Post-Exposure Procedures including Prophylaxis: First National Electronic Registry for Iran

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Abstract

Background: An estimated 385,000 percutaneous injuries (e.g., needlesticks, cuts, punctures and other sharp object injuries) occur in United States hospitals each year. Prevention of occupational transmission of bloodborne pathogens requires a diversified approach. This includes reduced exposure to blood and other patient body fluids and prevention of percutaneous injuries through improved engineering controls, work practices and use of personal protective equipment.

Over the last decade, use of electronic data capture systems and devices (EDCSD) has increased, replacing pen-and-paper methods traditionally used during field survey data collection. By combining data collection with data input, EDCSD can lower costs through better data management. Paper-based medical records can be incomplete, lost and difficult to read. Conversely, EDCSD can rapidly retrieve any number of entries; providing up-to-date, accurate information which can be easily shared anywhere in the world.

Method: This study describes the launching of a system that measures exposure to patient blood and body fluids including sharps injuries. The target population was individuals working in Namazi Hospital, Shiraz, Iran. First, a flowchart was created describing movement of data concerning 200 exposed hospital personnel referred to the Infection Control Section of Namazi Hospital from paper forms to an electronic format. The flowchart system was a modification of several mentioned in the published literature. Associated software was designed by hospital computer engineers. The 200 paper forms were used to pilot the new post-exposure registry system.

Results: The aim of this study was to build, launch and evaluate a registry system for recording cases of worker exposure to patient blood and body fluids including sharp (needlesticks) injuries and to monitor post-exposure prophylaxis and follow-up procedures.

Conclusion: Using a coordinated and comprehensive system on a provincial or national level could provide opportunities to compare the performance of the Infection Control Sections in different hospitals concerning causes of occupational exposure and post-exposure procedures, including prophylaxis. Such information could be useful in policy-making processes.

Key words: healthcare workers, sharps injuries, occupational hazards,
occupational acquired infections

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Methodology

The risk of occupational exposure of healthcare workers (HCW) to bloodborne pathogens, such as hepatitis B (HBV), hepatitis C (HCV) and human immunodeficiency virus (HIV) through sharps-related injuries, such as needlestick injuries (NSI), especially concerning dental, nursing and midwifery students, is a challenging issue. (1)

