ORIGINAL ARTICLE

# Knowledge of preventive measures against occupational risks and spread of healthcare-associated infections among nursing students. An epidemiological prevalence study from Ferrara, Italy

M. BERGAMINI, A. CUCCHI, A. STEFANATI, A. CAVALLARO, G. GABUTTI
* Department of Clinical and Experimental Medicine, Section of Hygiene and Occupational Health, University of Ferrara, Italy

Key words

Nursing students • Preventive measures • Healthcare-associated infections

Summary

**Introduction.** *Exposure to biological agents is the most common occupational risk for nursing staff. This study verified changes in attitudes and knowledge occurred in the nursing students after the first year of degree.*
**Methods.** *The survey was conducted in academic year 2006/07 among the students of the Professional Nursing Course at University of Ferrara (Italy) using a structured questionnaire. Students were 85 at the beginning and 80 at the end of the courses.*
**Results.** *The rate of subjects using gloves for intramuscular injections and fingertip puncture was unsatisfactory. A high percentage of students performed recap of needles. The use of gloves in case of washing of surgical instruments was high. The compliance in the use of gloves in handling test tubes remained low. Only 2/3 of the students washes their hands coming in ward. Incorrect attitudes have been observed in changing or wearing gloves. The students considered vaccination against hepatitis-B necessary, vaccination against flu unnecessary. A high percentage of students had not performed any prophylaxis for tuberculosis.*
**Discussion.** *Students intend the use of gloves mainly to perform self-protection. The concept of self-protection is contradicted by the large percentage of students that recap used needles. A significant percentage of students have not yet gained the critical thinking necessary to consider the importance of universal precautions as a means not only of self-protection but also of prevention of hospital infections.*
**Conclusions.** *Students consider the basic standard measures for the control of infectious diseases only like self-protection and not to prevent hospital infections.*

## Introduction

Exposure to biological agents is the most common occupational risk for health professionals [1]. The nursing staff is the most frequently involved among the hospital professional groups, probably because nurses frequently handle cutting and piercing objects while performing their tasks.

These occupational accidents may involve infections and diseases caused by the Human Immunodeficiency Virus (HIV), Hepatitis B and C viruses [2]. The possibility of lack of symptoms increases the possibility of a further contamination.

In Italy, between January 1994 and June 1998, the Italian Study on HIV Risk Occupational (SIROH) reported 19860 occupational exposures to blood or other potentially contaminated biological fluids. The highest rate of percutaneous exposures was observed among general surgery and general medicine nurses; the highest rates of mucocutaneous exposures were observed among midwives and dialysis nurses. The highest exposure rates to multiple pathogens were observed among nurses and physicians working in infectious disease units. The highest rates of high-risk percutaneous exposures were observed in nurses. The risk was higher in medical than in surgery areas [3]. On the other hand, healthcare-associated infections constitute a challenge of modern medicine. On average, infections complicate 7%-10% of hospital admissions [4]. Many studies [5-8] have shown that the rate of healthcare-associated infections among critically ill patients approaches 40% and may be as high as 60% among those who stay in the intensive care unit (ICU) more than 5 days. These ICU-related infections are causes of higher morbidity, mortality, and healthcare-related costs [9]. In Italy, a study carried out among 16 Italian hospitals, showed that the overall prevalence of healthcare-associated infections was 8.3% [10]. Many international studies [11-14] observed that the transmission of microorganisms from the hands of health care workers is the main cause of healthcare-associated infections, and that handwashing remains the most important preventive measure. Unfortunately, compliance with handwashing is low in most institutions [14]. For these reasons is particularly important to train nursing students to become able to recognize the importance of preventive measures in order to minimize professional exposures to biological agents and healthcare-associated infections.

The present study verified changes in professional attitudes and knowledge occurred in the nursing students before and after the first year of degree.

