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Needle stick injuries among nurses in Italy: a review

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ABSTRACT. **Background.** ***Needle stick injuries (NSI) are a frequent problem among the medical and nurse population: NIS can cause blood exposure pathologies like HCV or HIV. Aim of this study is to determinate an incidence rate and causes of NSI.***
Methods. ***A search was conducted on the main international databases, only studies conducted in Italian nurse are considered.***
Results. ***The incidence rate of NSI varies from 2.2 to 10.77 per 100 nurses per year. The major causes can be traced back to a large night shift, working in the operating block and in the medical departments, and the failure to use adequate devices.***
Conclusions. ***It is important to work on training, on the use of safety devices and on a better night shift.***

Key words: *Nurse, Needle Stick Injury, Prevention.*

RIASSUNTO. Infortuni da puntura da ago tra gli infermieri in Italia: una revisione della letteratura.
Introduzione. **Le lesioni da punture di aghi (NSI) sono un problema frequente tra la popolazione medica e infermieristica: le NIS possono causare patologie da esposizione al sangue come l'HCV o l'HIV. Scopo di questo studio è determinare un tasso di incidenza e le cause di NSI.**
Metodi. **È stata condotta una ricerca sui principali database internazionali considerando gli studi condotti in Italia.**
Risultati. **L'incidenza di NSI varia da 2.2 a 10.77 infermieri per anno. Le cause maggiori possono essere ricondotte in un'ampia turnazione notturna, il lavorare nel blocco operatorio e nei reparti di medicina, e nel mancato uso di device adeguati.**
Conclusioni. **È importante lavorare sulla formazione, sull'uso dei dispositivi di sicurezza e su una migliore turnazione notturna.**

Parole chiave: Infermieri, Infortuni da ago, Prevenzione.

Introduction

Needle stick injuries (NSI) are a frequent problem among the medical and nurse population, and it is difficult to estimate the risk in the world. In Italy every day, about 300 healthcare workers (HCW) sustain an injury caused a contaminated needle or sharp medical device (needlestick and sharps injuries, NSIs), totaling over 100,000 accidents per year, but only an estimated 45% are officially reported (1). These accidents place a high economic burden on healthcare facilities. Indeed, a study conducted in eleven States estimated costs of $ 425 (range $ 48-1,516) for direct costs and $ 322 (range $ 152-413) for indirect costs (2). In Italy each event is estimated to cost around € 375 (3). A study conducted in many hospitals of Liguria indicates an incidence rate of 23.4 per 10000 person per year for all healthcare workers (4). The Directive 2032/32/EC and the Law Decree 81/08, Implementation of Article 1 of Law no. 123, concerning the protection of health and safety in the workplace, with the consequent "Unique Text on Health and Security at Work" (in Italian "TESTO UNICO SULLA SALUTE E SICUREZZA SUL LAVORO") are documents that try to increase the protection about work injuries (5). NIS can cause blood exposure pathologies like HCV or HIV: the prevalence of anti-HCV positivity in healthcare workers ranges from 0% to 9.7% in different studies worldwide, and about 75% of the total occupational exposure is percutaneous (6); Prospective studies of HCWs have estimated that the average risk for transmission after a percutaneous exposure is approximately 0.3% for HIV and range 6-30% for HBV (7). More than 90% of these infections occur in low-income countries and most could be avoided (8). There are many consequences after NIS, and it is important to estimate the risk in Italy. In fact, it is unclear the value of the risk, that change by department and hospital. These data explain the situation of the risk to incur in NIS among nurses: in Italy there many studies that process the problem, but an idea of incidence can give the real scope of the problem. Therefore, there is not an approximate datum of NIS, and the causes are many and varied. Aim of this study is to establish the features of NSI in Italy, understand risk factors, try to give an incidence rate per year and improve the situation.

Method

A search was conducted on the main international databases (PubMed, SCOPUS, CINAHL, Web of Science) for doing a systematic review, considering the studies conducted only in Italy in the last ten years (since January 01 2012). The decision to carry out the research only in the Italian panorama was opted to give a precise idea of the problem in a nursing context as homogeneous as possible. Reviews, studies about students or other HCWs and studies with only surveys are not considered.

Results

At 06/30/2022, the search "needle stick injury Italy" with only studies published from 01/01/2012 has produced 40 results on PubMed, 243 results on Scopus, 10 on Web of Science and 4 on CINAHL. 32 results are duplicate records. After reading title, 56 results are considered. 7 studies concern students, 2 studies other HCWs, 5 results are reviews, 26 studies do not concern the aim of the study. Finally, 15 studies on PubMed, 11 on SCOPUS (10 studies shared in both databases), 2 on Web of Science and 2 on CINAHL (these studies are in all databases) were considered, for a total of 16 studies.