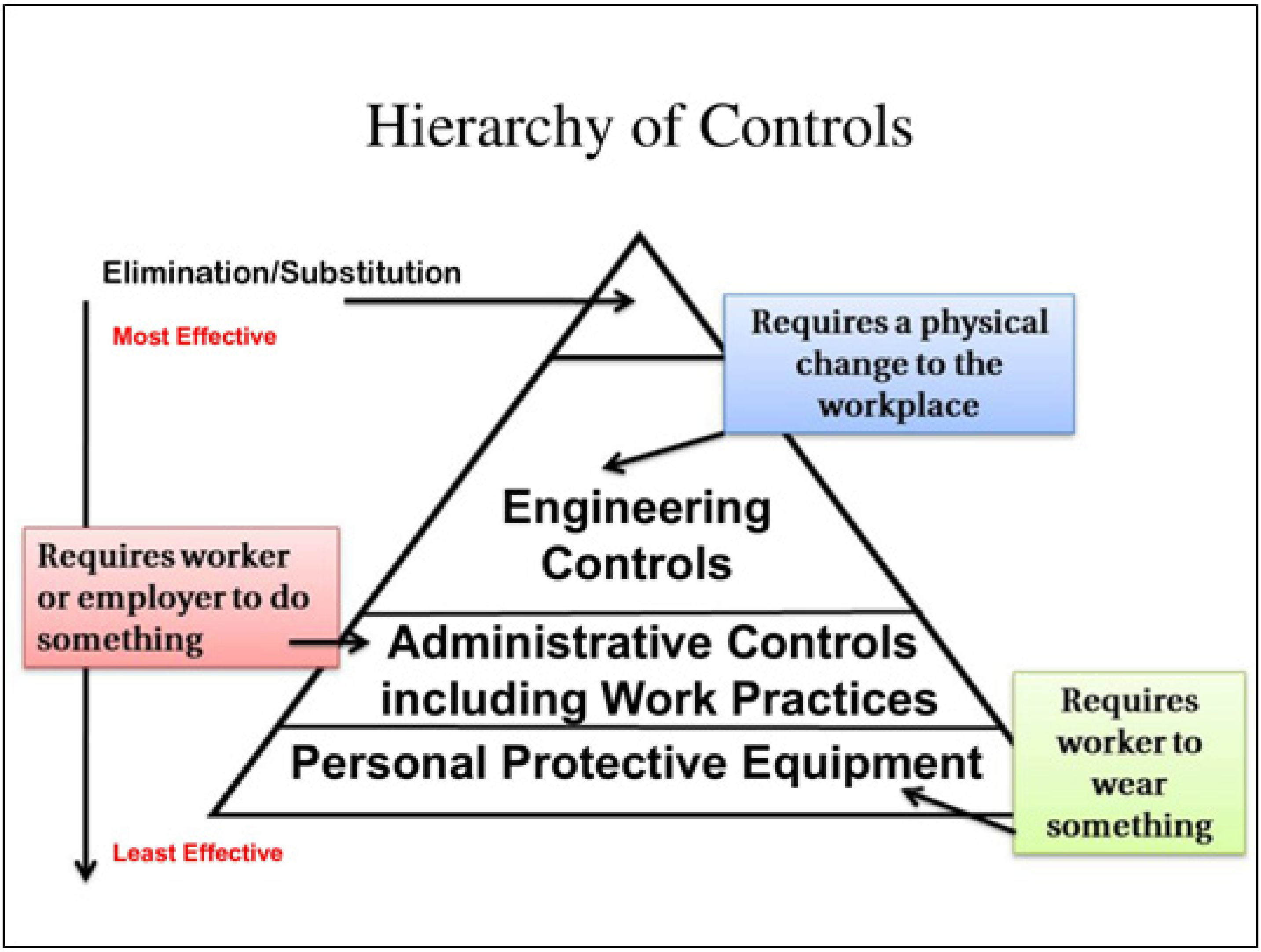
HBV, HCV, and HIV account for 37%, 39% and 4% of the infections transmitted through contact with contaminated sharps. (2,3) The risk for transmission after all types of occupational exposure of at-risk HCW is between 30%-60% for HBV, 3-4% for HCV and 0.3% for HIV. (4)

Approximately 64% of healthcare workers are exposed to patient blood or other body fluids during their professional careers. (5). Nurses are the most likely healthcare group to experience a sharps injury. (6,7,8)

Many reasons have been postulated for the occurrence of NSI, including lack of experience, insufficient training, work load, time of day, procedures performed and fatigue. (9) Providing HCW with devices with engineered sharps injury prevention features can reduce exposure. Such devices have built-in safety features or mechanisms that effectively reduce the risk of an exposure incident. Examples include needle-free IV systems, sheathed, blunted or retractable needles syringes with guards or sliding sheaths that shield the attached needle after use, needles that retract into a syringe and blood transfer adapters. (10,11)

The risk of bloodborne pathogens transmission following occupational exposure depends on a variety of factors including source patient characteristics (i.e., viral titer), nature of the injury, quantity of blood/body fluid transferred during the exposure and HCW immune status. The greatest risk of infection transmission occurs through percutaneous routes. However, HBV, HCV and HIV transmission after mucous membrane or non-intact skin exposure has also been reported; however, mucocutaneous exposure is considered to have lower levels of risk than percutaneous exposure. (12)

Every day, more than 1,000 American hospital HCW are injured with a needle or other sharp device. Prevention of occupational transmission of bloodborne pathogens requires a diversified approach to reduce percutaneous injuries and blood exposure, including elimination/substitutions, engineering controls, administrative controls/work practices and use of personal protective equipment (PPE). (12) Following is a diagram that describes a hierarchy of controls, from most to least effective. (13) PPE should be used when more effective controls are not available or possible.



