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Blood and body fluids exposure of healthcare workers in a university hospital of Palermo, Italy: a fourteen years long surveillance

C.M. Maida[1,2], L. Aprea[2], G. Calamusa[1,2], F. Campisi[1], D. Favaro[1], G. Russo Fiorino[1], A.M. Fodale[1], M.L. Maniglia[1], V. Marchese[1], M.M. Velardo[3], M.V. Torregrossa[1,2]

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Parole chiave: Rischio biologico, sicurezza sui luoghi di lavoro, prevenzione, addestramento

Abstract

Background. *Healthcare workers are habitually in direct contact with patients, possible carriers of infectious diseases and with potentially infectious biological materials; therefore, the implementation of standard precautions and good working practices represent an intervention strongly recommended by the Centers for Disease Control and Prevention, and required by Italian law, for the prevention of professional cut wounds. The study focused on assessing the exposure frequency and factors related to biological injuries among healthcare workers in a teaching hospital in Palermo, Italy.*

Methods. *We performed a 14-years retrospective descriptive analysis on blood and body fluids exposures in healthcare workers, documented by questionnaires administered at the time of injury and by data collected during the follow-up period. The questionnaire included questions concerning personal data (age, sex), job position (role, employment contract, ward), biological exposure (type of exposure, devices used and circumstance of blood and body fluids exposure), precautions adopted (personal protecting equipment, safety devices) and vaccination status.*

Results. *A total amount of 899 healthcare workers was investigated. The incidence rate per 100 beds was 10.7. Frequency of exposure to blood and body fluids among healthcare workers was 35.3% in nurses, 31.7% in physicians, 17.6% in students. The mean age of injured healthcare workers was 36 years. The most common blood and body fluids exposures were represented by needlestick injury (76.2%), splash and spill (15.0%) and sharp (8.3%). 585 out of 685 percutaneous exposures were caused by needles (syringe, peripheral venous catheter, butterfly needles, etc.) and occurred mainly to nurses (N=224, 38.3%), physicians (N=184, 31.4% of whom resident physicians=122, 20.1% and hospital doctors=62, 10.6%), students (N=96, 16.4%) and auxiliary personnel (N=77, 13.1%). No seroconversion among exposed healthcare workers was recorded in the whole survey period. Twenty-four healthcare workers (2.6%) received post-exposure prophylaxis against Hepatitis B Virus.*

Conclusions. *To our knowledge, this is the first long-term survey on blood and body fluids exposure in Southern Italy. Nurses are the most commonly affected group by biological injuries. Resident physicians and*

[1] *Department of Health Promotion, Mother and Child Care, Internal Medicine and Medical Specialties, University of Palermo, Palermo, Italy*
[2] *Azienda Ospedaliera Universitaria Policlinico "P. Giaccone", Palermo, Italy*
[3] *European School of Obstetric Anesthesia EESOA, Rome, Italy*

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students follow the nurses probably due to a lack of training and experience about biological risk. These last two groups, however, seem to have more awareness of blood and body fluids exposures to which they are susceptible during their training cycle; in fact, they mostly use personal protective equipment compared to other healthcare workers. The blood and body fluids exposures are a preventable and a major occupational hazard in healthcare. This focus highlights the need for interventions to enhance the occupational safety of workers and students.

