

Job stress and needlestick injuries in nurses: a retrospective observational study

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Abstract. *Background:* The prevention of needlestick injuries (NSIs) in nurses employed in Emergency Departments (EDs) represents a special issue for healthcare organizations globally. Stressful working conditions, lack of organizational arrangements and lack of supporting one another at work, may contribute to increase the risk of NSIs. *Methods:* We conducted an observational study to analyze: 1) the effectiveness of organizational interventions to minimize the occurrence of NSIs in ED nurses; 2) to measure the impact of such interventions on the safety budget. *Results:* The occurrence of NSIs detected after organizational level interventions was significantly lower than the occurrence observed previously such interventions ($p < 0,05$). By results, cost saving from managing fewer NSIs than the previous period was found. *Conclusion:* The study shows that the proactive, integrated and comprehensive management of organizational features at workplace brings benefits to employees and reduces the burden of the occurrence of NSIs. As result of the reduced NSIs frequency, the overall costs for follow-up of injured workers were reduced. (www.actabiomedica.it)

Key words: Emergency Department, healthcare worker, stress, risk management

Introduction

Needle stick injuries (NSIs) are frequently received by people handling needles in the medical setting and represent risks to health care workers (HCWs) worldwide (1-4). The World Health Organization estimates that every year 3 million healthcare workers experience percutaneous injuries (5). The National Institute for Occupational Safety and Health (NIOSH) USA has defined NSIs as injuries caused by needles such as hypodermic needles, intravenous (IV) stylets, and needles used to connect parts of IV delivery systems (6). The frequency of such events has been estimated to be about 600,000-800,000 cases annually in the USA (7), 100,000 NSIs occur in the UK (8) and 500,000 in Germany (9). These data underline that HCWs are at risk of acquiring blood-borne diseases; in fact by literature is reported that among HCWs the risk for acquiring infections with HCV, HBV, and HIV

attributable to occupational exposure to percutaneous injuries is estimated to be 39%, 37%, and 4.4% respectively (10). The economic cost of NSIs among HCWs varies country to country, due to different study methodologies; by the available reports the cost per year estimated in Germany is between €4.6 million and €30 million, \$6.1 million in France (considering nurses alone), €72 million in Italy (not considering long-term treatment, compensation or indirect costs) (11).

The cost per reported NSI (12,13) is due to interventions such as:

- Testing for infection in the injured worker and, if known, the patient on whom the sharp had been used.
- Post-exposure prophylaxis (PEP) to prevent or manage potential blood-borne virus transmission.
- Short- and long-term treatment of chronic blood-borne viral infections that are transmitted to injured workers.

- Staff absence and replacement.
- Counselling for injured workers.
- Legal consequences (e.g. litigation and compensation claims).

HCWs employed in Emergency Department (ED) are particularly exposed to NSI risk, due to specific occupational risk factors linked with the ED health-care professions such as high exposure to physical and biological risks, variable workloads, increasing and unpredictable job demand and three shift work (1, 12-14). In a recent study Weaver et al. observed an association between shift length and the risk of occupational injury and illness among Emergency Medical Services shift workers (15). The risk of injury was 60% greater (RR 1.60; 95% CI 1.22 to 2.10) for employees that worked shifts >16 and ≤24 h. Stressful working conditions, lack of organizational arrangements and lack of supporting one another at work, may contribute to increase the risk of NSI among HCWs (16-20). Furthermore, recently, Loerbroks A. et al. highlighted that the occurrence of NSIs is a predictive factor of less favorable perception of psychosocial work (19).

A study conducted among Japanese nurses showed that hospital safety climate has an important influence on NSI injury rates and reporting behavior among nurses (20); in fact, the interventions focused on the context area of the work, such as being involved in health and safety matters and being properly trained in risk control procedures, were associated with a reduced NSI risk. In a recent our study (21) we found the efficacy of primary-level interventions focused on work context area to minimize work-related stress (WRS); the interventions were focused on team development, on implementing safety training programs, and on adopting an ethics code for HCWs (Table 1).