## Methods

The present survey consisted in a prevalence study, which was conducted among the students of the first two years of the Professional Nursing Course in the University of Ferrara, Italy. The first phase of the study involved students attending the first lesson of courses of Hygiene and Occupational Health. The second phase involved students who have ended courses. These students had their apprenticeship in various health-care facilities where they developed a variety of activities. The survey was carried out using a structured questionnaire made of closed-ended questions (a set of answers or options from which a respondent indicates his choice). The questionnaire was submitted after an informative phase explaining the aims of the study, motivating the importance of collaboration, showing the benefits for participants, and giving instructions about compilation. The questionnaire contained no data that could be traced back to identify each student and had a cover finalized to mask the part of the questionnaire which included questions. It was guaranteed the statistical secret through the use and the dissemination of cumulative data. The questionnaire consisted of 45 questions aimed to investigate the knowledge of students nurses towards prevention both of hospital infections and professional exposures that may occur during the duties needed for patient care. The questions were designed to investigate the attitude to adopt control measures finalized to reduce transmission of infectious diseases during daily assistance, the adherence to hand-washing protocols, and the correct procedures for proper disposal of needles. The questions were divided into groups related to the following application areas: practices involving the use of needles, practices involving direct or indirect contact with patients, interventions without patient contact, knowledge of the basic preventive measures regarding hospital infections, knowledge about current guidelines in case of accidental exposure to biohazards and preventive vaccinations.

The study was conducted in full respect of Italian law about the protection of personal data [15]. Data were stored and analyzed using the software Microsoft Access 2003 [16].

## Results

The study involved a group of students enrolled in the academic year 2006-2007. The population sample at the beginning of the course consisted of 85 subjects, 26 males and 59 females, with an average age of 23.22 years. At the end of the courses, 80 subjects fro the same group (19 males and 61 females; average age: 24.21 years), agreed to complete the questionnaire.

The first area of application concerned questions about the use of gloves in activities involving the use of needles:

- to make an intramuscular injection;
- to take a venous blood sample or to make an intravenous injection;
- to make a fingertip puncture.

The final question of the first area of application regarded the habit to recap used needles.

The results are shown in Table I.

Before attending courses of Hygiene and Occupational Health, 95.24% of students referred the use of gloves for intravenous injections. At the end of courses, the percentage grew slightly (97.47%). The rate of subjects using gloves for intramuscular injections, and fingertip puncture, both at the beginning and the end of the courses, remained unsatisfactory. Regarding recap of needles, a high percentage (> 60%) of students performed this practice, universally considered highly dangerous [17, 18].

The second area of application concerned the use of gloves in the following situations:

- to catheterize the bladder;
- to aspirate secretions in trachea;
- to dress a wound;
- to perform a trichotomy;
- to clean the oral cavity.

The results are shown in Table II.

The percentage of subjects using gloves was generally satisfactory: it always exceeded 90% and without significant differences at the beginning and at the end of the courses.

The third area of application concerned the use of gloves in the following situations:

**Tab. I.** First area of application: use of gloves in activities involving the use of needles.

| | At the beginning of the courses | | | At the end of the courses | | |
|---|---|---|---|---|---|---|
| | Always | Sometimes | Never | Always | Sometimes | Never |
| | % | % | % | % | % | % |
| To make an intramuscular injection | 77.65 | 15.29 | 7.60 | 71.25 | 21.25 | 7.50 |
| To make a sampling of venous blood or an intravenous injection | 95.24 | 4.76 | 0.00 | 97.47 | 1.27 | 1.27 |
| To fingertip puncture | 76.47 | 18.82 | 4.71 | 78.75 | 16.25 | 5.00 |
| Do you recap the needles after the use? | 61.90 | 36.90 | 1.19 | 65.82 | 32.91 | 1.27 |