Bianco (9) et al do a retrospective study from 1995 to 2016 referred to the Infectious Diseases Unit of University Hospital "Federico II", showing 1477 injuries (67.1 injuries per year, about 22-23 injuries per year among nurses): 33% of cases are nurses, with a decline from 1995 (3.8% of the total among nurses) to 2016 (1.2%). Most injuries occurred in General Surgery (14.21%), Gynecology and Obstetrics (9%) and Pediatrics (6.49%). In about 34% the HCWs had been exposed to HCV infected fluids. Cofini (10) et al study from January 2010 to December 2016 the injuries of "SS. Filippo e Nicola" Hospital in Southern Italy: 335 injuries occurred, 144 were nurses. Incidence rates of injuries among nurses was 11.8 per 100 people per year in 2010, 3.3 per 100 in 2015, 4.2 per 100 in 2016. Morning is the period in which most injuries occur. D'Ettorre (11) conduces a retrospective observational study among 765 nurses: the period 2009-11 have an incidence rate of 13.5 injuries per 100 full time equivalent (FTE, 46 hours per week, 46 weeks per year) nurse

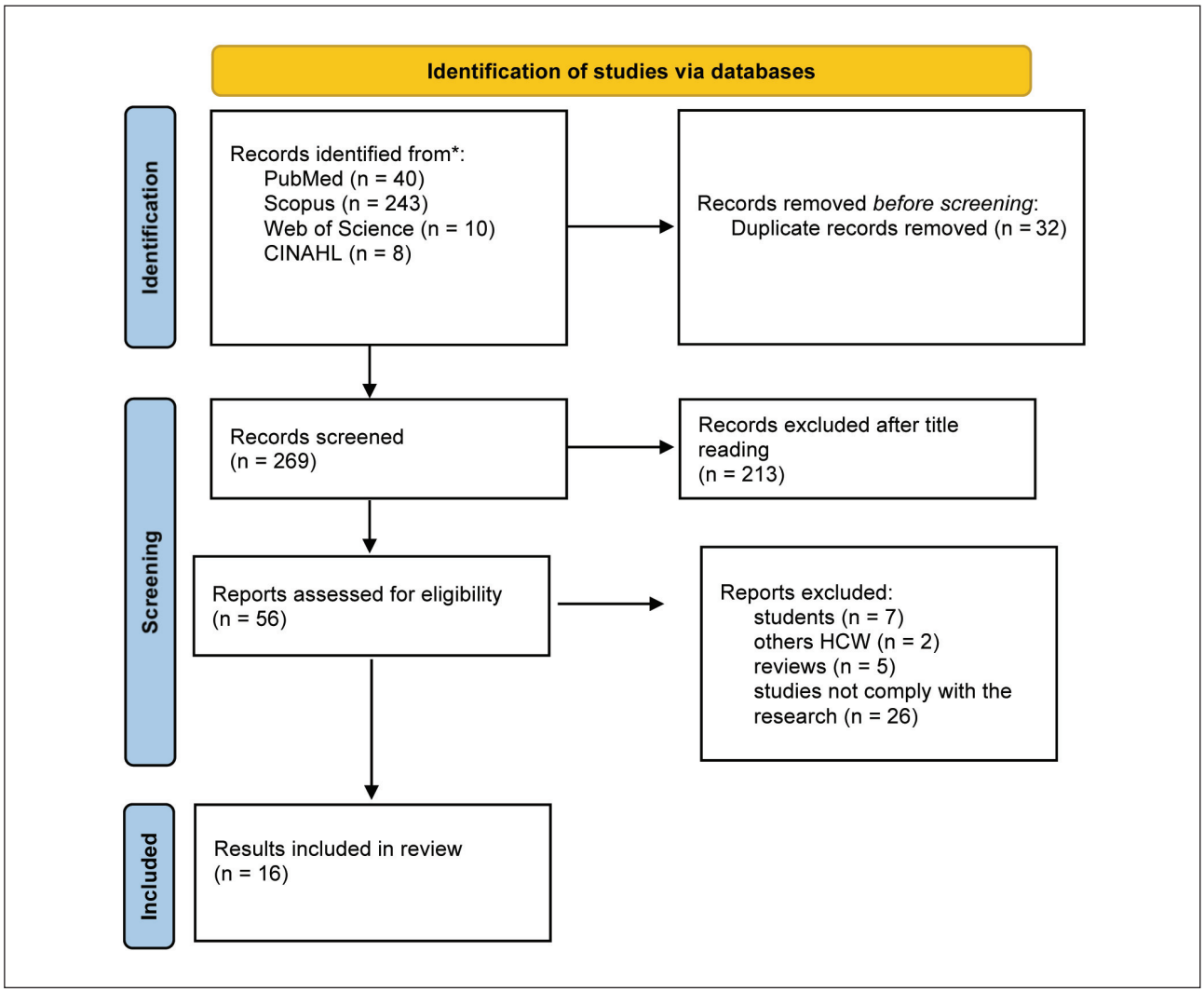

Figure 1. *Flow chart showing the stages of review and item selection*

positions versus 8.5 injuries per 100 FTE positions for the period 2012-14; the period 2012-14 is studied after the adoption of the organizational interventions (for reducing work related stress). Always D'Ettorre (12) in 2017 conduces another study analyzing the period January 2012 - December 2015 (four years), and finding 103 nurse injuries, with an incidence rate of 13.20 injuries per 100 FTE; NSI are frequent in night shifts > 9 compared to night shifts <= 3. D'Ettorre (13) et al show the results of a comparative study, examining 130 nurses of the Emergency Department in the periods January 2013 - December 2015 and January 2016 - December 2018: in the first period there is a rate of 26.15 per 100 FTE; in the second period the rate is 10.77 per 100 FTE, with costs saving estimated at € 13.073,00 per 100 FTE per 3-year. 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 implementation of an organizational model based on the achievement of occupational safety objectives; the style of management focused on the support towards workers and on the listening skills; the implementation of a safety system managed by Head Physicians and Head Nurses). Ferrante et al (14) investigate with a retrospective observational study from 2013 to 2015 about 5729 HCWs in Public hospital of Catania: 240 NSI occurred, with an incidence rate of 1.4 per year (2013 = 1.8%, 105 NSI; 2014 = 1.2%, 70 NSI; 2015 = 1.1%, 65 NSI). Weekend (Saturday and Sunday) is the period with the minor percentage of injuries, nurses had the 65.8% of total NSI; needle accidents' frequency was higher than accidents by scalpels blades (91.3% vs. 8.8%). Ferrario et al (15) conduct a study in "Fondazione Macchi" Varese Hospital between 2004 to 2011: the nurse population exposed is made up to 11870 nurses (in a total of 3398 exposed person per year), the biological injuries (BI) of nurses are 758 in all the period of study; the total of injuries is 1287 (61% NSI, 31% cut injuries). HCW > 35 years have BI incidence rate 3.88 per 100 person/year, HCW < 35 6.64 per 100 person/year. Operation Room and Emergency Department are the department with higher incidence of BI. Always Ferrario et al (16) conduct a study on 1615 nurses and 1679 nurse assistants between 1 January 2007 and 31 December 2016, showing 759 injuries (70.5% were percutaneous injuries, PI, the rest mucocutaneous, and 83.3% occurred to nurses), with an overall PI rate 3.9 injuries per 100 FTE, 4.4 per 100 FTE for nurses, 2.8 per 100 FTE for nurse assistants. The incidence is higher in night shift nurses respect daily nurses. Maida et al (17) study the risk of exposure to