Using an intravenous catheter system to prevent needlestick injury

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Abstract

Aim To identify the effect of a sharps awareness campaign and the introduction of a safety catheter device on the annual incidence of needlestick injuries between 2003 and 2007.

Method In 2003, a sharps awareness campaign began in San Martino Hospital in Genoa, Italy. In 2005, a safety catheter was introduced and healthcare workers were trained in its use. Data for all occupational accidents from 2003 to 2007 were collected and analysed.

Results After introduction of the sharps awareness campaign and use of safety catheters, reported incidents of sharps injuries involving catheters fell from 19 in 2004 to two in 2007 and in neither of those two cases were needlestick prevention devices used. Overall, the rate of needlestick injuries was 24.1 per 100,000 cases when conventional catheters were used and 0.4 per 100,000 cases with safety catheters.

Conclusion The sharps awareness campaign and newly adopted needlestick prevention device may have contributed to the prevention of percutaneous injuries caused by catheters. Until the onset of the campaign, the reported annual incidence of needlestick injuries was six. This increased to a peak of 19 reported injuries in 2004, which could be attributed to improved reporting effected by the campaign.

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Needlestick injuries, risk prevention, safety needle system

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SHARPS INJURIES are one of the most common types of occupational accidents that healthcare workers experience (Elder and Paterson 2006). The Centers for Disease Control and Prevention (2004) in the United States (US) has estimated that around 400,000 percutaneous injuries occur in the hospital setting each year. However, true injury rates are difficult to assess as underreporting is assumed to be as high as 70% (Lee *et al* 2005).

There is a risk of disease transmission of blood-borne pathogens with a sharps injury, particularly if it is caused by a hollow-bore needle used to access veins or arteries (Trim 2004). Worldwide, 2.5% of cases of human immunodeficiency virus (HIV) and 40% of cases of hepatitis B and hepatitis C among healthcare workers result from occupational exposure to infected blood (Wilburn 2004). The risk of infection following percutaneous exposure to infected blood is notable, with rates of 6-30% for hepatitis B, 0-7% for hepatitis C and 0.3% for HIV (White 2008). In addition to the hazard of disease transmission, the fear of potential infection may pose a considerable burden on the psychological, emotional and social wellbeing of the injured healthcare worker (Lee *et al* 2005).

More than 38% of all occupational accidents involving biological hazards in the NHS result from skin contact, while 24% are caused by accidental puncture with injection needles (Sossai 2006). The rates for hospitals are even more concerning. According to a study of the Italian National Society for Prevention and Protection in the Health Service (Associazione Italiana Responsabili Servizi Prevenzione e Protezione in Ambiente Sanitario), more than 50% of occupational accidents in hospitals are caused by accidental puncture with injection needles (Sossai 2006).

Exposure prevention remains the primary strategy for reducing occupational contact with blood-borne pathogens (Huber and Terezhalmy 2007). Over the past 20 years, numerous preventive measures have been implemented including educating and training staff, changes in practice, hepatitis B vaccinations, awareness campaigns and needlestick injury policies. One particular

preventive strategy uses engineered needlestick prevention devices to protect hospital workers from accidental injuries. There are two types. Passive needlestick prevention devices have a safety feature that is activated automatically, while active needlestick prevention devices require the user to activate the safety mechanism (Trim 2004).

The use of needlestick prevention devices and the documentation of all needlestick injuries by healthcare workers has been enforced by law since 2000. Similar regulation efforts are under way in Europe (Hadaway 2001, Wilburn 2004, Hoban 2005, White 2008). In Italy, and elsewhere in Europe, employers have a statutory obligation (Directive 2000/54/CE and 89/391/CEE) to prevent occupational risks and protect workers. In line with these requirements, San Martino Hospital in Genoa, Italy, one of the largest hospitals in Europe with more than 1,400 beds and more than 4,400 employees, launched a sharps awareness campaign in 2003. This campaign consisted of specific staff training, education and the gradual introduction of needlestick prevention devices (safety catheters) to replace conventional intravenous catheters. By March 2005, almost all conventional catheters had been replaced by needlestick prevention devices.