Based on these evidences we conducted a retrospective analysis of the occurrence of NSIs among the HCWs (Nurses) employed in an Hospital ED, in Salento, Italy, before and after the implementation of such organizational interventions. The aims of this study were: 1) to investigate the interactions between organizational level interventions focused on WRS and the occurrence of NSIs among ED nurses; 2) to determine the impact of such interventions on the economic burden of NSIs.

Methods

In the period between 2011 and 2014 was conducted an observational study to detect and analyze in different work settings the level of WRS among the ED HCWs (physicians and nurses) of the Local Health Authority, in Salento, resulting from organizational changes (21).

The study was performed using the multidimensional validated tool developed by the Italian Network for the Prevention of Work-related Psychosocial Disorders, in accordance with the Consultative Committee's specific requirements (22-24). In that study (21) the authors showed that the implementation of improvement interventions focused on team development and safety training programs, effectively and significantly reduced the WRS risk in the workplace from medium to low level. The results of the investigation highlighted that "work context" was the priority area of organizational interventions aimed to reduce WRS (Table 1). After such investigation, the authors compared the NSI occurrence among the nurses employed in the ED in the period January 2016 - December 2018 and in the period between January 2013 - December 2015, respectively after and before the adoption of organizational improvement interventions. The study population was the same, before and after such improvement interventions and is reported in Table 2. The study was conducted in an ED that had more than 100,000 admissions annually. The equipment of safety medical devices aiming to prevent percutaneous exposure injuries caused by needles was the same in the two periods examined and included blood collection systems, intravenous systems, injection systems, multiple devices and sharps containers intravenous. About the second objective of the study, the economic impact of NSIs was defined as: 1) direct cost of baseline and follow-up laboratory testing of each exposed HCW 2) direct cost of testing the source patient 3) cost of post exposure prophylaxis and other treatment that might be provided. In Italy the average cost of such post-exposure interventions was estimated by 850 € per reported injury (24); such cost doesn't consider long-term treatment, compensation or indirect costs. In this study the authors estimated the direct cost of NSIs per 100 full time equivalent (FTE) positions (Nurses) per 3-year.

Table 1. Work context critical issues and improvement interventions

Area of critical issues	Intervention
Function and organizational culture	<ul style="list-style-type: none"> - working towards goals that include occupational safety and wellness - adoption of a safety management system - adoption of code of ethics for healthcare workers
Role within the occupational organization	<ul style="list-style-type: none"> - clear definition of occupational roles - knowledge of hierarchical roles for occupational safety - employee involvement in corporate decision-making
Relationship at work	<ul style="list-style-type: none"> - communication with management staff - reflective dialogue and feedback among workers - clinical supervision in relation to WRS - constructive conflict

Table 2. Study population

Nurses	130
Gender (%) (M-F)	48 (37%) - 82 (63%)
Age (M-F) (SD)	45,8 (\pm 2,9) 43,4 (\pm 4,1)
Years of work (M-F) (SD)	22,9 (\pm 2,9) 20,7 (\pm 3,7)

Statistical analysis

The statistical analysis of the data was based on the calculation of the average, the standard deviation, the distribution, and the range in accordance with the nature of individual variables. The differences between the percentages and between the averages were compared using, respectively, the chi square test and the Student's t- test for continuous data. Differences were considered significant for values of $p < 0.05$.

Results

The cumulative 3-year incidence of NSIs occurred after the implementation of management stress interventions (period 2016-2018) was significantly lower than the cumulative 3-year incidence occurred in the period 2013-2015 (previously such implementations) (10,77 injuries per 100 FTE positions vs. 26,15 injuries per 100 FTE positions; $p < 0,01$ chi square test); the organizational interventions resulted effective in minimizing the occurrence of NSIs (OR=0,34; 95% CI = 0,17 - 0,67). No significant differences were found in the gender distribution of the NSIs, age and years of work of injured nurses in the two periods investigated ($p > 0,05$) (Table 3). The number of accesses to the ED in the 3-year periods analyzed did not show significant differences ($p > 0,05$). Cost savings from managing fewer NSIs in 3-year period 2016-2018 than the 3-year period 2013-2015 was estimated at €13.073,00 per 100 FTE positions (nurses) per 3-year.