Introduction

Risks and diseases associated with work activities represent a serious problem for our social organization, due to the high number of deaths and disabilities. Some socio-demographic characteristics (gender, age and educational level), type of work, job seniority and perceived risks are associated with work-related risk factors such as occupational accidents (1, 2). In clinical setting, the bloodborne infections have serious consequences, including long-term diseases, disability and even death, that unavoidably result in economic burden, mostly providing direct costs (i.e. post-exposure management) and indirect costs (i.e. counselling of injured victims, staff absence and compensation) (3). Now, it is clear that occupational exposure to biological risks, in particular from blood-borne pathogens, is a major priority issue for public and private health organizations around the world (4). National and international health authorities have recently stressed the role of prevention in improving the health status of people and communities, as well as a tool to promote the socioeconomic development of the population (5). In health facilities and services, the healthcare workers (HCWs) are the most exposed to biological risks, because of their daily contact with fluids from human body or microorganisms. Every year, in fact, hundreds of HCWs are exposed to deadly viruses such as hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV) due mainly to needle-stick injuries (6). Although the risk of exposure to blood and body fluids (BBF) in HCWs is high, more recent researches have shown that the biological risk is less known by HCWs than by other categories of workers (7, 8). Biological risk is present in all phases of care and handling of biological materials; therefore, the implementation of standard precautions and good working practices represent a necessary intervention required by law and strongly recommended by the Centers for Disease Control and Prevention (CDC) for the prevention of professional cut wounds (9). Percutaneous exposures represent an extremely frequent event in health facilities (6, 10, 11); among the many pathogens acquired through this type of exposure, those of greatest interest are HIV, HBV and HCV, due to the frequency of exposure and their health impact. The incidence of acute C hepatitis became significantly higher among HCWs (1.6 for 100,000) with respect to the general population (0.6), with a seroconversion rate following an occupational exposure between 0.5% and 1.8% (10). Given the serious consequences of acquiring HIV, HBV and HCV infection from the infected patient/resident populations, BBF exposure remains an ongoing and growing problem in most healthcare workplaces, despite published guidelines and training programs to prevent BBF transmission (12). It has been estimated that about 600,000 HCWs in the United States (13, 14) and 450,000 in Italy (15) are exposed to BBF every year. In Italy the device-specific needlestick injury rates are similar to those reported by the United States, suggesting similar exposure experience in the two countries (16). Cases of

professional infection with BBF have been documented for more than 50 different pathogens (17). Among these pathogens, 66,000 HBV, 16,000 HCV and 200-5,000 HIV infections are recorded worldwide annually, and attributed to contaminated sharp injuries (18). The risk of acquiring HIV (and other blood-borne diseases) through occupational exposure is very low and this risk can be further reduced by adopting safe work practices (19). Previous studies have identified the following professionals as vulnerable after exposure to BBF: nurses, doctors and surgeons, laboratory technicians, dentists, hygienists, dental surgery assistants, cleaning staff, medical students and nursing students (12). In Italy, the most important epidemiological data on occupational accidents derive from the Italian study on HIV risk (Studio Italiano sul Rischio Occupazionale da HIV - SIROH), launched in 1986 under the coordination of the Epidemiology Service of the National Institute for Infectious Diseases " L. Spallanzani " in Rome (20). SIROH has collected over 100,000 biohazard exposures reported by about 150 Italian hospitals and a occupational case of HBV, 6 HIV cases and 32 HCV cases have been documented from 1986 to 2009 (10). The risk of bloodborne pathogen transmission following occupational exposure depends on a variety of factors that include source patient factors (e.g., titer of microorganisms in the patient's blood/body fluid), type of injury and quantity of blood/body fluid transferred to the HCW during the exposure, and HCW's immune status (21). As well as having the highest prevalence of percutaneous and mucocutaneous injuries among HCWs, doctors and nurses also have the highest rates of underreporting of these injuries among HCWs (22). The most alarming concern refers to the high tendency of under-reporting BBFs among nursing students internationally, which ranges from 9.4% to 61.9% in Asia, US, Canada, Australia and European countries and non-reported injuries range from 39.5% to 96.2%. The lack of knowledge is the major reason for non-adherence to preventive strategies that leads to a biological exposure (23). Yao et al (4) documented an interesting result among nursing students following a specific training program about occupational exposure, finding a statistically significant difference ($p<0.0005$) in frequency of cases, according to the behavior and the knowledge in the prevention of biological injures. Trends and types of occupational injuries in Palermo University Hospital were analyzed to identify how to implement existing monitoring system of BBF exposures and prevention strategies in HCWs.

Methods

We performed a retrospective descriptive analysis of BBF exposures of the HCWs at the University Hospital in Palermo, Italy, which has 600 beds, and separate facilities for adults, children and dental patients. During the 14-year study period (from January 1, 2004 to January 1, 2018), the University Hospital had approximately an average of 2,364 HCWs, 570 of them being physicians, 739 nurses and 190 auxiliary personnel. Moreover, 883 residents, 3,309 medical students and 548 nursing students were present in the last few years of the survey. The population at risk included not only the personnel directly involved in patient care activities, but also those involved in cleaning tasks and anyone who had occasional contact with blood or other body fluids. Occupational exposure is an injury or incident that involves exposure to blood, visibly bloody fluids, other body fluids to which universal precautions apply (i.e., semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, and amniotic fluid), tissues and laboratory specimens that may contain concentrated virus (24, 25). All BBF exposures were documented with questionnaires administered by an interviewer to