blood and body fluids (BBF) in 2,364 HCW (570 of them being physicians, 739 nurses and 190 auxiliary personnel; moreover, 883 residents, 3,309 medical students and 548 nursing students were present) at the University Hospital in Palermo: in the period of study (from January 1, 2004 to January 1, 2018, 14 years) BBF are 899, 317 occurred at nurses; BBF exposure was needle-stick injury (685, 76.2%, nurses 263, 38.4% of total), 585 out of 685 percutaneous exposures were caused by needles (syringe, peripheral venous catheter, butterfly needles, etc.) and occurred mainly to nurses (224, 38.3%). In all healthcare facilities, 40.5% of the BBF exposures occurred in the 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 a medical device (12.9%), injection therapy (12.0%), surgery (11.2%) and detection of blood glucose (8.8%). Ottino et al (18) conduct a study between January 2015 and December 2016 in our hospitals (1640 events) for valuing an incidence rate of accident for 100000 needles used: from 2014, in which there were 1044 NSIs (with 209 safety device, SED, related accidents, 20% of the total NSIs, with a use of 77.8% of total SED butterfly, 57.3% peripheral venous catheters, 4% standard needles, 99.1% vacutainer standard needles, 94.4% vacutainer butterfly needles) with an accident rate of 2.8 per 100 HCWs; between 2015 and 2016, the total number of accidents involving SEDs was 298 (167 in 2015, 131 in 2016) out of 1640 total accidents and decreased by 21% from 2015 to 2016. Nurses were involved in 50% (812/1640) and were most exposed to SED-related incidents (231, 78% of the total SED); regarding SED-related injuries, the most frequent security devices involved were butterfly needles (77, 26%), peripheral venous catheters (42/298) and insulin and tuberculin syringes (29/298). Conventional devices NSI are in the operating room, SED NSI in patient room (more 50% of total). Parco et al (19) analyze the biological accidents in Burlo Garofolo Children's Hospital in Trieste between January 2012 and December 2013: 230 nosocomial risk events occurred in the departments of oncology and pediatric-obstetric surgery and in the intensive care unit, 158 reported by health care workers in 2012, comprised 55 needle stick injuries (34.81%), 59 blood splashes (37.34%) and 44 cuts with infected instruments (27.84%); 61 in 2013, comprised two needle stick injuries (3.27%), 35 blood splashes (57.37%) and 25 cuts with contaminated instruments (40.98%). Rapisarda et al (20) conduce a retrospective study about NSI and biological injuries in a university hospital of Southern Italy considering the years 2013 and 2014 and 3250 HCWs. The frequency of accidents during the 2-year period was always lower than 5% of total HCWs. In 2013, 103 cases occurred; in 2014, the number of injuries had significantly decreased (n = 60). 83.4% of injuries are NSI (83 in 2013, 53 in 2014). Nurses and obstetricians have 45% of total NSI in 2013 and 62% in 2014. The most common cause of occupational exposure among HCWs is needle-stick injuries (two-handed recapping, and unsafe collection and disposal of sharp-object waste), while no differences were noticeable as far as work shifts (i.e., night shift) and operational unit. Respect 2013, in 2014 injuries decrease, caused by prevention measures adopted for all HCWs (specific information about biohazards and specific monitoring of personal protective equipment usage and vaccination). Sossai et al (21) investigate about NSI in five public healthcare institutions located in Liguria (San Martino Hospital, Galliera Hospital, Local Health Agency 1, Local Health Agency 4 and Local Health Agency 5) for a total number of person-years at risk 122,464 over a five-year period (2006-2010): 286 NSI occurred, with an overall average NSIR of 23.4 per

