attitudes and practices of infection control in ward aides

| KAP score (0-50) | Pre-education (%) | 6 months (%) | 12 months (%) | 24 months (%) |
|------------------|-------------------|--------------|---------------|---------------|
| Excellent (>31)  | -                 | 32 (64.0)    | 20 (40.0)     | 9 (18.0)      |
| Good (26-37)     | 3 (6.0)           | 11 (22.0)    | 11 (22.0)     | 12 (24.0)     |
| Fair (13-25)     | 20 (40.0)         | 4 (8.0)      | 6 (12.0)      | 9 (18.0)      |
| Poor (0-12)      | 27 (54.0)         | 3 (6.0)      | 13 (26.0)     | 20 (40.0)     |

The pre-education and the first post-education responses. However, the improvement in answers declined in the post-education second assessment and still further dropped in the third post-education assessment. Studies by Angelillo et al. recommended that attending continuing education courses about hospital infection had a positive effect on infection control procedures and compliance with barrier techniques.13 We have suggested that yearly educational modules will help in retention of knowledge in the area of nosocomial infections and the prevention of infections. It would also translate in a behavioural change of attitudes and practices that would help in reducing the incidence of nosocomial infections.

In the present study, years of experience in the hospital significantly correlated to increased knowledge, attitudes and practices among the various categories of staff but this did not translate into good clinical practice in the ward. Studies by Gershon et al. on compliance to universal precautions among HCWs showed different levels of compliance.14 The study showed that the compliance was maximum among nurses, intermediate for technicians and the least for doctors.14 Our observational study on hand washing practices revealed that in spite of the educational program and the significant increase in the scores in the post-education period; doctors were less compliant. The ward aides who were more under direct supervision of a hospital supervisor complied the best. All the categories responded uniformly that institutions should have written guidelines. There were no suitable rewards offered for those who complied in the form of either incentives or verbal acceptance, seniors did not comply and therefore it was quite natural that the new recruits did not feel the importance to comply and also that the institution had not made hand hygiene agents available.
organizational culture of hand hygiene had a significant response from the staff by compliance to hand hygiene, eventually reducing the incidence of methicillin resistant Staphylococcus aureus (MRSA) and vancomycin resistant enterococci (VRE).

From the results of the study we have drawn conclusions that a yearly education program on nosocomial infections and its prevention will help in the retention of knowledge, attitudes and practices among the various categories of HCWs. This will help in better adherence to barrier protection such as hand washing, use of gloves and hand disinfection. We also recommend written guidelines in every institution for HCWs. A regular system of monitoring infection rates as well as dissemination of the data will form a link between the management and the HCWs and thus help in implementing and improving strategies for prevention of nosocomial infections.

References

1. Jarvis WR. Selected aspects of the socioeconomic impact of nosocomial infections: Morbidity, mortality, cost and prevention. Infect Control Hosp Epidemiol 1996;17:552-7.

2. Horn WA, Larson EL, McGinley KJ, Leyden JJ. Microbial ßora on the hands of health care personnel: Differences in composition and antibacterial resistance. Infect Control Hosp Epidemiol 1988;9:189-93.

3. Albert RK, Condie F. Hand-washing patterns in medical intensive-care units. N Engl J Med 1981;24:1465-6.

4. Kristensen MS, Wernberg NM, Anker-Moller E. Healthcare workers' risk of contact with body fluids in a hospital: The effect

---

Table 8: Basic demographic characteristics

| Basic characteristics | Doctors | Nurses | Ward aides |
|-----------------------|---------|--------|------------|
| Number                | 10      | 10     | 10         |
| Age in years (Mean ± SD) | 29.60±5.19  | 32.90±8.07  | 34.20±7.15  |
| Sex                   | Male=50.0%  | Female=100.0% | Male=50.0%  |
|                       | Female=50.0% | Female=50.0% | Female=50.0% |
| Years of experience   | 5.40±2.91  | 11.30±8.03 | 12.70±6.62 |
| Hand washing (Occasion 1) | Complied=50.0% | Complied=60.0% | Complied=50.0% |
|                        | Not      | Not    | Not        |
| Hand washing (Occasion 2) | Complied=50.0% | Complied=80.0% | Complied=90.0% |
|                        | Not      | Not    | Not        |
| Hand washing (Occasion 3) | Complied=40.0% | Complied=60.0% | Complied=80.0% |
|                        | Not      | Not    | Not        |
| Overall               | 46.7%    | 66.7%  | 76.7%      |
| (10x3 = 30 occasions) |          |        |            |
| Adjustedwald 95% CI   | 30.23-63.83 | 48.68-80.67 | 58.80-88.48 |