HCWs face-to-face, reporting injuries and collecting data during the follow-up period (12 months). The questionnaire included questions on personal data (age, sex), on job position (role, employment contract, ward), on biologic exposure (type of exposure, device used and circumstance of BBF exposure), on precautions adopted (personal protecting equipment, safety devices) and on vaccination status. The Prevention and Monitoring of Hospital Acquired Infections Unit monitored all occupational exposures within the Hospital. Data were stored and analyzed using software R version 3.4.4. Descriptive statistics were also computed on the entire set of data.

Results

Over the 14-year study period, a total of 899 BBF injuries were recorded, with an average of 64 accidents per year (SD=11.6; 95% CI=57-71). The incidence rate was 10.7 per 100 beds. There was also a decrease in overall incidence of injuries over the study period (-32.5%).

Figure 1 and Table 1 show the distribution of accidents per year and per HCW qualification. The mean age of injured HCWs was 36 (SD=±11.65; 95% CI=35-37). Trends of injuries for hospital doctors, resident

Table 1 - BBF exposure distribution of HCWs

Profession	N = 899 (%)
Nurses	317 (35.3)
Physicians	285 (31.7)
Residents	194 (21.6)
Hospital doctors	91 (10.1)
Students	158 (17.6)
Nursing students	79 (8.7)
Midwifery students	20 (2.2)
Medical students	8 (0.8)
Other students	51 (5.7)
Auxiliary staff	109 (12.1)
Others	30 (3.3)

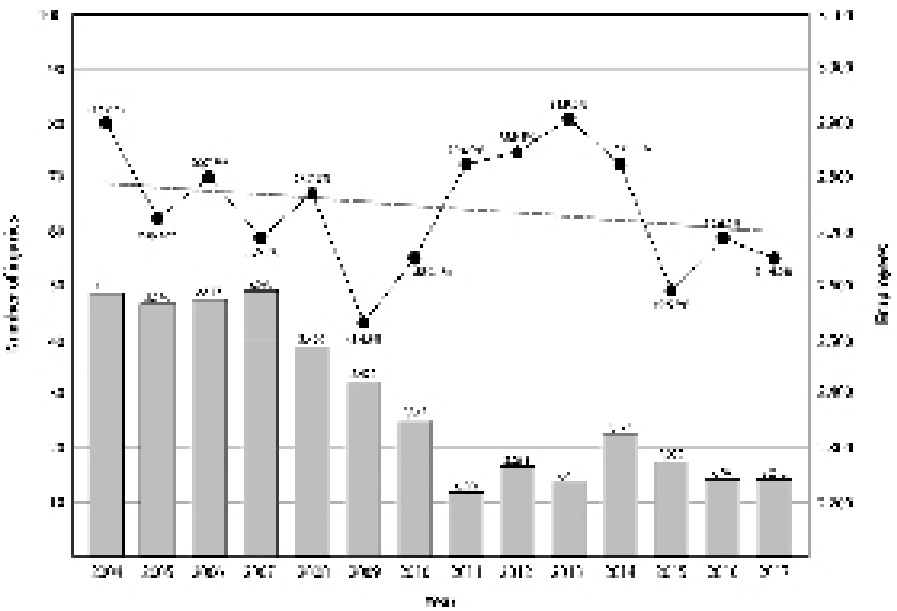

Fig. 1 - Distribution of BBF exposures per year and number of hospital employees.