In the past decade, electronic data capture systems have displaced traditional pen-and-paper methods for field survey data collection. (14) By combining data collection with data input, electronic data capture systems and devices (EDCSD) may lower costs and provide better data management. (15,16,17)

Paper-based medical records can be incomplete, fragmented and difficult to find or read. Conversely, EDCSD can rapidly retrieve any number of entries; providing up-to-date, accurate information which can be easily shared anywhere in the world. EDCSD require less space and administrative resources and have the potential for automating structuring and streamlining of clinical workflow.

EDCSD can maintain substantial databases which can readily undergo analysis during a medical audit, research and quality assurance investigations, epidemiological monitoring review, disease surveillance and supporting continuing medical education. (18) The use of EDCSD for cases of exposure to blood and body fluids, including sharps injuries was first developed at the University of Virginia in 1991 and provided standardized methods for recording and tracking percutaneous injuries and blood and body fluid contacts. The Exposure Prevention Information Network (EPINet) consists of a Needlestick and Sharp Object Injury Report and a Blood and Body Fluid Exposure Report and software for entering and analyzing data from the forms. A post-exposure follow-up form is also available. Since its introduction in 1992, more than 1,500 hospitals in the United States use EPINet. It has been adopted for use in other countries (Canada, Italy, Spain, Japan and United Kingdom). (13,19, 20)

Specifically, the EPINet surveillance system gives healthcare facilities the ability to: 1) track occupational sharp object injuries and other blood and body fluids exposure; 2) better prevent occupational injuries and illness; 3) reduce exposure to microorganisms that cause illness and infection and 4) reduce costs and improve quality.

In this study, we used the EPINet model (21,22) to create an Electronic Registry of Data for cases of exposure to blood and body fluids and injuries caused by sharp objects among HCW. The goal was a system with an electronic data collection form having the following capabilities: 1) ease of use at the national level; 2) is in accordance with current CDC guidelines and the new Iranian national protocol; 3) have data collecting properties and decision-making capabilities and 4) be cost effective and easily implemented.

Methods

Phase One

This project involved 200 HCW at Namazai Hospital, who were occupationally exposed to blood and body fluids or were injured by sharp objects and then referred to the hospital's Infection Control Section. Selection was by simple sampling of the exposed HCW pool. Exclusion criterion was an unwillingness to participate in the study.

Flowchart and guidelines development was based on updated guidelines and valid websites such as those of the WHO and CDC as well as the Iranian National Guideline 2017. Flowchart structure begins with emergency actions for exposed personnel and then continues with a referral to a section manager and finally on to the hospital's infection control supervisor.

The supervisor investigates the nature of the exposure, determining infectious source(s) through the presence of HBV, HCV and HIV antibodies and HBV surface antigens. Also, the supervisor investigates the protective controls, including PPE in place when the exposure occurred. The same procedure is followed if risky HCW behavior was noted and the source was unknown.

When a source is known to be HIV-positive, post-exposure procedures, including post-exposure prophylaxis (PEP) are reviewed. Similar activities occurred when the source was HCV or HBV antigen-positive. Finally, a course of action is designed based on currently used flowcharts (Table 1).

Data collection forms were developed based on the tenets of the flowcharts. Form design included variables such as HCW name, age, gender, exposure/injury location, occupation, wound/injury type, location of exposure, type amount of patient body fluids involved, time/day of exposure, treatment provided immediately after exposure, risk assessment for bloodborne disease transmission, description of devices involved, HBV vaccination status and protective controls used, including PPE.

Forms also collected data on HCW post-exposure prophylaxis (PEP) and follow-up experiences. This included the type(s) of prophylaxis offered and received and future referrals and follow-ups (Table 2). After being designed, the paper form was reviewed and approved by a group of infectious disease specialists, with several changes made.

Of the HCW referred to the Namazi Infection Control Clinic, 200 were selected by simple sampling and their information entered onto paper forms. Then, the functionality of the form was reviewed manually and possible errors resolved. Information from the paper forms was entered into the electronic forms and compared.

Phase Two

The next phases of the project involved extraction of HCW information including exposure types and PEP and follow-up procedures which were then comparable.