**Tab. II.** Second area of application: use of gloves in activities involving direct contact with patient.

| | At the beginning of the courses | | | At the end of the courses | | |
|---|---|---|---|---|---|---|
| | Always | Sometimes | Never | Always | Sometimes | Never |
| | % | % | % | % | % | % |
| To catheterize the bladder | 98.82 | 0.00 | 1.18 | 98.75 | 1.25 | 0.00 |
| To aspirate secretions in trachea | 98.44 | 0.00 | 1.56 | 95.83 | 2.78 | 1.39 |
| To dress a wound | 98.81 | 1.19 | 0.00 | 96.25 | 2.50 | 1.25 |
| To perform a trichotomy | 91.07 | 7.14 | 1.79 | 88.61 | 8.86 | 2.53 |
| To clean the oral cavity | 96.05 | 2.63 | 1.32 | 96.15 | 2.56 | 1.28 |

**Tab. III.** Third area of application: use of gloves during other clinical duties.

| | At the beginning of the courses | | | At the end of the courses | | |
|---|---|---|---|---|---|---|
| | Always | Sometimes | Never | Always | Sometimes | Never |
| | % | % | % | % | % | % |
| To wash surgical instruments | 90.91 | 4.55 | 4.55 | 100.00 | 0.00 | 0.00 |
| To handle test tubes containing blood | 58.23 | 34.18 | 7.59 | 60.00 | 32.50 | 7.50 |
| To handle dirty linen of the patient | 90.59 | 9.41 | 0.00 | 93.75 | 6.25 | 0.00 |

- during the wash of surgical instruments;
- when handling test tubes containing blood;
- when handling dirty linen of the patient.

The results are reported in Table III.

The use of gloves in case of washing of surgical instruments was persistently high at the beginning and at the end of courses. High percentage of subjects used gloves when handling dirty linen of the patients (90.59% and 93.75% at the beginning and at the end of courses, respectively). The low compliance in the use of gloves in handling test tubes containing blood observed both at the beginning (58.23%) and at the end of courses (60.00%) remains unexplained.

The fourth area of application concerned the knowledge of basic prevention measures regarding hospital infections. The results are shown in Table IV.

**Tab. IV.** Fourth area of application: knowledge of prevention measures regarding hospital infections.

| | At the beginning of the courses | | | At the end of the courses | | |
|---|---|---|---|---|---|---|
| | Always | Sometimes | Never | Always | Sometimes | Never |
| | % | % | % | % | % | % |
| Do you wash your hands after removing gloves? | 67.06 | 30.59 | 2.35 | 70.00 | 28.75 | 1.25 |
| Do you wash your hands when you come into the hospital ward? | 65.88 | 29.41 | 4.71 | 56.25 | 38.75 | 5.00 |
| Do you wash your hands at the end of the work shift in hospital ward? | 86.90 | 11.90 | 1.19 | 84.81 | 12.66 | 2.53 |
| Do you change gloves from one patient to another? | 69.41 | 29.41 | 1.18 | 86.08 | 12.66 | 1.27 |
| Do you change gloves when you perform different duties on the same patient? | 21.18 | 71.76 | 7.06 | 29.49 | 62.82 | 7.69 |
| Do you move into the ward wearing the same gloves used on a patient? | 14.30 | 58.30 | 27.40 | 5.10 | 64.10 | 30.80 |
| If not always you follow the guidelines of hygiene hands, what is the reason of this: | At the beginning of the courses % | | | At the end of the courses % | | |
| – the lack of time | 75.36 | | | 62.50 | | |
| – supports for the hand-washing are not easily available | 8.70 | | | 18.75 | | |
| – the frequent washings could irritate the skin of hands | 15.94 | | | 18.75 | | |

The most surprising finding was that only 65.88% of the students washes their hands when they come in ward. This percentage was reduced to 56.25% at the end of lessons. Students who do not wash hands justified their attitude invoking the lack of time (75.36%), the fact that frequent washings irritate the skin (15.94%), and the unavailability of hand cleansers (8.7%). Incorrect attitudes have also been observed in regard to use a new pair of gloves for each patient, even if positive changes have been registered at the end of lessons: the rates of students changing gloves from one patient to another increased from 69.41% to 86.08%. However, we consider unacceptable that a percentage of students that change gloves for different operations on the same patient remained low, increasing from 21.18% to 29.49%, and that 71.76% and 62.82% of students declared to change gloves only "sometimes", respectively at the beginning and at the end of the lessons.
A high percentage of students had the habit to move into the ward wearing gloves already used on a patient. In this case, the percentages are increased from 58.33% to 64.1% at the end of the lessons.
The fifth area of application concerned the knowledge current guidelines in case of accidental exposure to biohazards and preventive vaccinations [2].
The results are reported in Table V.