physicians and nurses were moderately declining, with an average reduction of 0.25%, 0.45% and 0.46%, respectively in the 14-year period, while the trend for medical and nursing students was significantly growing (average increase= +6,67%). The most common BBF exposure was needle-stick injury (N=685, 76.2%), followed by splash and spill (N=135, 15.0%), sharp (N=75, 8.3%) and others (N=4, 0.5%). Sub-group analysis of HCWs showed different patterns of type of exposure by categories, with nurses, physicians and students reporting more injuries, except cuts, as shown in Table 2. This relation showed a statistically significant association ($p<0.05$) when assessed by a chi-square test of independence (c^2 (55, N=866) = 523.36). Table 3 summarizes the hospital settings where accidents occur most frequently. In all healthcare facilities, 40.5% of the BBF exposures occurred in patient's room at the patient's bedside, 22.0% in operating rooms and 11.0% in outpatients' clinics. Higher cases of accidents were recorded during blood sampling (14.5%), managing of a medical device (before and during use, before and after disposal) (12.9%), injection therapy (12.0%), surgery (11.2%) and detection of blood glucose (8.8%). We examined the relation between the main medical devices that caused injuries and professional profiles. 585 out of 685 percutaneous exposures were caused by needles (syringe, peripheral venous catheter, butterfly needles, etc.) and occurred mainly to nurses (38.3%), to resident physicians (23.7%), students (16.4%) and auxiliary personnel (13.1%).

The HCWs who, at the moment of the accident, wore at least one personal protective equipment (PPE) were 81.2% as an average, somewhat higher between students (87.3%) than other HCWs (resident physicians=83.0%, nurses=80.1%, hospital doctors=78.0%, others=56.0%). The most used PPEs by HCWs are lab coats or uniforms (72.6%), gloves (70.2%), shoe covers

Table 2 - Distribution of HCWs qualifications according to type of BBF exposure.

Exposure and profession	N = 899 (%)
Needlestick	685 (76.2)
Nurses	263 (38.4)
Physicians	201 (29.3)
Students	117 (17.1)
Auxiliary staff	95 (13.9)
Others	9 (1.3)
Splash and spill	135 (15.0)
Physicians	46 (34.0)
Nurses	36 (26.6)
Students	36 (26.6)
Others	9 (6.8)
Auxiliary staff	8 (6.8)
Sharp object	75 (8.3)
Physicians	37 (49.3)
Nurses	16 (21.2)
Auxiliary staff	9 (12.0)
Others	8 (11.0)
Students	5 (6.5)

Table 3. Hospital settings where the BBF exposure occurred

Hospital setting	N=899 (%)
Clinical	586 (65.2)
Internal medicine	72 (7.3)
Emergency	66 (7.3)
Dermatology	40 (4.4)
Gastroenterology	32 (3.5)
Oncology	24 (2.6)
Surgical	244 (27.1)
Obstetrics and gynecology	60 (6.6)
General surgery	52 (5.7)
Plastic surgery	36 (4.0)
Cardiac surgery	33 (3.6)
Oncologic surgery	29 (3.2)
Hospital services	69 (7.7)
Pathology	16 (1.8)
Radiology	14 (1.5)
Occupational medicine	8 (0.9)
Clinical laboratory	6 (0.7)
Blood bank and trasfusion center	5 (0.5)

(23.0%), respirator filters (20.4%), head covers (19.3%) and glasses or face shields (18.8%). We documented a significant increase ($p<0.05$) in use of PPE over the time of this survey (c^2 (13, N=866) = 75.3). Moreover, we found resident physicians (66.6%) and students (60.7%) used multiple PPEs simultaneously more often than hospital doctors (53.8%), nurses (40.0%) and auxiliary personnel (37.7%).

The serological tests were performed to 24 source patients/year (37.6% of total BBF exposures; SD =±15.3; C.I. 95%=15.3-32.6) and to 28 HCWs/year (43.3% of total BBF exposures; SD=±26; C.I. 95%=12.9-43.0) as a mean, with values that ranged from 20 and 35% in 2004 to 85 and 70% in 2017 for sources and HCWs, respectively. The 25.0% of all exposures involved source patients testing positive for blood viruses (HBV, HCV, HIV). In particular, 2.7% of source patients were testing positive for HBV, 6.4% for HIV and 15.8% for HCV. No seroconversion among exposed HCWs were recorded during the whole survey period. Twenty-four HCWs (2.6%) received post-exposure prophylaxis against HBV, consisting in vaccination and immunoglobulins within 72 hours of injury, because they did not have a protective antibody titre.

The vaccination coverage level of HCWs was also assessed. 721 (80.2%) out of the 899 injured HCWs declared to be vaccinated against hepatitis B, 144 (16.0%) against tetanus, 116 (13.0%) against tuberculosis and 27 (3.0%) against typhoid fever. The seasonal flu vaccination coverage was around 25.0% and it has strongly grown in the last year of survey due to an aggressive campaign to raise awareness among healthcare professionals.