Aim

The aim of this study was to verify the effect of the sharps awareness campaign and the introduction of needlestick prevention devices on the rate of needlestick injuries in San Martino Hospital.

Method

The hospital chose the passively activated Introcan Safety IV Catheter system (B. Braun). This has a self-activating safety clip that automatically shields the needle's sharp bevel during retraction of the needle after cannula insertion. With regard to design and handling, this safety catheter is identical to the conventional catheter (Trim 2004, Wilburn 2004).

At San Martino Hospital, a sharps awareness campaign was launched in 2003. In 2005, safety devices were first introduced, initially in departments at increased risk of needlestick injuries or infection (infectious diseases, general surgery and organ transplant departments). By the end of 2005, they had been introduced in all hospital departments. Healthcare workers in approximately 90 departments including outpatient clinics, operating theatres, intensive care units, day hospitals and surgery, received training in using the device. Training sessions were carried out by manufacturers of the safety catheter and by members of the hospital's department of health safety and prevention.

Between 2005 and 2007 this practical training was supplemented by courses on the biological risk of needlestick injuries aimed at all long-term employed healthcare staff. In addition, a compulsory training course on the need for prevention and safety precautions related to needlestick injuries, and the correct practical application of safety devices for all new employees, began and was carried out monthly. During this period, 596 of 3,392 (18%) long-term employed physicians, nurses and technicians and 882 (100%) new employees received safety training.

In San Martino Hospital, a specific protocol needs to be followed when an accident entailing biological risk occurs. The affected employee has to report the accident to the department of preventive and occupational medicine where health monitoring and infectious prophylaxis are initiated, if required, in collaboration with the Institute for Hygiene and Preventive Medicine. Subsequently, the injured person is required to register the accident at the hospital's human resources department where detailed information on the injury and the injured person are recorded on a standardised incident report form and in an incident reporting file. Reports of the accident are forwarded to the National Institute for Insurance against Accidents at Work (Istituto Nazionale per Assicurazione Infortuni sul Lavoro) and the Hygiene Institute of Genoa University.

The incident reporting file is the hospital's internal administrative database for all occupational accidents and is used for statistical purposes. It provides the data for an annual injury monitoring report. The file began in 1994 and holds detailed documentation of all occupational injuries occurring at San Martino Hospital. Documented details include the time, location and accurate descriptions of an accident, and the profession, department, ward or operating unit of the injured employee involved. The type of device responsible for sharps injuries and the use of any safety measures during the incident are also documented.

In this study, occupational injury data collected between 2003 and 2007 were obtained from the incident reporting file and analysed retrospectively. Data of interest included all occupational incidents and all percutaneous injuries caused by catheter needles and sharps. In particular, needlestick injuries caused by catheters were investigated. For all needlestick injuries from catheters, the occupation of the affected staff member was examined. The total number of catheters used each year was the denominator. All hospital employees were included in the study. The human resources department supplied data on the number and

type of staff in the hospital. Formal ethical approval was not required because the population used was recruited from the database of the occupational injuries register of the human resources department. The data used were taken from official declarations and total anonymity was guaranteed.

Results

The overall number of employees at San Martino Hospital fluctuated annually between 4,447 and 4,636 individuals from 2003 to 2007. The number of occupational accidents documented decreased from 537 to 405 in the same period. During the study, the number of injuries with needles and sharps entailing biological risk reported annually reduced from 163 to 86. These accounted for approximately one quarter to one third of all occupational incidents. After launching the sharps awareness campaign in 2003, the number of injuries caused by catheters increased initially (n=10 in 2003 and n=19 in 2004), possibly because the sharps awareness campaign aimed to reduce underreporting.