At the group level the barriers to practice hand hygiene was attributed to lack of education, high work load especially when the ward was occupied to its full capacity, understaffing, working in the critical care units, lack of encouragement and lack of a role model among senior staff. At the individual level the barriers perceived was the lack of knowledge and experience, lack of knowledge of guidelines set by the institution or being a refractory non-complier. Pittet et al. were the first to document that a high workload is associated with poor compliance to hand washing. Low compliance during the care of patients in intensive care units may also be a reason for the spread of multi-drug resistant organisms. Studies by Larson et al. and Zimakoff et al. have shown that HCWs perceived factors that deter them practicing hand washing was either due to skin irritation or dryness of the skin, being too busy, inconvenient location of sinks, lack of institutional guidelines, lack of knowledge or experience, lack of a role model and lack of rewards. In our study most of the doctors felt that universal precautions were protective (58%) and should be made compulsory (32%) as compared with 16% who perceived universal precautions as expensive and 14% who perceived the same as cumbersome. Nurses felt that universal precautions were protective (72%) and compulsory (60%). Only 2% found it cumbersome and 14% expensive. Among ward aides, a different trend of thought was observed. Most of them found universal precautions expensive (74%) and cumbersome (26%). 12% of the ward aides found it protective and 6% compulsory. In 1993, Kretzer and Larson revisited the major behavioural theories and their applications with regard to the HCW in an attempt to better understand how one might plan more successful interventions. Larson et al. reported that top level management involved in increasing organizational culture of hand hygiene had a significant response from the staff by compliance to hand hygiene, eventually reducing the incidence of methicillin resistant Staphylococcus aureus (MRSA) and vancomycin resistant enterococci (VRE). From the results of the study we have drawn conclusions that a yearly education program on nosocomial infections and its prevention will help in the retention of knowledge, attitudes and practices among the various categories of HCWs. This will help in better adherence to barrier protection such as hand washing, use of gloves and hand disinfection. We also recommend written guidelines in every institution for HCWs. A regular system of monitoring infection rates as well as dissemination of the data will form a link between the management and the HCWs and thus help in implementing and improving strategies for prevention of nosocomial infections.
of complying with the universal precautions policy. *Infect Control Hosp Epidemiol* 1992;13:719-24.

5. Meengs MR, Giles BK, Chisholm CD, Cordell WH, Nelson DR. Handwashing frequency in an emergency department. *J Emerg Nurs* 1994;20:183-8.

6. Zimakoff J, Kjelsberg AB, Larsen SO, Holstein B. A multicentric questionnaire investigation of attitudes towards hand hygiene, assessed by staff in fifteen hospitals in Denmark and Norway. *Am J Infect Control* 1992;20:58-64.

7. Leaper DJ. Risk factors for surgical infection. *J Hosp Infect* 1995;30:127-39.

8. Lynch P, White MC. Perioperative blood contact and exposures: A comparison of incident reports and focused studies. *Am J Infect Control* 1993;21:357-63.

9. Kampf G, Gastmeier P, Wischnewski N. Schlingmann J, Schumacher M, Daschner F, et al. Analysis of risk factors for nosocomial infections-results from the first national prevalence survey in Germany (NIDEP study, Part 1). *J Hosp Infect* 1997;37:103-12.

10. Pittet D, Mourouga P, Perneger TV. Compliance with hand washing in a teaching hospital. Infection Control Program. *Ann Intern Med* 1999;130:126-30.

11. Rosner B. Fundamentals of biostatistics. 5th ed. Duxbury: 2000.

12. Angelillo IF, Mazzotta A, Nicotera G. Nurses and hospital infection control: Knowledge, attitudes and behavior of Italian operating theatre staff. *J Hosp Infect* 1999;42:105-12.

13. O’Boyle WC, Campbell S, Henry K, Collier P. Variables influencing worker compliance with universal precautions in the emergency department. *Am J Infect Control* 1994;24:138-48.

14. Gershon RR, Vlahov D, Felkner SA, Vesley D, Johnson PC, Delclos GL, et al. Compliance with universal precautions among health care workers at three regional hospitals. *Am J Infect Control* 1995;4:225-36.

15. Pittet D, Mourouga P, Perneger TV. Compliance with handwashing in a teaching hospital. Members of the infection control program. *Ann Intern Med* 1999;130:126-30.

16. Larson E, Killien M. Factors influencing handwashing behavior of patient care personnel. *Am J Infect Control* 1982;10:93-9.

17. Pettinger A, Nettleman MD. Epidemiology of isolation precautions. *Infect Control Hosp Epidemiol* 1999;130:126-30.

18. Kretzer EK, Larson EL. Behavioral interventions to improve infection control practices. *Am J Infect Control* 1998;26:245-53.

19. Larson EL, Early E, Cloonan P, Sugrue S, Patrides M. An organizational climate intervention associated with increased handwashing and decreased nosocomial infections. *Behav Med* 2000;26:14-22.

Source of Support: Nil, Conflict of Interest: None declared.