Discussion and conclusions

To our knowledge, this is the first long-term survey on BBF exposure in Southern Italy. The proportion of HCWs who had an accidental exposure to BBF in our study was 2.6%, less than in other surveys (26-28). Nursing personnel and medical students are the most commonly affected group, with significant gender differences (rate female/male=1.8). Protano et al. (29) reported that there are a great number of differences in term of risk, both regarding the exposure to occupational risks and/or the related adverse effects between female and male, for biological, genetic, hormonal, physiological body/organ factors and behaviors, social, economic and family roles. In this survey, we assume that the difference is mainly due to the predominance of women working in our hospitals. Regarding nurses, this is likely to be due to their close daily contact with patients (30) and the fact that they are expected to do the routine blood draws and intravenous insertion procedures (31). Students and resident physicians have awareness of BBF exposures to which they are susceptible during their training cycle, in fact, they are the group who has higher percentages of use of PPE between HCWs and higher simultaneous use of PPE. Probably due to a lack of training and experience about biological risk, they are a group with a high incidence of BBF exposures. Almost similar results were reported in other studies (32-34), although the literature on the subject also presents evident differences regarding the survey methodology, making it difficult to compare the results produced in the different countries. In the present study we have also demonstrated that needlestick injuries are the most common accidents in our teaching hospital. The characteristics of sharp injuries vary with the kind of instrument, and this has important implications for planning measures to prevent sharps injuries. To avoid the transmission of blood-borne pathogens, HCWs must adhere to universal precautions and follow fundamental infection control principles (35). These principles and practices need to be made explicit in

institutional policies and reinforced through in-service education for all HCWs, including those in ambulatory care settings (25). The HCWs working in a busy hospital are usually under extreme pressure and overburdened. Thus, personal protection may not always remain a priority for them (36). The decrease in BBF exposure of HCWs in the University Hospital in Palermo during this 14-years' survey, could be explained just by improvements in exposure and risk-reduction policy and efforts. Cumulatively, the data suggest that if sharps injuries are to be reduced, preventative efforts must be focused on the devices and settings in which the injuries most commonly occur (37). Prevention of occupational transmission of bloodborne pathogens requires a diversified approach to reduce blood contact and percutaneous injuries including improved engineering controls (e.g., safer medical devices), work practices (e.g., technique changes to reduce handling of sharps), the use of PPE (e.g., impervious materials for barrier precautions) and vaccination programs to reduce the number of unprotected operators and the resulting risks to acquire infections and to transmit them to patients or other health professionals as documented by Sernia et al. (38). These efforts include training in prevention and procedure. The theoretical teaching of hygiene and occupational medicine provided by the educational system of nursing and medicine school was the main source of information for students about occupational risk and post-exposure prophylaxis in case of injuries with biological fluid until April 2008 (23). De Giusti et al (39) emphasize that perception and knowledge of biological risk is lower among HCWs than among those in other work sectors, suggesting the need of specific training on biological risk in order to reduce the lack of knowledge in this area. In Italy, in fact, in 2008 the Decree No. 81/2008 "Testo Unico sulla Salute e Sicurezza sul Lavoro" was enforced, that is the leading Occupational Safety and Health (OSH) legislation in this Country (40). This legislation reinforces the general measures to protect the health and the safety of workers at workplace including information and training for workers. Signorelli et al. (5) showed that in Italy health expenditure on workplace prevention increased by 21% over a period (2006-2013) with a wide regional range over total expenditure (5.5%-27.5%; 7.7% in Sicily) and that there is a positive correlation between regional health expenditure on workplace prevention and safety and numbers of workers, although in some regions the increase in expenditure does not correspond to a decrease in occupational accidents. In our teaching hospital, according to the OSH legislation, a series of measures have been adopted which have contributed to the reduction of BBF exposures. Firstly, in 2009, a specialized face to face personal protective equipment training was introduced for HCWs, in order to complete skills and knowledge on the use of PPEs. This training program could have contributed to the increase in use of PPE from a mean of 33.5% to 40.0% (+ 6.5%). Another important step toward the safety of HCWs from BBF exposure was the adoption in 2010 of an accurate diagnostic-clinical path after every occupational accident. Finally, in 2012, an advanced training on biological risk was introduced to protect health and safety of workers. Despite the introduction of these measures, although there has been a reduction in injuries, they remain a preventable, frequent, major occupational hazard in healthcare. Future researches in our area are needed to focus on work organization, safety behavior of HCWs, to provide better insight into the occurrence of BBF exposures and to include, into the academic curriculum, more training about the skills required to stay safe in the work environment.