From 2005 to 2007 the total number of reported injuries decreased (n=10 in 2005, n=3 in 2006, and n=2 in 2007). During the study period, nurses were affected more often by needlestick injuries than physicians. The overall annual number of needlestick prevention devices used by the hospital after their introduction in 2005 (n=130,000) increased to 165,000 in 2006 and decreased to 163,000 in 2007 (Tables 1 and 2). The average number of annual injuries per 100,000 phlebotomies performed were calculated (estimated by needles used per year). The relative risks were calculated as the ratio of the injury rates for the conventional catheters and for the safety catheters. These results indicate that healthcare staff's risk of injury when using a conventional device is more than 25 times higher than the risk associated with the use of the safety device.

Discussion

The implementation of a sharps awareness campaign and the introduction of needlestick prevention devices at San Martino Hospital resulted in a significant reported decrease in needlestick injuries. Conventional catheters appear to carry a significantly higher risk of injuries than safety catheters (Table 1). This suggests that the needlestick prevention devices contributed to the prevention of percutaneous incidents. A potential problem of this type of surveillance results from factors that could influence healthcare staff to report injuries, especially those with a low risk of infection. In this study, reporting rates are unknown and these could have influenced the findings. Injury reporting was encouraged during training, so an increasing rate of underreporting appears unlikely.

Similar results have been observed with other safety needle devices (Asai *et al* 2002, Trim 2004, Adams and Elliott 2006, Tuma and Sepkowitz 2006). These results are consistent with estimates in which the use of engineered safety devices accounts for definite prevention in 21% and probable prevention in 61% of needlestick injuries (Elder and Paterson 2006). However, the results of the current study are limited by the short observation period and initial findings need to be confirmed by a follow-up study.

Three and two incidents occurred with catheters in 2006 and 2007 respectively. Only one of these incidents occurred with a safety catheter. The catheter's safety mechanism was not activated because of an unexpected movement by the patient before insertion of the cannula. Risk for the healthcare worker was estimated at almost zero, as the needle had not come into contact with the patient's blood. In the other four incidents, conventional devices were used that did not have a safety

TABLE 1

Reported injuries at San Martino Hospital between 2003 and 2007

Year	Hospital employees	Total accidents at work	Incidents with catheters and sharps	Incidents with catheters	Nurses	Physicians	Safety catheters used	Conventional catheters used	Total catheters used
2003	4,593	537	163	10	9	1	–	138,000	138,000
2004	4,608	492	135	19	14	5	–	157,000	157,000
2005	4,636	467	126	10	9	1	130,000	43,000	173,000
2006	4,617	413	105	3	3	–	165,000	6,000	171,000
2007	4,447	405	86	2	2	–	163,000	5,000	168,000

TABLE 2

Frequency of reported needlestick injuries by year and by type of catheter

Year	Device	Needlestick injuries/ total devices	Needlestick rate injuries rate per 100,000 devices
2005	Safety catheters Conventional catheters	1/130,000 9/43,000	0.8 20.9
2006	Safety catheters Conventional catheters	1/165,000 2/6,000	0.6 33.3
2007	Safety catheters Conventional catheters	0/163,000 2/5,000	0 40
Total	Safety catheters Conventional catheters	2/458,000 13/54,000	0.4 24.1

mechanism (probably old stock in the department). Although the changeover from conventional to safety systems had officially concluded by March 2005, and no more unsafe catheter systems were purchased after that time, these four incidents indicate that conventional catheter devices were probably present in several departments and were still being used after this date. Future studies designed to evaluate the efficacy of needlestick prevention devices compared with conventional catheters should consider complete removal of conventional catheters before starting the trial.

The results highlight a lower rate of annual needlestick injuries until the start of the sharps awareness campaign and an escalation of reported incidents after its launch. This phenomenon might have resulted from underreporting, confirmed by the low incident rate of reported needlestick injuries before the onset of the campaign. Underreporting of needlestick injuries is a common and serious problem. It is even observed after needlestick injuries with high-risk patients and occurs with all types of healthcare worker (Wilburn 2004, Hoban 2005, Makary *et al* 2007).

True injury rates may be ten times higher than those reported (Elder and Paterson 2006). The increase in incidents in 2003 suggests that educational measures and training might have sensitised healthcare staff to the seriousness of the problem and increased their readiness to report needlestick injuries for their own safety. Only timely reported needlestick injuries allow for immediate preventive measures and effective post-exposure treatment (Lee *et al* 2005).