Various other HCW study factors were also compared which included education level, occupation/position, work experience, location, shift, type of device(s) present, type and amount of body fluids involved, exposed body area(s), injury characteristics and protective procedures and equipment used.

Table 1. Number and title of pathways in flowcharts

Pathway title	Pathway Number
0	Contact with blood and body fluids or damage by sharp devices
1	Screen source patient for HBsAg, anti-HIV, anti-HCV
2	Assessing the risk of exposure to high-risk sources for infection with hepatitis B and hepatitis C and HIV
3	Is the safety of exposed personnel normal and healthy?
4	Is the vaccination of the exposed personnel complete?

Table 2: Number and title of data collection forms

Form Number	Form title
1	demographic questions
2	time and place and type of exposure questions
3	blood and body fluid exposure questions
4	sharps injury and needlestick questions
5	human bites questions
6	when the source of exposure is known questions
7	when the source of exposure is unknown questions
8	a) when source of exposure and HBsAg is known or if source is unknown with high risk for HBsAg b) when source of exposure and HBsAg is known or if source is unknown with low risk for HBsAg
9	when source of exposure and anti-HCV is known or if source is unknown with high risk for HCV
10	when source of exposure and anti-HIV is known or if source is unknown with high risk for HIV
11	when source of exposure is unknown with a low risk for HIV
12	records of all lab data, their answers, prophylaxis, drug usage and drug reactions (summary of HCW medical record)

Results

The aim of this study was to develop and evaluate an EDCSD scheme concerning HCW occupational exposure to blood and body fluids and injuries caused by sharp objects, such as needlesticks and PEP and follow-up activities performed.

Outcomes included creation of a registry system for sharps-related occupational exposures designed to collect, store, recover, analyze and disseminate information of exposed individuals and the appropriateness of PEP and follow-up measures. By creating a registry, the incidence and prevalence of exposures and injuries caused by sharp objects and needlesticks can be examined more carefully and temporal and spatial changes evaluated properly.

Additionally, a registry system could provide evidence of the long-term effectiveness of PEP protocols. The system's web-based software can measure the quality and quantity of care provided, which is not possible using paper forms. It should be noted that this software powers not only registry information, but can also monitor the correctness of the procedures used and the paths that PEP and follow-up took.

Also, it is possible to provide printed records for individuals, if necessary, to relevant specialists, for follow up treatments and to compare feedback forms. The system is also able to generate different tables and charts for registered information, compare different data and other statistical analyses and present results in varying forms (Figures 1-5). These capabilities cannot be performed by similar software. Following are possible examples of analyzed data presentations.