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management. The Authors declare also that no conflict of interest exists that could inappropriately bias conduct and findings of the study and that no grant support was used for this study. The present study did not require the approval of the Ethics Committee as the anonymous review of the accidents and their characteristics is an obligation already covered by the law.

Riassunto

Quattordici anni di sorveglianza degli incidenti occupazionali a rischio biologico tra gli operatori sanitari di un ospedale universitario di Palermo, Italia

Premessa. Gli operatori sanitari sono figure professionali ad alto rischio di esposizione a sangue e fluidi biologici potenzialmente contaminati. Il rischio biologico è intrinseco a tutte le fasi di assistenza sanitaria e di manipolazione di materiali biologici; pertanto, l'implementazione di precauzioni standard e di buone pratiche di lavoro rappresentano un intervento necessario richiesto dalle normative sulla sicurezza sui luoghi di lavoro e dai Centers for Disease Control USA al fine di prevenire le esposizioni a rischio biologico da punture e ferite da taglio. Lo studio è stato incentrato sulla valutazione della frequenza di esposizione e dei fattori correlati agli incidenti occupazionali occorsi agli operatori sanitari di un ospedale universitario a Palermo, Italia.

Metodi. È stata condotta un'analisi descrittiva e retrospettiva della durata di 14 anni delle esposizioni a sangue e fluidi biologici documentate da questionari somministrati al momento dell'infortunio e durante il periodo di follow-up. Il questionario comprendeva domande relative a dati personali (età, sesso), posizione lavorativa (ruolo, contratto di lavoro, reparto, ecc.), modalità di esposizione, precauzioni adottate (dispositivi di protezione individuali, dispositivi di sicurezza) e stato della vaccinazione.

Risultati. Il campione oggetto di studio era formato da 899 operatori sanitari infortunati. Il tasso di incidente per 100 letti è stato di 10,7. Tra gli operatori sanitari, la frequenza di esposizione a sangue e fluidi biologici è stata del 35,3% tra gli infermieri, 31,7% tra i medici e del 17,6% tra gli studenti. L'età media degli operatori sanitari infortunati era di 36 anni. Le esposizioni più comuni sono state causate da punture accidentali (76,2%), schizzi e sversamenti (15,0%) e tagli (8,3%). 585 ferite percutanee su 685 (85,4%) sono state causate da aghi (siringa, catetere venoso periferico, aghi a farfalla, ecc.) e sono occorse principalmente ad infermieri (N=224, 38,3%), medici (N=184 o 31,4%, dei quali N=122 o 20,1% in formazione specialistica e N=62 o 10,6% medici ospedalieri), studenti (N=96; 16,4%) e personale ausiliario (N=77; 13,1%). Tra gli operatori sanitari esposti non è stata registrata nessuna sieroconversione. Ventiquattro operatori sanitari hanno ricevuto una profilassi post esposizione contro l'HBV.

Conclusioni. Questo è il primo studio a lungo termine sulle esposizioni a rischio biologico in operatori sanitari nel sud Italia. Gli infermieri sono gli operatori sanitari che più frequentemente hanno subito un incidente a rischio biologico, seguiti dai medici in formazione specialistica e dagli allievi infermieri. Nonostante ciò, questi ultimi due gruppi sembrano più consapevoli del rischio a cui sono esposti durante il loro periodo di formazione e addestramento, infatti, risultano il gruppo che maggiormente utilizza i dispositivi di protezione individuale a loro disposizione. Le esposizioni a sangue e fluidi biologici costituiscono un rischio professionale grave ma prevenibile. Questo studio evidenzia la necessità di attuare ulteriori interventi per migliorare la sicurezza sul lavoro degli studenti e degli operatori sanitari in generale.

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Corresponding author: Carmelo Massimo Maida, Department of Health Promotion, Mother and Child Care, Internal Medicine and Medical Specialties University of Palermo, Via del Vespro 133, 90127 Palermo, Italy
e-mail: carmelo.maida@unipa.it