Even after 2003, it may still be possible that not all needlestick injuries were reported. Although all new employees received training after 2005, accounting for approximately 25% of the hospital's healthcare staff until 2007, before then only 18% of employees of long standing participated in safety education measures. Thus, the majority of employees lack theoretical education in sharps safety and may be more prone to misjudge the risk of needlestick injuries and consequently fail to report incidents. It might also be possible that some long-term staff increased their risk awareness after observing colleagues. It is to be expected that the awareness of possible injury outcome and reporting will improve further as the sharps safety awareness campaign continues as a result of cumulative training of hospital staff (Makary *et al* 2007).

Despite introducing continuous on-the-job training with all employees, a certain degree of underreporting is still likely to occur because, contrary to better knowledge, some employees will avoid the time-consuming effort associated with administrative and medical procedures involved in needlestick injury reporting (Lee *et al* 2005, Makary *et al* 2007).

Of the 44 catheter-associated injuries reported, 7 (16%) occurred in physicians and 37 (84%) in nurses. These findings are consistent with other study reports (Ippolito *et al* 1999, Hoban 2005).

Before the introduction of needlestick prevention devices at San Martino Hospital, a systematic evaluation of scientific data, including a review of more than 140 articles (Lavery and Ingram 2006), and of Italian national data (Ippolito *et al* 1999) was undertaken. The annual documentation of reported needlestick injuries was later incorporated into a comprehensive prevention campaign.

Information and training on the use of needlestick prevention devices for healthcare workers during the sharps awareness campaign was intended to achieve safe handling of the new safety catheter devices and staff acceptance. Preparatory procedures of this kind are recommended to ensure user acceptability of these devices (Trim 2004). To a certain extent, the fact that more than 80% of long-term employees did not participate in the training schemes presented a problem. Continued avoidance of catheter injuries can only be achieved by repeated use of the newly adopted needlestick prevention device and continuous awareness training of all hospital personnel. This advice is consistent with good practice recommendations for preventing

infection associated with peripheral intravenous devices (Ross *et al* 2000).

The results of this study suggest that during the past five years the safety level at the hospital has increased, both for staff and patients, because of increased staff awareness and the gradual introduction of an intravenous safety device. During the study period, the proportion of documented needlestick injuries compared with all other occupational incidents varied between 0.3% and 3.9%. Although the number of reported needlestick injuries in the hospital is low compared with other occupational accidents, the consequences for the individual and the hospital involved may be considerable.

The affected member of staff is confronted with the risk of disease transmission and psychological stress. Moreover, the hospital is faced with the economic burden of managing these injuries. When considering the costs of treating a potential resulting infection, of liability incurred by the hospital, or of lost working hours, the costs of a needlestick injury are considerable. Initially, the use of engineered safety devices imposes higher costs on the hospital than conventional devices. However, when one examines the clinical and economic benefits of preventing needlestick injuries, and considers the human, ethical and safety concerns, the true cost of needlestick prevention devices is lower than that of conventional devices (Lee *et al* 2005).

Conclusion

In 2005, a safety catheter device was introduced at San Martino Hospital to replace conventional catheters, and healthcare staff received training on how to use it. Following the implementation of these interventions, a significant decrease in the number of reported needlestick injuries was observed, consistent with reports in the literature. Despite the fact that a potential reporting bias cannot be ruled out, the findings suggest that the intervention had a positive effect on the number of needlestick injuries and increased staff awareness. The relative role of the two different components of the intervention cannot be assessed definitively, although a greater reduction in needlestick injuries was observed after the introduction of safety catheters. In the long term, the hospital and its employees are expected to benefit further from these preventive measures **NS**

IMPLICATIONS FOR PRACTICE

- The prevention of needlestick and sharps injuries is an essential element of standard safety precautions.
- Education and training of healthcare staff is a prerequisite for ensuring that policies and procedures for standard precautions are understood and practised.
- Safety-engineered needles and sharps devices should be considered as part of a comprehensive injury prevention programme.

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