Figure 1. Recording of demographic information

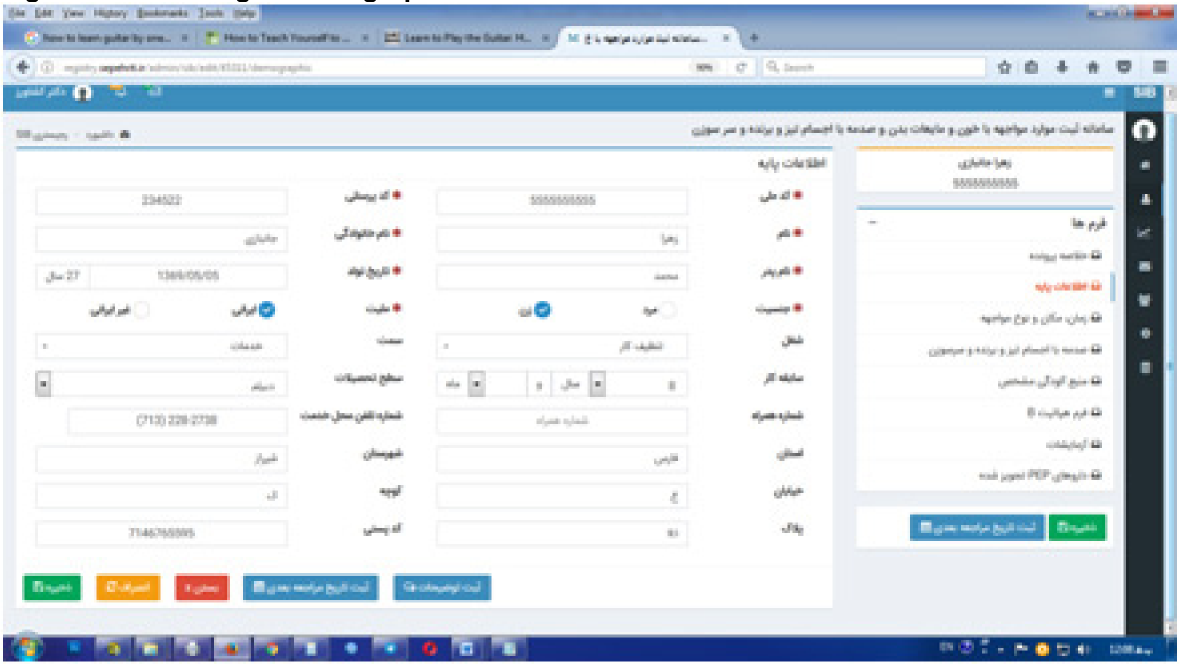


Figure 2. Recording of the related data to time and place of occurrence of exposure

Figure 3. Data recording of cases of exposure to blood and fluids separately based on type of the exposed body fluids, approximate amount of the exposed fluid, type of exposure whether it was dermal or mucosal, type of activity that ended to impairment or exposure and protective conditions of personnel upon incidence of exposure

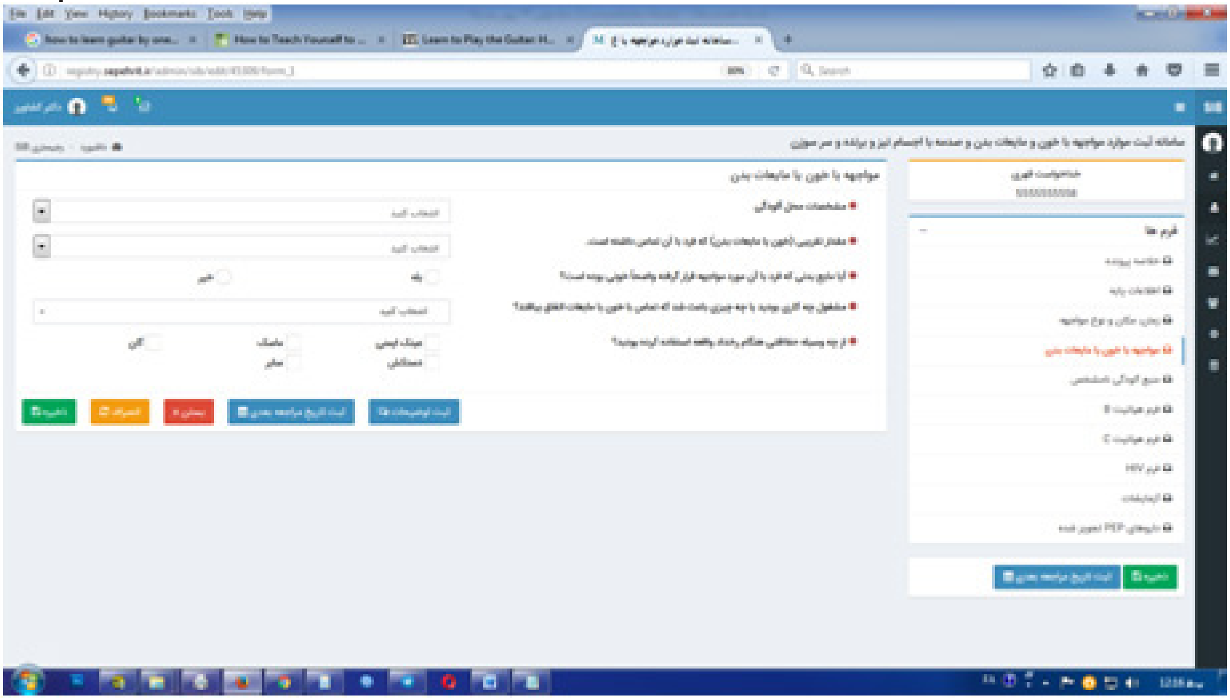


Figure 4. Percentage of exposures to the blood and body fluids based on activity being performed during exposure