Table 3. Gender, age and years of work of injured nurses, per year (SD)

Year	2013	2014	2015	2016	2017	2018
Gender(%) (M-F)	27,5-72,5	23,2-76,8	28,9-76,1	25,4-74,6	26,3 - 73,7	28,3 - 71,7
Age (years) (M-F)	45,2 (\pm 3,7) 44,1 (\pm 4,1)	43,7 (\pm 3,1) 47,4 (\pm 3,5)	46,6 (\pm 4,4) 45,7 (\pm 2,8)	42,9 (\pm 2,9) 44,1 (\pm 3,1)	46,2 (\pm 3,7) 45,3 (\pm 3,4)	48,2 (\pm 4,4) 44,3 (\pm 2,8)
Years of work (M-F)	23,4 (\pm 2,9) 25,1(\pm 3,4)	23,7 (\pm 3,1) 26,5(\pm 2,5)	24,9 (\pm 3,4) 19,7(\pm 3,1)	22,1 (\pm 2,7) 18,7(\pm 3,9)	24,4 (\pm 1,8) 26,6(\pm 3,2)	25,4 (\pm 3,8) 19,6(\pm 2,1)

Discussion

In this study the organizational level interventions aimed to minimize WRS through improving the work context area, were effective in minimizing the occurrence of NSIs among the ED nurses. The aim of the interventions was to encourage the participatory solution-oriented steps involving managers and workers in primary prevention and working conditions improvement. In particular, proactive interventions focused on the area of “Function and organizational culture” consisted in the organization of occupational safety trainings for Head Physicians and Head Nurses; the targeted were: 1) the implementation of an organizational model based on the achievement of occupational safety objectives; 2) the style of management focused on the support towards workers and on the listening skills; 3) the implementation of a safety system managed by Head Physicians and Head Nurses. The Company Management established, in addition, the code of ethics for healthcare workers. In order to the interventions about the area of “Role within the occupational organization”, the authors organized the training for all HCWs, designed to explain the work roles and to encourage the involving of workers in decision making process. The improvement of the issues related to the area of “Relationship at work” was obtained by the training of Head Physicians and Head Nurses; the objectives of the training were: 1) to improve communication skills 2) to ensure the reflective dialogue and feedback among workers; 3) to manage conflict constructively. Head Physicians and Head Nurses were, also, trained in the workers’ supervision about occupational hazards, including WRS”. (Table 1).

The evaluation suggested us to train Head Physicians and Head Nurses about a supportive leadership style, as effective in moderating to reduce the stressors to which HCWs resulted to be exposed. A success factor for this improvement intervention was certainly the high motivation of Head Physicians and Head Nurses toward the process of change.

The study has some limitations: 1) the period investigated is short to draw strong conclusions about the relationship between stress management interventions and occurrence of NSIs. 2) the analysis is conducted

on a small sample; 3) the results of this study are referred to the NSIs and do not take into account other types of injuries.

Further longitudinal studies will be necessary to clarify the relationship between stress management interventions and occurrence of NSIs.

Highlights

We conducted an observational study to detect and analyze the level of WRS among healthcare workers of an Emergency Department.

The study allowed to suggest organizational interventions aimed at reducing the sources of WRS.

The organizational interventions resulted effective in minimizing the occurrence of NSIs

The study showed the cost savings from managing fewer NSIs

The management of WRS brings benefits to employees and reduces the burden of the NSIs occurrence.

Ethical approval and consent to participate: The study was performed as part of the obligatory evaluation of work related stress, required by Italian Legislative Decree 81/08, and needed no formal approval by the local ethics committee and needed no consent to participate.

Conflict of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

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