10^4 person-years; the risk of NSI due to conventional and safety catheters was respectively 44.9 and 1.8. Stefanati et al (22) conduct a study about NSI occurred to nurses and nursing students in eight departments of the University Hospital of Ferrara from January 01 2002 to December 31 2012 (11 years): 909 biological injuries occurred, 738 on nurses. 84.16% of injuries are NSI. 20.14% of injuries occurred in all Surgical Room Department, 12.43% in Medicine Department, 9.57% in Emergency Department, 8.68% in Surgical Department. Vaccari et al (23) study the numbers of injuries in two Italian hospitals of Lombardia (1,036 activated beds for Hospital 1 and 145 activated beds for Hospital 2 at the time of the study): Hospital 1, the number of injuries fluctuated significantly between 1994 and 2014 (without 2011) with on average of 30 incidents each year; at Hospital 2 (during 2010-2015), the average is 20 injuries per annum. Around 66 per cent of the injuries were percutaneous, while 30 per cent were mucocutaneous; nurses (including students and apprentices), made up 73% of the cases, with the higher frequency leading up to April-June, primarily during the first four working hours and the key areas where the accidents took place was general medicine (21 per cent), followed by first aid (15 per cent), and surgery and psychiatry (11 per cent). Vitale et al (24) show results about injuries in "F. Miulli" Hospital in Puglia between 2014 to 2018 (five years) for a total of 1259 workers: 249 injuries occurred at nurses (165) and nursing students in five years, 75.9% of all injuries are NSI, 82.3% in the upper limb, 55.4% in Medicine Department.

Discussion

The studies selected give different data: the incidence rate varies from 2.2 to 10.77 per 100 nurses per year,