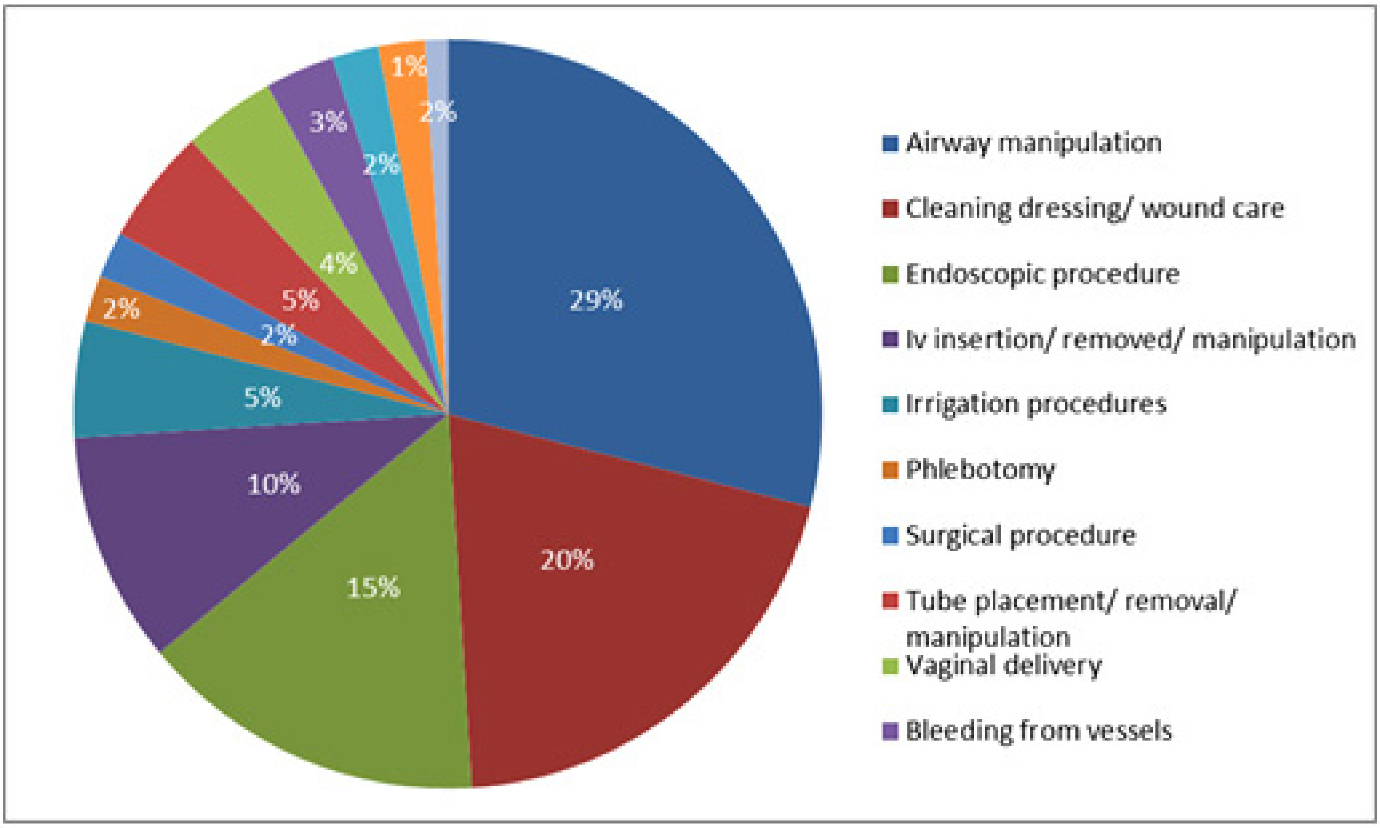