The percentage of students well-knowing the guidelines about the prevention of infectious diseases after exposure to biological agents, grew from 64.49% at the beginning of the courses to 83.54% at the end of lessons. In contrast, the percentage both of those who did not know the existence of the guidelines and those who do not know the details decreased, respectively, from 11.10% to 2.53% and from 28.40% to 13.92%.
When asked: "have you been vaccinated against hepatitis B before starting the technical/scientific training?", at the start of courses 80.56% of the students answered positively; this percentage increased to 88% at the end of lessons. None of the students considered unnecessary this vaccination and those who have not yet done, planned to do it as soon as possible (19.44%).
The percentage of students who consider vaccination against flu useful ranged between 69.74% and 76.06%; in contrast, a percentage of students (26.32 and 18.31%) deemed unnecessary vaccination against flu, because they consider flu a disease with spontaneous good resolution.
Regarding tuberculosis prevention, at the beginning of the lessons 44.12% of the students had not done anything, 36.76% undergone Mantoux/PDD tuberculosis skin test, and only 19.12% had run vaccination against tuberculosis through BCG vaccine. At the end of the

**Tab. V.** Fifth area of application: knowledge about guidelines in case of accidental exposure to biohazards and preventive vaccinations.

| | At the beginning of the courses | | | At the end of the courses | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 1 | 2 | 3 |
| | % | % | % | % | % | % |
| Do you know the current guidelines after accidental exposure to biohazards? | | | | | | |
| 1. Yes, quite<br>2. No, quite<br>3. Yes, incompletely | 64.49 | 11.11 | 28.40 | 83.54 | 2.53 | 13.92 |
| Have you been subjected to vaccination against hepatitis B? | | | | | | |
| 1. Yes<br>2. No, I have not yet had the opportunity<br>3. No, because I do not think useful | 80.56 | 19.44 | 0.00 | 88.00 | 12.00 | 0.00 |
| Are you interested in vaccination against flu? | | | | | | |
| 1. Yes<br>2. No, flu is a non-serious illness with spontaneous resolution<br>3. No, because I do not think useful | 69.74 | 3.95 | 26.32 | 76.06 | 5.63 | 18.31 |
| Have you run a form of tuberculosis prevention? | | | | | | |
| 1. Yes, I did BCG vaccine<br>2. I did Mantoux/PDD tuberculosis skin test<br>3. No | 19.12 | 36.76 | 44.12 | 21.92 | 52.05 | 26.03 |

courses, the percentage of those who had not done anything fell to 26.03%, 52.05% of the students undergone Mantoux/PDD tuberculosis skin test, while the percentage of vaccinated with BCG had not been significantly increased (21.92%).

## Discussion

Italian Nursing Schools use a wide range of tutorial strategies (laboratory sessions, intensive clinical tutoring, and weekly tutoring) aimed to enhance nursing students' clinical reasoning: these strategies have different impacts on promoting student critical thinking. Italian nursing students are asked to develop abilities to check, monitor and constantly evaluate the accuracy of the skills needed for patient care. However, the present study demonstrates there are inconsistencies in student instruction, in particular regarding the relationship between nurses' knowledge/abilities and patient outcomes.