Table I. ***Summary of the reviewed studies about response of students***

First author	Year of publication	Methods	Results
Bianco et al[9]	2019	Retrospective study from 1995 to 2016	490 nurse NSI, 22-23 cases per year
Cofini et al[10]	2018	Retrospective study from 2010 to 2016	144 nurse NSI, incidence rate 4.2 per 100 person in 2016
D'Ettorre[11]	2016	Retrospective comparative study on 765 nurses from 2009 to 2011 and 2012 to 2014	2009-11: 13.5 injuries per 100 FTE 2012-14 8.5 injuries per 100 FTE
D'Ettorre[12]	2017	Retrospective observational study from 2012 to 2015	103 nurse NSI, 13.20 injuries per 100 FTE
D'Ettorre et al[13]	2020	Retrospective comparative study on 130 nurses of ED from 2013 to 2015 and 2016 to 2018	2013-15: 26.15 per 100 FTE 2016-18: 10.77 PER 100 FTE
Ferrante et al[14]	2018	Retrospective observational study from 2013 to 2015 about 5729 HCWs	240 NSI (158 nurses) incidence rate 1.4 per year
Ferrario et al[15]	2012	Retrospective observational study from 2004 to 2011 to an exposed population of 3398 person for year (a total of 11870 nurses)	758 BI BI rate 6.39 per 100 61% of all BI are NSI
Ferrario et al[16]	2021	Retrospective observational study on 1615 nurses and 1679 nurse assistants from 2007 to 2016	759 PI (83.3% nurses) Nurses PI rate 4.4 per 100 FTE
Maida et al[17]	2020	Retrospective observational study on 899 workers (317 nurses) from 2007 to 2016	685 NSI, 263 at nurses
Ottino et al[18]	2019	Retrospective study from 2015 to 2016 after increasing SED	812 nurse NSI, 2.2 per 100 nurses
Parco et al[19]	2015	Retrospective observational study of biological exposure (317 nurses) from 2012 to 2013	55 NSI in 2012, 2 NSI in 2013
Rapisarda et al[20]	2019	Retrospective observational study of biological exposure (3250 HCW) from 2013 to 2014	163 injuries, 83 NSI in 2013, 53 NSI in 2014
Sossai et al[21]	2016	Retrospective observational study of NSI (total number of person-years at risk 122,464) over a five-year period (2006-2010)	286 NSI 23.4 per 10^4 person-years
Stefanati et al[22]	2015	Retrospective observational study of biological exposure on nurses (738) and nursing students in eleven years and a survey	NSI 84.16% of all biological exposures
Vaccari et al[23]	2018	Retrospective observational study of two hospitals: Hospital 1, period 1994-2014 (no 2011), and Hospital 2, period 2010-2015	Average 30 incidents per year at Hospital 1; 20 injuries per years at Hospital 2
Vitale et al[24]	2021	Retrospective observational study of biological exposure on nurses (738) and nursing students in five years	165 nurse NSI

NSI Needle stick injuries; FTE full time equivalent nurse positions; ED Emergency Department; PI percutaneous injuries; SED safety device; BI biological injuries; HCW healthcare workers

taking into consideration only the last chronological value in comparative studies. The incidence drops if we consider all HCWs.

The principal factor that reduces NSI is the use of SED: comparative studies agree about a significant decrease between the period preceding the use of the SED and the period next, and the application of the Directive 2032/32/EC and the Law Decree 81/08 have contributed to the decrease. In Italian literature there are many studies that indicate reduced NIS with the use of SED (25), and the application of the last law indications (26). In fact, it is demonstrated that the use of instrumental needle sticks Prevention Devices occupational exposure to biological risk (from 63% to 100% reduction), costs and number of accidents (21); thank to legislations training and organization are factors that are slowly improving. Furthermore, studies generally agree that the major part of NSI happens in bed patients, and that the Surgical Department and the Medicine Department are the departments with a major incidence of NSI. On other causes, the studies investigate more individually: Cofini indicates the morning, thinking that this is the moment of the day with the most things to do; D'Ettorre in his three studies reports that NSI decrease with work related stress interventions, a lower number of night shift monthly and the implementation of the organization; Ferrario shows the difference of NSI in daily nurses and night shift nurses (higher incidence); Ferrante finds the weekend (the period with fewer activities) the period with the lower incidence of NSI; Vaccari indicates an increase of NSI in the period April-June. It is interesting the causes listed by D'Ettorre: work related stress and night shift are common causes for various problems of nurses, like low back pain (27), burnout, accidents and injuries, absenteeism and, consequently, reduced work efficiency (28). While night shift is a problem difficult to resolve, the stress work related can partially improve through training, lifestyle and periodical rotation in department with high incidence of burnout. Ottino estimates the higher risk of NSI during the use of butterfly needles: it is important supply to a training (or retraining) of the correct use of devices. Finally, Stefanati shows that NSI are the more numerous biological exposures.

Conclusions

It is important to do not underestimate the problem of NSI in HCW and, mainly, in nurses. Significant progress has been made over the past decade, and it is important continue in this direction. SED and training are the immediate and economic solutions to reduce NSI. Night shift nurses have a higher incidence of NSI. At the end, it can be useful to think a better night shift rotation.

Limits

The limitations of the study are represented by the selection of considerably diverse samples: the researches often discuss only some problems about NSI, and results give different types of range; the no use of grey literature can give reduced final results.

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Declaration of Interest

The author declares that he has no conflicts of interest associated with this study.

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