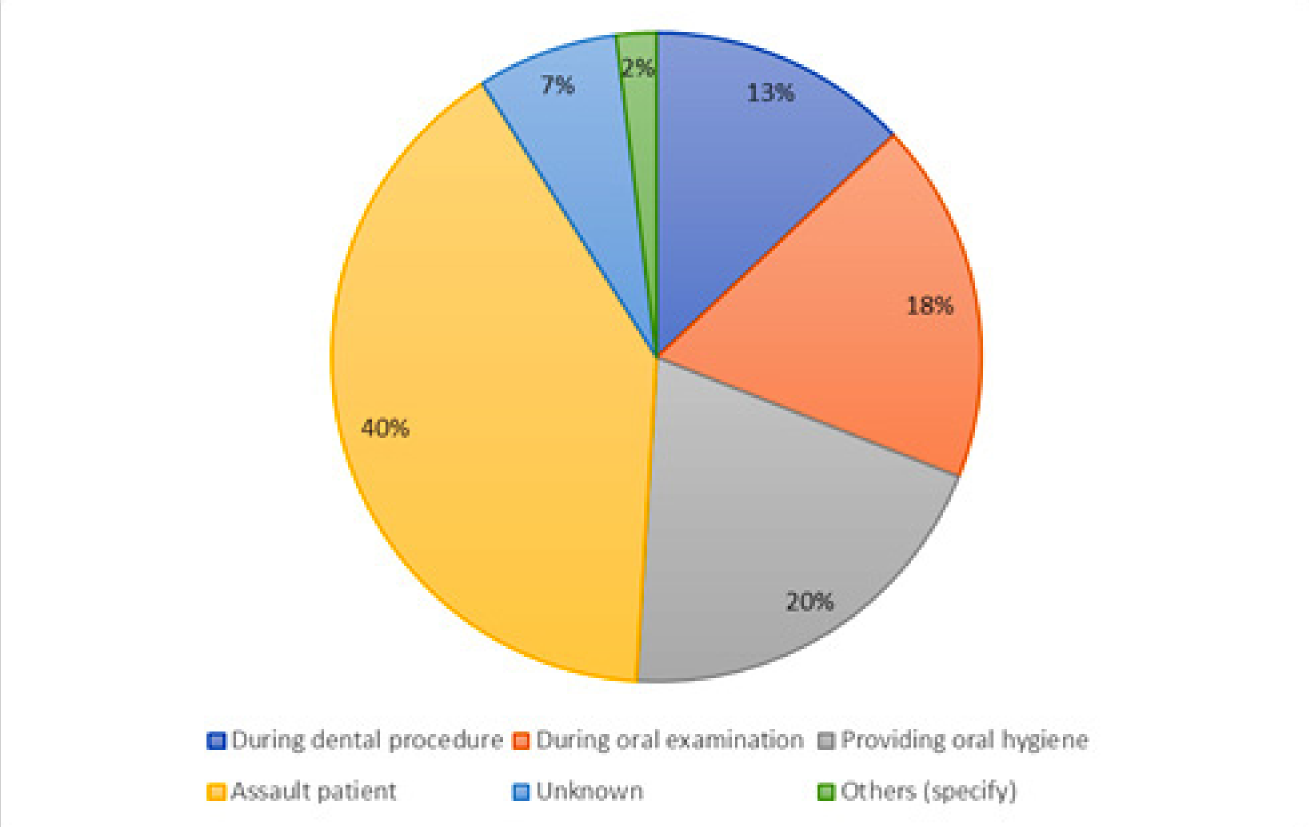