The present study showed that students of the first two years of the Professional Nursing Course intend the use of gloves during the handling of needles, mainly to perform self-protection. In fact, a high percentage of nursing students used the gloves both in the execution of intravenous injections and in blood sampling; on the other hand, the use of gloves was considered unnecessary to perform both intramuscular injections and fingertip punctures, considered less dangerous practices. However, the concept of self-protection is contradicted by the fact that a large percentage of nursing students kept the habit of recap used needles. Although this practice is universally considered highly dangerous [19, 20], the lack of a mature critical thinking leads nursing students to wrongly consider the recap of needles as another form of self-protection. This may be explained by the results of the second area of application, which concerns the use of gloves during operations involving a direct contact with patient. In this case, there was an almost universal acceptance in the use of gloves in duties involving contact with the patient secretions, but there was less agreement in case of the execution of a trichotomy, which is considered as a practice with fewer possibility of direct contact, even if it involves the use of a sharp instrument.

Similarly, the use of gloves as a way of self-protection is further confirmed by results observed in the third area of application, showing an almost general acceptance in the use of gloves both to clean surgical instruments and to exchange dirty linen of the patients. The fact that only 60% of respondents deemed useful the use of gloves in handling test tubes containing blood remains incomprehensible.

The fourth area of application concerned the knowledge of basic prevention measures regarding hospital infections. The most surprising finding is that only 65.88% of responders washed their hands when coming in ward. This involves that a significant percentage of students of the early years of the nursing curricula have not yet gained the critical thinking necessary to consider the importance of universal precautions as a means not only of self-protection but also of prevention of hospital infections. This is confirmed by the fact that the change of gloves from one patient to another was practised "sometimes" by 29.41% of the students and "never" by 1.18%. In this case the teacher assumes great importance to promote critical thinking. In fact, the percentage of students who persisted in this attitude decreased at the end of courses. Moreover, the percentage of students used to change gloves from one patient to another 'only sometimes' decreased to 12.66%. A small percentage ("never": 1.27%) persisted in their wrong attitude even at the end of lessons.

The fifth area of application concerned the knowledge about both the current guidelines in case of accidental exposure to biohazards and preventive vaccinations. This is the area where the teaching had the biggest influence in correcting wrong attitudes. The completion of the cycle of lessons in Hygiene and Occupational Health, indeed, led to a general improvement in levels of knowledge relating to guidelines for the prevention of infectious diseases after exposure to biological agents. However, some problems relating to different students' believes towards certain vaccine preventable diseases remained open. While there was a general consensus about the importance of vaccination against hepatitis B, considered as a useful self-protection, there were a high percentage of students judging the flu as a non-serious illness with spontaneous resolution; for this reason, they believed vaccination unnecessary. With regard to tuberculosis, at the end of the lessons only 52.05% of the students had agreed to undergo Mantoux/PDD tuberculosis skin test (before lessons: 36.76%) and only 21.92% had run vaccination with BCG (before lessons: 19.12%). Noteworthy, the high percentage of students (26.03%) that had not yet performed any prophylaxis against TBC remains unexplained.

## Conclusions

The analysis of all these results permits to draw some conclusions. First of all, students of the first two years of nursing course consider the basic standard measures for the control of infectious diseases only like self-protection and not to prevent hospital infections. The fact that at the end of courses of Hygiene and Occupational Health a large percentage of students continues to have poor clinical skills indicates that it is necessary to implement the practical aspects of these courses, stimulating critical thinking applied even to the minutest features of the practical nursing care. Second, this study shows that it is necessary to introduce the use of questionnaires in order to check learning effectiveness. The use of structured questionnaires during the period of lessons may be a valuable tool to identify and update critical points, especially in reference to:

- the attitude to make something understandable;
- the attitude to represent an event or a fact;

- the attitude to establish a two-way communication system;
- the possibility to have a feedback and consequently improve communication techniques.

The enhancement or modification of these skills by teachers could decrease the nursing students' gap between the acquired knowledge and its application in routine clinical practice.

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■ Correspondence: M. Bergamini, Department of Clinical and Experimental Medicine, Section of Hygiene and Occupational Health, University of Ferrara, via Fossato di Mortara 64/b, 44100 Ferrara, Italy - Tel. +39 532 455 273 - Fax + 39 532 205066 - E-mail: brm@unife.it