Figure 5. Percentage frequency of human bite cases based on the activity being performed during exposure



Discussion

Despite the effectiveness of PEP in controlling hospital occupationally acquired infections, no software has been developed to support an electronic registry in Iran concerning HCW exposure to patient blood and other body fluids. This pilot project used PEP software developed at Namazi Hospital in Shiraz.

Currently, EPINet is the most successful software for recording information about sharps injuries and other types of exposure to blood and body fluids and PEP and follow-up practices. Collected information can be used to identify materials and methods that can help reduce the frequency of occupational exposure to bloodborne viruses (21). Specifically, the EPINet system can help: 1) prevent occupational injuries and illness; 2) reduce exposure to microorganisms that cause infections, disease and illness; 3) reduce costs and 4) improve quality. (22)

Paper-based medical records can be incomplete, difficult to read and sometimes, difficult to locate. Electronic registries can provide a single, shareable, up-to-data, accurate and rapidly retrievable source of information, potentially available anywhere any time. Such registries require less physical space and other administrative resources. (23) During the software pilot implementing phase, all these capabilities and benefits of our software were noted, especially concerning accuracy and ease of analysis.

Our software consists of 9 forms with demographic information of exposed HCW recorded on Form 1. Form 2 covers injuries caused by sharp object injuries, while Form 5 records all forms of exposure. Form responses help develop differing surveillance paths where size and direction can be modified to address the varying types of exposure. While like EPINet, our software also has decision-making capabilities it can readily recognize the proper therapeutic path for an exposed HCW, including PEP and follow-up activities. As with EPINet, our software can generate a variety of illustrations and tables. (19)

Collected data are electronically entered; however, the software will not allow the process to move forward unless all data are entered correctly. This stands in contrast to paper-forms which can contain incorrect and/or missing entries and be erroneously changed. (24)

Electronic reporting systems can be used in any sized healthcare facility. Such technology is relatively easy to install, support and use. Also, it can be adapted to meet local needs and requires a modest resource investment. (25)

An important first step in achieving change is for those involved to realize that change is possible. However, it does require "local ownership." Buying in to the change process involves a local commitment of all involved individuals to solve inevitable problems that arise and to provide local expertise to train and motivate. Appropriate support resources must be provided. Program leadership can be any individual in a facility. However, this person must be highly respected and have the background, motivation and commitment to affect change. (26)

Health Canada commissioned a study of general medical practices in ten countries concerning office automation.

One result was that if a physician is not the champion of change, then a practice administrator can play that role. (26)

A study conducted by African Partnership for Chronic Disease Research compared their electronic data capture system (Electronic Question, EQ) to traditional paper-based data collection methods for a cohort of 200 exposed HCW. EQ increased accuracy and effectiveness, produced similar interview durations and increased data collection costs when compared to paper-based data collection methods. Overall, EQ appears to offer a feasible and cost-effective alternative to paper-based data collection methods in sub Saharan Africa. (27)

Patient charts can be in multiple places (e.g., private physician offices, chart rooms or at nurse stations). An EDCSD saves staff time otherwise used searching for charts and entering change manually. Depending on the size of the practice, this “found time” can be devoted to value-added activities or reducing worker overtime hours. Using EDCSD can improve office productivity and efficiency. (27)

As with other successful registry examples, the accuracy of a data registry is dependent on the quality of its software. Reliable information can be used in future cohort studies.

Conclusion

Our web-based reporting system can be considered a timely registry that properly monitors treatment follow-up. It helps reduce reporting difficulties for personnel working in the Infection Control Section concerning PEP and follow-up activities.

When considering use of a comprehensive reporting system at the provincial or national level, it is possible to review functions and performance of multiple hospital Infection Control Clinics collectively. Results could be useful for policy development and making final decisions to improve PEP.

This web-based system is the first in Fars province. Positive results could be shared with other hospitals and governmental agencies, influencing policymaker, managers and practitioners.

Limitation

It was difficult to develop and implement PEP software. Included are: 1) confidentiality of personnel information; 2) not having valid HCW hepatitis B immunization histories; 3) delays in exposure reporting; 4) transforming data collected by paper forms to an electronic form and 5) coordinating collaboration with expert computer engineers.

Despite difficulties and limitations, PEP software was developed in Iran for hospital use and was implemented at the Namazi Hospital in Shiraz. With support of relevant authorities and health system, we hope that this project could eventually be used in all Shiraz hospitals and even in hospitals in other cities.

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